Pulmonary function, respiratory muscle strength and quality of life in patients submitted to elective thoracotomies

Comportamento da função pulmonar, força muscular respiratória e qualidade de vida em pacientes submetidos às toracotomias eletivas

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A B S T R A C T

Objective: To evaluate pre-and postoperative pulmonary function, respiratory muscle strength and quality of life in patients submitted to elective thoracotomy. **Methods**: We selected 19 patients undergoing elective thoracotomy to assess the following parameters: forced vital capacity (FVC), forced expiratory volume in one second (FEV1), maximal inspiratory pressure (MIP), maximal expiratory pressure (MEP) and quality of life through implementation of the SF-36. The examinations were performed preoperatively and in the second, 10th, 15th, 30th and 60th days postoperatively. We conduced data normality analyzes were made with the Shapiro-Wilk test, descriptive analysis of the study variables, as well as analysis of variance with multiple comparisons using ANOVA and Friedman, p-value < 0.05. **Results**: There was a significant decrease in spirometric levels and in maximal respiratory pressures in the second postoperative day. FVC returned to preoperative values between the 15th and 30th postoperative days, whereas FEV1, between the 10th and 15th. MIP and MEP returned to preoperative values between the 10th and 15th postoperative days. There was a decrease in quality of life as for functional capacity and physical aspects, which returned to preoperative values within two months after surgery. **Conclusion**: There was significant reduction in lung function and respiratory muscle strength, which returned to baseline within 30 days after surgery. There was a decrease in quality of life that persisted for up to 60 days after the operation.

Key words: Thoracic surgery. Respiratory function tests. Quality of life. Thoracotomy. Vital capacity.

INTRODUCTION

The incidence of post-operative respiratory complications after thoracotomy ranges from 10% to 40%[1]. As well as significantly contributing to morbidity and perioperative mortality, they increase length of hospital stay and hospital costs [2,3]. Many develop as a result of changes in lung volumes that occur, in part, in response to respiratory muscle dysfunction[3]. A reduction between 60% and 71% in vital capacity is attributed to postoperative diaphragmatic dysfunction, that parameter returning to preoperative values between seven and 10 days after the operation[4].

Although controversial, much attention has been given to preoperative and postoperative evaluations of pulmonary function in elective thoracotomies and supraumbilical laparotomies, especially in patients with respiratory symptoms and in lung resections[5,6].

Respiratory muscle strength has been studied as a predictive factor for postoperative complications after thoracotomy. When lower than predicted preoperatively, It has been observed to confer a higher relative risk for the occurrence of complications in elective thoracotomies and supraumbilical laparotomies[7] and it was suggested that this variable in the risk score for surgical patients undergoing cardiac surgery[8]. Patients who can not raise its values of maximal respiratory pressures in the postoperative period have a higher risk of developing respiratory complications[9].

At thoracotomy, especially in lung resection, there is a negative impact resulting from the surgical procedure in the perception of quality of life that can be influenced by several physical and emotional factors, the postoperative pain being an important limiting factor[10].

It is suggested that the intensity of respiratory muscle dysfunction, with consequent reduction in lung function after the surgery, contributes to increase in length

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of full restoration of respiratory function, promoting deterioration in functional status, favoring the development of respiratory complications and increasing time to return to normal activities.

Therefore, the objective of this study was to evaluate pulmonary function, respiratory muscle strength and quality of life in pre and postoperatory periods in patients undergoing elective thoracotomies.

METHODS

We conducted a prospective, descriptive study of case series. Data collection was conducted between March 2006 and April 2008. The sample consisted of 19 patients from the Department of Thoracic Surgery, University Hospital of the State University of Londrina. All enrolled patients signed an informed consent and this study was approved by the Ethics Committee in Research of the State University of Londrina with the number 161/05.

Patients over 13 years of age were admitted for elective, open chest, non-cardiac surgery under general anesthesia.

Exclusion criteria were: 1) Uncooperative patients; 2) use of psychotropic drugs, immunosuppressive drugs in the last 30 days or muscle relaxants in the 24 hours preceding the test; 3) the presence of pulmonary infection occurred between the time of preoperative evaluation and operation. We also excluded patients who underwent surgical intervention during the follow-up study, as well as those who failed to be accompanied by the reviewers of this research more than twice after surgery.

Preoperatively, we obtained the following data: age, gender, smoking (patients were considered smokers when reported having smoked at least one cigarette per day for over a year until then, or more than 20 packs during their lifetime), respiratory symptoms (cough, sputum or dyspnea), pulmonary disease (chronic obstructive or restrictive disease diagnosed prior to or during hospitalization), comorbidities (hypertension, diabetes mellitus and/or heart disease), body mass index, spirometry, respiratory muscle strength and quality of life.

During surgery we studied operative time (more or less than 210 minutes) and anesthesia time.

Patients' follow-up were set to the 2nd, 10th, 15th, 30th and 60th days after surgery, in order to evaluate respiratory muscle strength, lung function, quality of life and the occasional occurrence of respiratory complications (pneumonia, atelectasis with evident clinical consequences, bronchospasm, mechanical ventilation for more than 48 hours, pleural effusion or pneumothorax, acute respiratory failure or death).

Spirometry was performed to obtain the following parameters: forced vital capacity (FVC) and forced expiratory volume in one second (FEV1), in accordance with the recommendations of the II Brazilian Guidelines for Pulmonary Function Tests[11]. The technique was explained and demonstrated to the patient and he/she should perform the test in sitting position, using a nose clip and the mouthpiece tightly coupled between the teeth and lips. We performed at least three valid tests and recorded the highest value obtained, as long as it was not the last assessment. We used apparatuses of brands Pony (Cosmed, Italy) and Respiradyne (Sherwood, USA), and each patient was evaluated with a single unit throughout the follow-up.

Respiratory muscle strength was measured by maximal respiratory pressures: Maximum Inspiratory Pressure (MIP) and maximal expiratory pressure (MEP)[12], using an analog manovacuometer (Makil - Londrina, Brazil) with a scale of -200 to 200 cm H2O. The patient sat with the nose clip, using a rigid plastic mouthpiece. The technique was repeated until the values †from three valid maneuvers were obtained, with a variation of less than 10% between them and with one minute intervals for rest. The highest sustained value obtained was registered, as long as it was not the last obtained.

Pulmonary function and respiratory muscle strength tests were performed in the preoperative period and in the second, 10th, 15th, 30th and 60th days after surgery. The values †of FVC, FEV1, MIP and MEP were compared according to the averages and percentages obtained by dividing the values †obtained postoperatively by the preoperative ones †and multiplying them by 100.

Quality of life was assessed by applying the generic quality of life Medical Outcomes Study 36 - Item Short-Form Health Survey (SF-36),[13] validated for the Portuguese language. This questionnaire included the investigation of eight domains: functional capacity, physical aspects, pain, general health, vitality, social, emotional and mental health. Although it is a self-administered questionnaire, we chose it to be applied by the examiner. The questionnaire took place in the preoperative period and in the 30th and 60th postoperative days.

The patients were operated by the same team, with similar surgical and anesthetic techniques. All were accompanied by the Physiotherapy Service schemes with similar care pre and postoperatively. Evaluations of this research were performed by a single team, which previously received similar training.

Analyzes of data normality were made using the Shapiro-Wilk test, descriptive analysis of the study variables by calculating the averages, standard deviations, medians and interquartile ranges. We conducted analysis of variance with multiple comparisons using ANOVA and Friedman, with Tukey and Dunns post-tests. The significance level was 0.05 for the á error.

RESULTS

The anthropometric and functional data of the 19 subjects evaluated are described as mean and standard deviation in table 1.

Regarding the variables of pulmonary function and respiratory muscle strength, we noted a significant reduction in the spirometric and maximal respiratory pressures in the immediate postoperative period; these presented with progressive increments throughout the study period. The evolutionary analysis of means and standard deviations of FVC, FEV1, MIP and MEP are shown in table 2.

We found an average decrease in FVC of 41.5%, 30.7%, 25.08%, 20.1% and 15.5% in the second, 10th, 15th, 30th and 60th days after surgery, respectively, when compared to preoperative values. There was a recovery of FVC between the 15th and 30th days (p> 0.05). As for FEV1, we observed the same behavior exhibited by FVC, with a reduction of 48.7%, 26.1%, 22.2%, 14.1% and 11.1% of the preoperative values. FEV1 returned to baseline between the 10th and 15th days after surgery (p> 0.05) (Figure 1).

The analysis of respiratory muscle strength demonstrated significant decreases in MIP during the postoperative period of 55%, 33.5%, 13% and 5.6% in the 2nd, 10th, 15th and 30th days, respectively. The values of MEP reduction were 58.1%, 31.4%, 14.4% and 2.3% in the 2nd, 10th, 15th and 30th days. On day 60, patients surpassed their preoperative values of MIP and MEP (106.3% and 106.6%, respectively). We observed normalization of both MIP and MEP between 10th and 15th days (p> 0.05) (Figure 2).

According to Table 3, when evaluating quality of life, there was a clinically significant reduction in all parameters evaluated. However, this reduction was not statistically significant for most areas. In the field of "functional capacity" there was a statistically significant difference between the 30th and 60th days after surgery (p = 0.02) and in the "physical aspects" there was a statistically

Table 1 - Characteristics of the study population, with absolute values and percentages or means and standard deviations.

Variables		Study Sample
Gender:	Male	10 (52.6%)
	Female	9 (47.4%)
Age (years)*		43 ± 19
BMI (kg/m^2)*		21.5 ± 4
Smokers		10 (52.6%)
Previous pneumonia		9 (47.4%)
Previous respiratory symptoms		12 (63.2%)
Comorbidities		6 (31.2%)
Operative time (minutes)*		198.3 ± 130
Anesthesia time (minutes)*		269.6 ± 140
Thoracotomy without resection		10 (52.6%)

**Values expressed in means ± standard deviation.*
BMI: Body Mass Index.

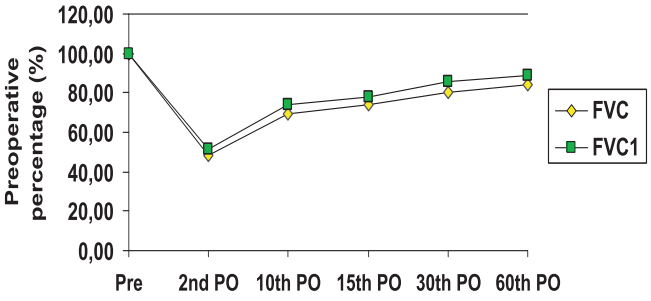

Figure 1 - *Values †in percentage of preoperative FVC and FEV1.*

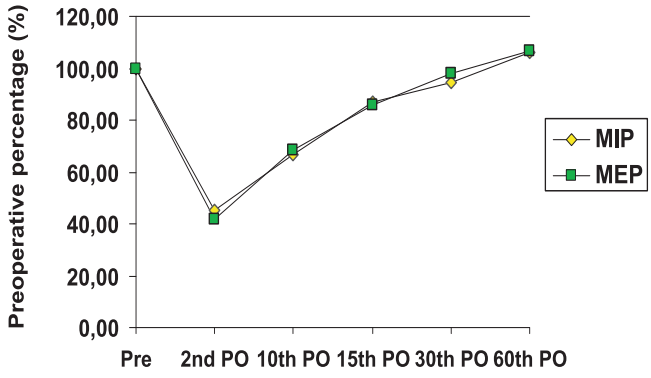

Figure 2 - *Values †in percentage of preoperative MIP and MEP.*

Table 2 - Means and standard deviations of FVC, FEV1, MIP and MEP.

Variable	Pre	2nd PO	10th PO	15th PO	30th PO	60th PO
FVC (l)	3.03 ± 0.86	1.47 ± 0.46	2.1 ± 0.7	2.25 ± 0.83	2.42± 0.81*	2.56± 0.68
FVC1 (l)	2.34 ± 0.77	1.20 ± 0.33	1.73 ± 0.57	1.82 ± 0.68*	2.01± 0.62	2.08± 0.54
MIP (cmH_2O)	84.1 ± 32.4	37.9 ± 19.7	55.9 ± 29.7	73.2 ± 35.1*	79.4 ± 42.3	89.4± 39.7
MEP(cmH_2O)	98.2 ± 34.1	41.2 ± 16.9	67.4 ± 22.2	84.1 ± 31.1*	95.9 ± 34.8	104.7± 31.6

** p>0,05*

significant difference between preoperatory and 30th days after the procedure (p = 0, 0005).

The mean postoperative hospital stay was 11 ± 9 days, and from the 19 patients, 12 required assistance in the ICU for at least one day. Only one patient developed respiratory complications, which were diagnosed as pneumonia.

DISCUSSION

This study evaluated the pulmonary function, respiratory muscle strength and quality of life in patients undergoing elective thoracotomies. The results showed significant reductions in lung volumes and capacities, as well as in respiratory muscle strength in the postoperative period.

The reduction in lung function that occurs after thoracotomy is associated with changes in the respiratory pattern, CO2 retention, reduction of arterial O2 and impairment in pulmonary defense mechanisms [2,14], sometimes progressing to respiratory complications when there is deviation from the expected outcome of the surgical procedure[15].

In this study there was a decrease of 41.5% in FVC and FEV1 of 48.7% on the second day after surgery and these results converge with those of other authors[16,17]. In the evolutionary analysis of spirometric parameters FVC returned to preoperative values between the 15th and 30th days, whereas FEV1 returned between the 10th and 15th. These results were similar to those of other authors who have studied the changes in respiratory function in after thoracic and upper abdominal operations [18.19].

In this sample, there was a decrease of 55% for the values of MIP and 58.1% for the values of MEP in the second day after surgery, which returned to preoperative values between the 10th and 15th days. These results were similar to the literature [9]. Studies on risk operations performed during the period of hospitalization or follow-up time less than eight days after surgery were not able to detect the return of pulmonary function and respiratory muscle strength[20,21].

The reduction in lung volume is accompanied by decreased lung compliance, with increased lung elastic work. These changes in respiratory mechanics require greater work from the respiratory muscles for lung expansion. When this mechanism of action of the ventilation pump is inefficient areas of atelectasis occur, with subsequent retention of secretion[14], the earlier normalization of respiratory function in risk operations being related to the lower incidence of respiratory complications[19].

All patients underwent physiotherapy before and after surgery. Both pre and postoperatively, they received guidance on the operation, about the importance of early ambulation and coughing, practiced respiratory exercises and underwent techniques of lung re-expansion, without a specific protocol, as individual needs.

The literature states that physical therapy is more effective in preventing complications than its non-performance [20,22]. Studies suggest the benefits of conducting techniques of pulmonary re-expansion [23], respiratory exercise [19], cough stimulation and early ambulation in patients undergoing risk operations [22].

Respiratory muscle training has been extensively researched and the results indicate success in using this practice of physical therapy in the prevention of respiratory complications. Several authors have found that pre and post-op respiratory muscle training improves lung function, respiratory muscle strength[9,24], reduces the incidence of respiratory complications [25] and decreases the length of hospital stay [9,26]. However, in order for this technique to be used properly it is necessary to monitor the respiratory muscle strength of the patient to regulate the load to be imposed[27], which certainly justifies its timely evaluation.

In this study, there was worsening of quality of life in the parameter "physical aspects". Other authors [10,28,29] also attribute this worsening, especially of the areas of "functional capacity" and "physical aspects", to worse lung function, worse aerobic capacity and, in cases of malignancy, poor prognosis.

Table 3 - Quality of life features.

Domains SF-36	Preoperatory	30th PO	60th PO
Functional Capacity	68.6 ± 28.9	61.8 ± 23.6	76.4 ± 18.9*
Physical Aspects	56.9 ± 41.8	13.9 ± 17.6*	36.1 ± 38.6
Pain	64.4 ± 36.9	56.1 ± 27.7	63.6 ± 26.4
General Health State	74.8 ± 20.7	68 ± 23.2	71.4 ± 22.4
Vitality	72.2 ± 25.6	61.6 ± 27.9	65.8 ± 24.5
Social Aspects	55.6 ± 33	61.6 ± 37.8	68.8 ± 27.5
Emotionlal Aspectd	51.8 ± 43.1	38.4 ± 37.6	53.7 ± 39.8
Mental Health	67.6 ± 25.7	68 ± 30.6	66.8 ± 25.4

* p<*0,05*

The incidence of complications after thoracotomy ranges from 10% to 40%[1]. In this study only one patient (5.26%) complicated with pneumonia. Physical therapy, coupled with greater discretion on the part of the team involved in assessing the operability of patients, seems to have influenced the low incidence of complications or death in this study.

We conclude that there is significant reduction in lung function and respiratory muscle strength in the postoperative period of elective thoracotomies. Normalization of FVC was found between the 15th and 30th days of the postoperative period and of FEV1 between the 10th and 15th days. Both MIP and MEP normalized between the 10th and 15th days. There was also worsened quality of life in the functional capacity and physical aspects domains, detected one month after the operation, returning to preoperative values within two months after surgery.

RESUMO

Objetivo: *Avaliar o comportamento da função pulmonar, força muscular respiratória e qualidade de vida no pré e pós-operatório de pacientes submetidos às toracotomias eletivas.* ***Métodos:*** *Foram avaliados 19 pacientes submetidos à toracotomia eletiva para obtenção dos parâmetros: capacidade vital forçada (CVF), volume expiratório forçado no primeiro segundo (VEF_1), pressão inspiratória máxima (PImax), pressão expiratória máxima (PEmax) e qualidade de vida mediante aplicação do questionário SF-36. Os exames foram realizados no pré-operatório, 2°, 10°, 15°, 30° e 60° dia de pós-operatório. Foram feitas análises de normalidade dos dados utilizando-se o teste de Shapiro-Wilk, análise descritiva das variáveis de estudo, bem como, análise de variância com comparações múltiplas utilizando-se os testes ANOVA e Friedman, com valor de* p *<0,05.* ***Resultados:*** *Houve significativa redução nas variáveis espirométricas e nas pressões respiratórias máximas no 2° pós-operatório. CVF retornou aos valores pré-operatórios entre o 15° e o 30° pós-operatório, enquanto que VEF_1 retornou entre o 10° e 15°. PImax e PEmax retornam aos valores pré-operatórios entre o 10° e 15° pós-operatório. Houve redução da qualidade de vida nos domínios capacidade funcional e aspectos físicos, que retornaram aos valores pré-operatórios em até dois meses após o procedimento cirúrgico.* ***Conclusão:*** *Foi verificada significativa redução na função pulmonar e na força muscular respiratória, que retornaram aos valores basais em até 30 dias após o procedimento cirúrgico. Houve queda na qualidade de vida, que persistiu por até 60 dias após a operação.*

Descritores: *Cirurgia torácica. Testes de função respiratória. Qualidade de vida. Toracotomia. Capacidade vital.*

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