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Comparison between deep breathing exercises and incentive spirometry after CABG surgery

Comparação entre exercícios de respiração profunda e espirometria de incentivo no pós-operatório de cirurgia de revascularização do miocárdio

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Abstract

Objective: **To compare the effects of deep breathing exercises (DBE) and the flow-oriented incentive spirometry (IS) in patients undergone coronary artery bypass grafting (CABG) through the following variables: forced vital capacity - FVC, forced expiratory volume in 1 second - FEV_1, maximal respiratory pressures and oxygen saturation.**

Methods: **Thirty six patients in CABG postoperative period underwent thirty minutes of non-invasive ventilation during the first 24 hours after extubation and were randomly shared into two groups as following: DBE (n=18) and IS (n=18). The spirometric variables were assessed on the preoperative period and seventh postoperative day (POD). The respiratory muscle strength and oxygen saturation were assessed on the preoperative period, first, second and seventh POD.**

Results: **The groups were considered homogeneous in relation to the demographic and surgical variables. It has been noted fall in the values of FVC and FEV_1 between the preoperative period and the seventh POD, but without significant differences between groups. The maximal respiratory pressures showed drop in the first POD but with gradual and partial recovery until the seventh POD, also without significant differences between groups. The oxygen saturation was the only variable that was completely recovered on the seventh POD, also without significant differences between groups.**

Conclusion: **There were not observed significant differences in maximal respiratory pressures, spirometric variables and oxygen saturation in patients undergone deep breathing exercises and flow-oriented incentive spirometry after coronary artery bypass grafting.**

Descriptors: **Breathing exercises. Postoperative care. Physical therapy modalities. Postoperative complications. Coronary artery bypass.**

Resumo

Objetivo: **Comparar os efeitos dos exercícios de respiração profunda (ERP) e espirômetro de incentivo a fluxo (EI) em pacientes submetidos a cirurgia de revascularização do miocárdio (CRVM) por meio das seguintes variáveis: capacidade vital forçada - CVF, volume expiratório forçado**

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de primeiro segundo - VEF_1, pressões respiratórias máximas e saturação de oxigênio.

***Métodos:* Trinta e seis pacientes foram submetidos a aplicação de ventilação não-invasiva por dois períodos de 30 minutos durante as primeiras 24 horas pós-extubação e distribuídos randomicamente em dois grupos, a saber: ERP (n=18) e EI (n=18), sendo as variáveis espirométricas avaliadas no pré-operatório e sétimo dia pós-operatório (DPO) e a força da musculatura respiratória e saturação de oxigênio no pré-operatório, primeiro, segundo e sétimo DPO.**

***Resultados:* Os grupos foram considerados homogêneos em relação às variáveis demográficas e cirúrgicas. Observou-se queda dos valores referentes à CVF e VEF_1 entre o pré-operatório e o sétimo DPO, porém sem diferença estatística entre os grupos. Houve queda das pressões respiratórias máximas no primeiro DPO, mas com restabelecimento gradual e parcial até o sétimo DPO, também sem diferença estatística entre os grupos. A saturação de oxigênio foi a única variável restabelecida no sétimo DPO, mas também sem diferença estatística entre os grupos.**

***Conclusão:* Não foram observadas diferenças significativas nas pressões respiratórias máximas, variáveis espirométricas e saturação de oxigênio entre pacientes submetidos a exercícios de respiração profunda e espirometria de incentivo no pós-operatório de cirurgia de revascularização miocárdica.**

***Descritores:* Exercícios respiratórios. Cuidados pós-operatórios. Modalidades de fisioterapia. Complicações pós-operatórias. Ponte de artéria coronária.**

INTRODUCTION

Despite advances in surgical techniques and improvements in perioperative and postoperative cares, the heart surgeries are responsible for high rates of morbidity and mortality. Patients undergoing CABG surgery often develop pulmonary dysfunction, such as atelectasis, restrictive ventilatory disorder and hypoxemia [1]. The pain and postoperative (PO) fear associated with changes in lung mechanics resulting from the surgery [2] affect the performance of periodic deep inspiration and effective cough, allowing the accumulation of secretion, alveolar collapse and changes in gas exchange [3].

It is requested respiratory physiotherapy aiming to reverse pulmonary dysfunction after CABG, thus avoiding the development of pulmonary complications [1]. In this context, it can be highlighted early mobilization, positioning, breathing exercises and techniques for bronchial hygiene.

Among those breathing exercises, the deep breathing exercises (DBE) will not require any mechanical resource and aim at lung expansion through slow and uniform nasal inspiration, followed by relaxed oral expiration. The incentive spirometer (IS) also emphasizes deep inspiration up to total lung capacity (TLC), providing visual feedback. Both techniques are commonly used, dependent on the cooperation of the patient, but with easy fulfillment. If the similarity of results obtained with the use of the two techniques is confirmed, both may be indicated to the patients preoperatively and, in the case of non adaptation to one of the types of exercise, the other can be used with equal effectiveness in post-CABG.

The aim of this study was to compare the effects of IS and DBE on spirometric variables (forced vital capacity - FVC and forced expiratory volume in one second - FEV_1), respiratory muscle strength (RMS) and oxygen saturation ($SatO_2$) in patients undergone CABG.

METHODS

This is a prospective, experimental, randomized study, approved by the Research Ethics Committee of Santa Casa de Misericórdia of Belo Horizonte (SCMBH) linked to CONEP, research project No. 021/2007. The patients were informed about the procedures to be performed and signed the written informed consent (WIC).

Patients hospitalized at the SCMBH were assessed in preoperative of elective CABG, with normality standard or mild ventilatory disorder on spirometry, after signing the WIC. We excluded patients with hemodynamic instability, prior heart surgery, difficult to understand or perform the measures or physiotherapeutic conducts and those undergoing invasive mechanical ventilation (IMV) or noninvasive (NIV) for a period exceeding 24 hours after admission to the Intensive Care Center (ICU).

Patients were allocated by the selection of marked tickets, in one of the groups of intervention: DBE or the flow-oriented IS (RESPIRON ®).

All patients received general anesthesia and the surgical procedure was performed with cardiopulmonary bypass (CPB) via median sternotomy by using saphenous vein and/or mammary artery grafts under moderate hypothermia (28°C to 30 ºC) and crystalloid cardioplegia. In the postoperative, the patients underwent IMV with end-expiratory positive pressure (PEEP) of 5 cmH_2O, tidal volume (TV) of 6 to 8 ml/kg and respiratory rate set to maintain the $PaCO_2$ within the normality parameters.

Before surgery, patients received general information about the surgery and postoperative routines, including guidelines related to the respiratory exercises. All patients received PO physiotherapy care twice daily during the stay in ICU, and once a day at the hospital. The care consisted of early mobilization, assisted cough and/or huffing (forced expiration with the glottis opened), in addition to the use of NIV with two pressure levels during the first 24 hours after extubation, during two periods of approximately 30 minutes with use of the respirator and by adjusting safe and comfortable levels of support pressure and PEEP. After this period, the proposed approaches have began. The care protocol was similar between groups, except for the breathing exercises performed.

The patients included in the group that underwent DBE (group I) performed, under care, three series of ten DBE that prioritized the diaphragmatic breathing through a slow and uniform nasal inspiration from functional residual capacity (FRC), progressing to slow flow until the TLC, without the aid of mechanical resources. Assisted cough and/or huffing and early mobilization exercises were also performed.

Patients from IS group (group II) underwent the same care protocol with slow inspiration from FRC until achievement of the desired level marked in the spirometer cylinder, by maintaining therefrom the inspiration sustainance. The position of the regulator ring ranged from 0 to 2, prioritizing slower lung flows.

The spirometric measurements to assess the FVC and FEV_1 were performed preoperatively and on the 7th PO day using the MultiSPIRO™ sensor, with patients seated and using a nose clip. The technical procedures, criteria for acceptability and reproducibility followed the Guidelines for Pulmonary Function Tests [4] and the reference values of Pereira [5] were used. The equipment was calibrated and checked daily before the measurements, as specific regulations for the equipment.

Maximum respiratory pressures (Maximum Inspiratory Pressure - MIP and Maximal Expiratory Pressure - MEP) were assessed preoperatively, 1st PO day (after extubation and before initiation of NIV application), 2nd and 7th PO day, using Wika manovacuometer, with operating range of $\pm$ 300 cmH_2O. Prior to performance of the maximum inspiration for MIP measurement, the patients were guided to expire up to the residual volume. The MEP evaluation was preceded by the fulfillment of inspiration up to TLC. The measurements were performed using rigid buccal and nose clip. During the evaluation of MEP, the patients held the perioral muscles by using hands to prevent leakage and accumulation of air in the lateral region of the oral cavity. Three to five maneuvers were performed with sustenance of at least a second, by selecting the higher measure, since with range less than 10% compared to the other maximum value [6].

The $SatO_2$ was estimated noninvasively with the use of pulse oximeter (Nonim Onix® model 9500), preoperatively, 1st, 2nd and 7th PO day. The inspiratory fraction of oxygen at the time of assessment was similar between groups. On the 1st PO day, supplemental oxygen was administered by face mask at 6.0 l/min. In subsequent days, in case of need for supplemental oxygen, the evaluation was performed after removing the source of oxygen for seven minutes, by taking the value that may remain consistent over a period of 30 seconds [7].

Patients were guided to perform a series of ten breathing exercises every two hours throughout the day. Adherence was evaluated by the own patients through the "Adherence Log", which remained under care of them.

Statistical analysis

For verification of normality and homoscedasticity of data the Liliefors and Cochran & Bartlett tests were used, respectively. The demographic, surgical and spirometric variables were presented as mean and standard deviation and underwent analysis of variance (ANOVA) for comparison between groups.

MIP, MEP and $SatO_2$ were assessed as continuous flow response. Due to the presence of normality and homoscedasticity after radical change in MIP and MEP variables, their analysis were performed by a completely randomized design in a split plot system (Split-Plot). The SatO2 response showed no normal distribution and homoscedasticity even after mathematical changes, therefore, its statistics were based on nonparametric Kruskall-Wallis and Friedman methods.

The significance level (α) was previously established as 0.05 for all tests.

RESULTS

Of the 63 patients allocated, 27 were excluded: a) difficult to perform spirometry (n=5), b) need for IMV or NIV for more than 24 hours (n=7 and n=6, respectively), c) desire to be withdrawn from the study (n=2), d) personal waiver to not undergo surgery procedure (n=2), e) non-adherence to treatment and/or refusal to perform the physiotherapy according to the protocol (n=3); f) countraindication to perform efforts due to paroxysmal supraventricular tachycardia in the postoperative period (n=1) g) postoperative respiratory failure that required reintubation (n=1). Table 1 shows the distribution of frequencies of the circumstantial classificatory variables by groups of treatments.

Tests of significance showed tendency of homogeneity of the means of each circumstantial quantitative variables, and these, combined with the balance of data have proved that there was balance of the sample. Both strengthened the internal validity in addition to minimize bias, as shown in Table 2.

There was significant decrease between the mean preoperative FVC and on the 7th PO day in all cases, being found, respectively, 3.76 ± 0.85 liters and 2.42 ± 0.85 liters (decrease of 35.64 %). Similarly, the mean values of FEV_1 were 2.87 ± 0.73 liters and 1.82 ± 0.69 liters for the preoperative period and on the 7th PO day (decrease of 36.59%) for all cases.

Table 1. Table of rate distribution of the dependent variables classified by groups.

Variables	Group I (n =18)	Group II (n =18)
Men/ Women (n)	13/5	16/2
Physician (1/2/3)	7/7/4	9/6/3
Number of grafts (1/2/3/4)	1/5/8/4	1/3/9/5
Mammary graft (0/1)	1/17	2/16
Saphenous graft (0/1/2/3)	1/4/9/4	1/2/9/6
Drains (1/2/3)	3/12/3	6/9/3
Prior AMI (n)	13	12
Diabetes mellitus (n)	4	3
ASH (n)	17	15
Smoker/ex-smoker/non-smoker	8/6/4	6/6/6

ASH = Arterial Systemic Hypertension; AMI = Acute Myocardial Infarction

Tables 2. Table of rate distribution of the dependent variables quantitative by groups.

Variables	Group I (n =18)	Group II (n =18)	*p* value*
Age (years)	54.83 ± 7.43	58.72 ± 9.27	*0.17*
Weight (kg)	69.38 ± 14.07	75.61 ± 8.9	*0.12*
Height (cm)	161.77 ± 9.63	165.72 ± 6.55	*0.16*
BMI (kg/m²)	26.36 ± 4.21	27.51± 2.9	*> 0.1*
Tobacco intake (YP)	20.66 ± 40.73	29.77 ± 34.97	*> 0.1*
CPB time (min)	80.94 ± 25.34	84.77 ± 32.29	*> 0.1*
AC time (min)	45.77 ± 15.66	49 ± 20.1	*> 0.1*
OTI (min)	618.33 ± 248.55	738.05 ± 436.51	*0.32*

*Tobacco intake = years/package; AC = Aortic clamping; CPB = Cardiopulmonary bypass; BMI = Body mass índex; OTI = Orotracheal intubation. *ANOVA*

As detailed in Figure 1, the mean values for the difference between forced vital capacity (DFVC) and difference between forced expiratory volume in one second (D FEV_1) of the preoperative and on the 7th PO day did not result in a statistically significant difference between groups.

There was no significant difference between mean values of respiratory muscle strength between the groups when it was taken into account the values obtained preoperatively, 1st , 2nd and 7th PO day (MIP of 44.30 cmH_2O and 47.04 cmH_2O, and MEP of 58.30 cmH_2O and 69.64 cmH_2O for groups DBE and IS, respectively).

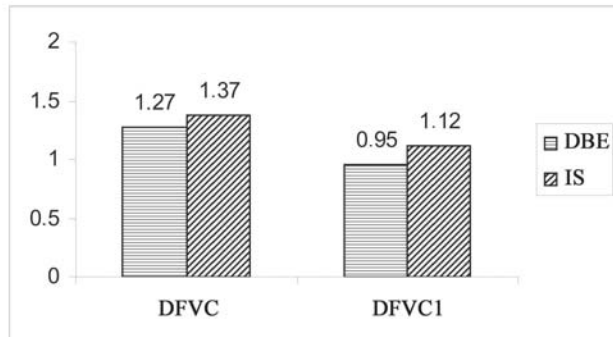

Fig. 1 – Comparison of DFVC and $DFVC_1$ between groups, in liters

The mean of MIP showed statistically significant differences in relation to the PO period as follows, namely: drop on the 1st PO day with partial recovery at 2nd and 7th PO day. The mean MEP values also showed significant decrease at 1st PO day, remaining with no statistically significant difference at 2nd PO day, with partial recovery on 7th PO day (Figure 2).

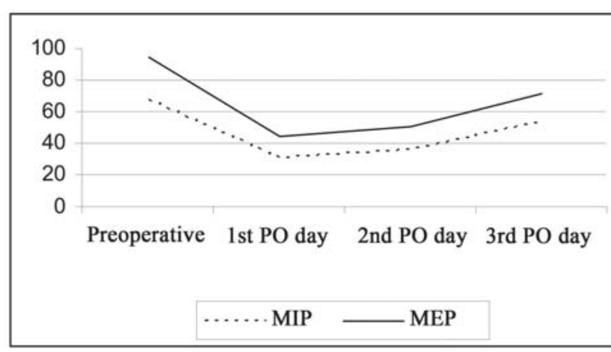

Fig. 2 – Behavior of the means of MIP and MEP values throughout the evaluation days, in CMH_2O

When compared to the 1st PO day, there was no significant drop in preoperative $SatO_2$ (*P*> 0.05), however, patients were assessed with additional oxygen therapy. There was a statistically significant decrease of $SatO_2$ when compared preoperative and 2nd PO day (*P*<0.001). We noted statistically significant increase of $SatO_2$ (*P*<0.001) when compared 2nd and 7th PO day. There was no statistically significant difference between the values of $SatO_2$ from the 7th PO day and preoperative values (*P*> 0.05) (Figure 3).

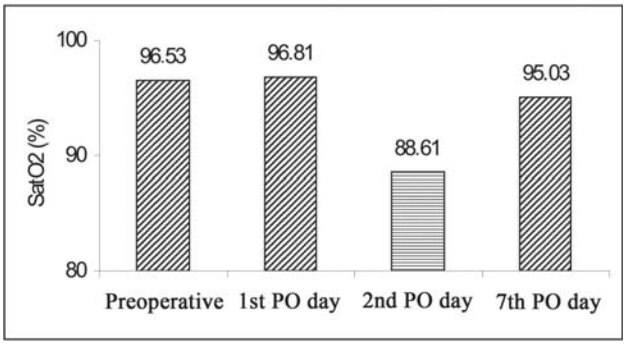

Fig. 3 – Mean of oxygen saturation values throughout the evaluation days

There were no statistically significant differences between groups in any of the assessments.

With respect to performing voluntary exercises, not all patients completed the Adherence log. Twenty-five of 36 patients (69.4%) filled out such log, and 11 patients in group I and 14 in group II. The mean rate of peformance of breathing exercises was 5.08 $\pm$ 2.22 series of 10 exercises per day, with no statistically significant difference between groups. In group I, the mean was 4.7 $\pm$ 2.11 series per day and in group II was 5.37 $\pm$ 2.34 series per day.

DISCUSSION

Anesthesia, CPB and surgical trauma contribute to changes in pulmonary mechanics, decrease in FRC and changes in the production of surfactant on the postoperative of CABG surgery [2.8]. These factors, associated with immobility, pain [9] and fear, favor the adoption of a monotonous breathing pattern without performing sporadic sighs to total lung capacity, promoting alveolar collapse [3]. In addition to that, damage to cough and bronchial hygiene contribute to the development of atelectasis, causing ventilation-perfusion disorder [2] with changes in blood oxygenation [10] and predisposing to the occurrence of lung infections [3].

Studies have shown occurrence of restrictive ventilatory disorder in postoperative of CABG surgery [8,11,12], findings that are consistent with those obtained in this study on the 7th PO day. Restrictive changes can be explained by the decrease in lung compliance, resulting from the accumulation of extravascular liquid and increased capillary volume, associated with alveolar collapse [12], and uncoordination and reduction in the thoracic cavity movement [8].

Guilizilini et al. [9] reported that patients who had undergone off-pump surgery with insertion of pleural drain in the intercostal (lateral) region showed decrease of 44.87% in FVC at 5th PO day, a value significantly higher for patients with insertion of subxiphoid drain. In this study, 58.3% of patients who had undergone on-pump surgery used a lateral drain and 16.6% used two, which partially explains the decrease in spirometric values observed. The same authors also observed that patients who had undergone off-pump surgery presented better preservation of pulmonary function when compared to those who had undergone on-pump surgery [13].

There were no significant differences between groups in relation to FVC and FEV_1, corroborating data of Crowe and Bradley [14], who also observed no significant differences in recovery of values of FVC and FEV_1 when comparing the fulfillment of respiratory physiotherapy (DBE, early mobilization and bronchial hygiene techniques) with respiratory physiotherapy associated to IS. In this study, there was no addition of IS to the protocol composed of performance of DBE, but replacement of one technique by another.

As often, the observations from Westerdahl et al. [1], which showed correlation between atelectasis and decrease of FEV_1 in the postoperative of CABG, did not assess chest radiographs, arterial gasometry and left ventricular ejection fraction due to limitation of costs, since such comparative analyses could require methodological rigor, larger sample and greater availability of professional examiners, a fictional reality in our current health care system.

Jenkins et al. [15] compared IS, DBE and control group (that performed only early mobilization), coughing/huffing and observed that there was no difference between groups in recovery of pulmonary function or incidence of pulmonary complications. However, Westerdahl et al. [16] has shown by chest computed tomography and arterial gasometry, that DBE caused significant reduction in areas of atelectasis and improvement in oxygenation.

Corroborating the complexity of variables that are involved in this context, Celli et al. [17] compared the control group, which has not performed breathing exercises, intermittent positive pressure breathing (IPPB), IS and DBE in the PO of abdominal surgery. Despite the finding that no significant differences have occurred in the prevention aspect of pulmonary complications between the groups IS and DBE, it was clear that both techniques significantly reduced such complication when compared with the same patients who has not performed such techniques. Moreover, the period of hospital stay was significantly lower among those who performed IS.

Indeed, similar studies that do not use any technique of respiratory physiotherapy do not meet ethical principles, which explains the model used in this clinical research study, or that is, to deprive the patients of respiratory physiotherapy to be a control group of both techniques.

It is suggested that the weakness of respiratory muscles is another mechanism contributing to restrictive ventilatory disorder [3,11,12], hypoxemia and ineffective cough [11]. Assessments of mean respiratory pressures allowed us to prove reduction in RMS as previously observed [8,11,12,18]. The function of the respiratory muscles is affected directly by thoracic incision [19], pain [3], paresis and/or diaphragmatic dysfunction [2] as well as anesthesia and positioning on surgical table, which favors cephalic displacement of the diaphragm with reduction of RMS [2].

As observed by Borghi-Silva et al. [11] and Van Belle et al. [12] significant reduction of MIP at 1st PO day was verified, with gradual improvement until the 7th PO day, but without full recovery of preoperative values. It was also found reduction of MEP at the 1st PO day, without significant increase at 2nd PO day, but with partial recovery of the preoperative values at 7th PO day, but statistically significant differences between groups were not observed. The reflex inhibition of the function of abdominal wall muscles caused by sternotomy is cited as one of the reasons involved in these observations [8] and corroborates the findings.

Romanini et al. [18] observed significant improvement in the RMS by using IS, which was evident in the group undergone exercises with IPPB only for MIP. The authors attribute this result to the work imposed on the respiratory muscles by using IS, generating greater motor unit recruitment and, ultimately, muscle strengthening.

The results observed in this study suggest that both techniques were equally effective in promoting the recruitment of respiratory muscles. Also, it is certain that the clinical improvement and gradual resolution of pain is linked to these findings, which ultimately lead to recovery of pulmonary volumes and optimization of the length-tension curve of the diaphragm.

Despite being described that shunt, changes in ventilation-perfusion and diffusion capacity are mechanisms responsible for changes in blood oxygenation in postoperative of CABG [2], there was no significant difference between the preoperative and 1st PO day due to the use supplemental oxygen, a routine procedure on the service in which the study was performed. The $SatO_2$ was the only variable which was completely restored at 7th PO day, however, significant drop in the 2nd PO day has occurred, as well as proposed by Matte et al. [10]. It is important to mention that the respiratory physiotherapy promotes recovery of lung function after major surgical procedures, as the CABG surgery, since it leads to increased alveolar recruitment, increase in FRC and improves the diffusion capacity [3,15,20] .

The maximum insufflations performed actively or passively by application of positive airway pressure showed to be effective resources in improving lung compliance, gas exchange and also capacity to prevent alveolar collapse, in addition to reinsufflation of areas of atelectasis, favoring the removal of pulmonary secretions and potentiating the recovery of FRC [3]. Such insufflations may also improve the production of surfactant [3] and thoracic mobility.

Postoperative pain, the drains and the effects of the surgery-anesthesia makes the patient, in most of the times, less cooperative and justifies the physiotherapeutic protocol for both groups, which included the fulfillment of NIV in the first 24 hours after extubation. Due to the fact that it is independent from patient's cooperation and causes less pain, it favored the maintenance of spontaneous ventilation, as stated Matte et al. [10] and was well tolerated by all patients. However, despite its effectiveness in the early days of PO [21], when the ventilation is characterized by low tidal volumes and high respiratory frequency [10], the NIV was restricted to the first 24 hours after extubation because of the difficulty of accomplishing it at in-patient units. Matte et al. [10] observed that the intensive use of IS in PO immediately after extubation was unable to prevent increase in shunt and worsening in pulmonary function tests, which was not observed by the same authors with the use of positive airway pressure.

After this period, the breathing exercises were initiated, different for each group. Due the fact that the IS is able to provide visual feedback specially to increase adherence to treatment [14,16] and to improve its performance, it has been widely used for prophylaxis and in treatment of postoperative pulmonary complications. Although the literature demonstrates the superiority of volume IS, to the detriment of the flow IS in relation to increases in TV and abdominal displacement [22], the flow IS is often used because it is more economically affordable, which allows its continuity after hospital discharge, a period on which still persists as significant restrictive lung disorder [11] even four months after surgery [23].

The DBEs, or diaphragmatic breathing, are easy to perform, but during its fulfillment the hands of the physiotherapist and/or patient should be placed below the xiphoid process by guiding the patient to breath while his hands are lifted up. It was shown that performing DBE with or without IS were associated, in healthy patients, with significant increase in TV with decreased basal respiratory rate [24], and reduction of areas of atelectasis and increased oxygenation immediately after its fulfillment at 2nd PO day of CABG [16]. However, there is increased use of sternocleidomastoid and increased respiratory rate with use of flow IS when compared to the diaphragmatic breathing or volume IS [24].

Although the use of flow IS in this study, we attempted to achieve more harmonious air flow, thus simulating a volume IS. For this, low flows (300 to 500 ml/ sec) were determined. However, as noted by Tomich et al. [24], the flow rates achieved are significantly different from those estimated, which does not guarantee, therefore, the reliability of flow rates determined.

The results obtained suggest that the use of flow IS as used in this study was also effective to the DBE in recovering the variables analyzed, which can be explained by the use of slow and homogeneous inspiratory flow, as it is already known to be linked to a greater diaphragmatic excursion and a progressive and more efficient reinsufflation of the collapsed lung areas, a fact in full agreement with the results described.

Despite the agreement between the results and the scietific literature, the manner the flow IS was applied in this study is not identical to that shown in prior review of the literature [21], which contradicts the need for additional studies on the subject, particularly those whose designs have as purpose the comparison of the usual manner to perform the exercises with flow and volume IS.

Despite the breathing exercises are easy to perform, they suffer interference from various factors, such as pain, personality or motivation. At the time of assessments or physiotherapeutic sessions, patients presented no pain or with complaints of mild pain. Certainly the way the patients were approached, based on warmth, tenderness, understand of the delicate patient's moment and also strongly encouraging his recovery, are certainly variables that, although not described in the scientific method, interfere significantly in clinical research and can never fail to be mentioned and, mainly forgotten.

The younger patients present a greater ability to perform the exercises with the RESPIRON®. However, the use of mechanical assistance favors older patients to remember the breathing exercises [16]. The small difference in favor of IS in the frequency of exercises performed throughout the day was interesting, as can be verified by the adherence log, even if it was filled out by 69.4% of patients, a value well above that found by Crowe and Bradley (16.6%) [14], but less than Brasher et al. (79.4%) [20].

Although the patients in this study were guided to perform 10 repetitions for each two hours, the mean rate of fulfillment of breathing exercises was less than that observed by Westerdahl et al. [1], whose mean was 7 ± 2 times a day. The literature suggests that such exercises are performed every one or two hours [3], but there is no consensus on the optimal frequency or whether the increase in daily frequency of the exercises adds benefits to the treatment.

Stiller et al. [25] also assessed if the quantity of care offered to patients during the day, or that is, if the intensity of treatment may influence the results, and also has found the same incidence of pulmonary complications. But as the rate of adherence to such treatment was not measured, there may have been interference in the results.

None of the patients has shown signs of pulmonary infection during hospital stay. Two patients in group I developed infection in the surgical incision performed for the saphenectomy, one in the sternotomy, and one case of infection in the urinary tract and one in the place of insertion of central venous catheter. In group II only one patient presented infection of the sternotomy. Despite this, there were no statistically significant differences between groups in respect to corbidities, duration of CPB, surgeons and the length of hospital stay. But there was significant difference between groups only in the length of stay in ICC (P=0.049), with larger time for the Group II (2.61 + 0.69 days versus 3.22 + 1.06 days).

Finally, one can say that the breathing exercises, when properly performed, exclude the need for incentive spirometry. However, one should emphasize the need to assess the frequency and the correct fulfillment of the technique, since its effectiveness can be influenced by many factors. If the patient does not adapt or avoid intentionally to perform one of the techniques, the other can be used with equal effectiveness. However, there is a need for frequent physiotherapeutic supervision.

CONCLUSION

There were no significant differences in maximal respiratory pressure, spirometric variables and oxygen saturation in patients undergoing deep breathing exercises and incentive spirometry in the post-CABG.

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