Comparative study of preoperative and postoperative pulmonary function in open abdominal surgeries

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Abstract

Objectives: To compare the post operative pulmonary function with the preoperative pulmonary functions in patients undergoing laparotomy.

Methods: 50 patients undergoing laparotomy under general anaesthesia were tested for pulmonary functions (Forced vital capacity [FVC], Forced expiratory volume at first second [FEV1], Peak expiratory flow [PEF], Forced expiratory flow at 25% to 75% [FEF25-75%] and blood gas analysis (pO2, pCO2) preoperatively and on the second postoperative day using RMS MEDSPIROR® and capillary blood gas analysis.

Results: There was a decrease in FVC, FEV1, PEF, FEF25-75%, pO2, pCO2 to 65%, 67%, 65%, 66%, 92% and 99% of the preoperative value respectively.

Conclusions: Pulmonary function is drastically reduced after laparotomy.

Keywords: laparotomy, open surgery, anaesthesia, lungs, spirometry

1. Introduction

Laparotomies are associated with a decrease in respiratory function123. Respiratory movements are decreased in the postoperative period as a result of division of muscles and postoperative pain. Consequently breathing is predominantly by movements of thoracic cage. Hypoxaemia and atelectasis have been reported by some authors after abdominal operations4. Recovery of normal respiratory movements takes several days. With the use of computerized spirometry it is possible to measure the lung volumes, expiratory flow rates, forced vital capacity ratios along with the plotting of flow volume loops and volume time curves. We decided to study the effect of open abdominal surgeries on respiration in this part of the country as there are few Indian studies on this subject5.

2. Materials and methods

The study was carried out prospectively on 50 patients going for elective laparotomy at Gandhi Hospital, Secunderabad between January 2011 and July 2011. Inclusion criteria were age between 20 to 60 years, no history of respiratory illness, no history of smoking habits, elective surgeries and normal preoperative respiratory function. Exclusion criteria were emergency surgery, pulmonary disease. The study was approved by the Ethics Committee of Gandhi Medical College, Secunderabad.

Subjects participating in the study were tested for lung function tests between 11 am to 1 pm using MEDSPIROR® (RMS systems – Chandigarh) with the subject lying supine. The subjects were instructed to exhale into the spirometer after taking a deep breath after demonstration by the examiner. Values were noted down after taking three readings. Blood gas analysis was carried out using capillary blood obtained from the fingers or toes after warming the area to approximately 45 degrees Celsius. The tests were performed a day before surgery and on the second post operative day. All measurements on the subjects were done after taking informed consent.

2.1 Statistical methods

Mean and standard deviation values of all parameters were calculated and summarized as mean (SD). The differences between the parameters were tested using Z test. p < 0.05 was taken as a significant difference.

3. Results

The demographic data of the 50 subjects who participated in the study is given in Table 1. Preoperative pulmonary function test parameters showed highly significant decreases on the second post operative day compared to the preoperative mean values p < 0.001 (Table 2). Post operatively the mean reduction in FVC, FEV1, PEF and FEF25-75% was 65%, 67%, 65% and 66% of the preoperative value (Table 2). Blood gas analysis did not show significant changes in most parameters with the exception of the mean value of pO2 which was decreased to 92% of the preoperative mean value p < 0.001 (Table 1).

Table 1: Anthropometric data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>50</td>
</tr>
<tr>
<td>Sex (M,F)</td>
<td>28,22</td>
</tr>
<tr>
<td>Age (years)</td>
<td>33.86 (9.25)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>159.42 (9.15)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>54.92 (8.62)</td>
</tr>
</tbody>
</table>

Last three values as mean (SD)
Table 2: Pulmonary Function Tests and Blood Gas Analysis preoperative and on second post operative day

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Preoperative</th>
<th>Day 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>2.38 (0.60)</td>
<td>1.57 (0.41)***</td>
</tr>
<tr>
<td>FEVI (L)</td>
<td>1.91 (0.51)</td>
<td>1.29 (0.35)***</td>
</tr>
<tr>
<td>PEF (L/s)</td>
<td>6.36 (1.27)</td>
<td>4.13 (0.83)***</td>
</tr>
<tr>
<td>PEF 25%-75% (L/s)</td>
<td>3.10 (0.60)</td>
<td>2.03 (0.40)***</td>
</tr>
<tr>
<td>FEVI / FVC (%)</td>
<td>80.1 (2.04)</td>
<td>81.8 (2.07)***</td>
</tr>
<tr>
<td>pO2 (mmHg)</td>
<td>89.68 (4.88)</td>
<td>82.88 (4.89)***</td>
</tr>
<tr>
<td>pCO2 (mmHg)</td>
<td>41.2 (3.18)</td>
<td>41.02 (3.11)</td>
</tr>
<tr>
<td>pH</td>
<td>7.39 (0.03)</td>
<td>7.38 (0.03)</td>
</tr>
<tr>
<td>Bicarbonate (mg/dL)</td>
<td>24.06 (2.43)</td>
<td>24.8 (2.11)</td>
</tr>
</tbody>
</table>

Values as mean (SD)

*p<0.05, **<0.01, ***<0.001

4. Discussion

The result of our study indicate that there is a significant decrease of lung volumes and expiratory flow rates along with a some degree of hypoxaemia even after 48 hours following open abdominal surgery. All the subjects who took part in the study had normal preoperative pulmonary function tests in accordance to the norms set for the Indian population5-23.

Changes in pulmonary physiology after open abdominal surgeries have been well studied10,11,12,13,14,15,16. Earlier studies have shown that vital capacity is halved from the preoperative value while decrease in functional residual capacity is a bit less. There is no alteration in respiratory minute volume though there is tachyypnea with shallow respiration. Upper abdominal surgery is associated with a restrictive pattern of pulmonary function16 (reduced vital capacity and functional residual capacity17,18), hypoxaemia, decrease in compliance19 and a change from abdominal to thoracic breathing. The site and size of incision, post operative pain20-21 and altered function of the diaphragm22-24 have been found to be the factors contributing to reduction of pulmonary function in the post operative period. General anaesthesia affects lung mechanics that results in impaired gas exchange25. These effects are temporary and usually subside in 24 hours. But upper abdominal surgery prolongs these changes which return to the baseline in 10 days. Previously observed reduction of lung volumes and flow rates to about 60%-70% of the preoperative value in open abdominal surgeries was confirmed by this study. Our study confirmed the restrictive changes in pulmonary function following abdominal surgery from the previous studies, but we noted decrease in peak expiratory flow suggesting obstruction.

A fall in arterial oxygen saturation has been noted by many authorities, even in patients who do not develop pulmonary complications26,27. Arterial carbon dioxide remains unchanged along with pH and bicarbonate23,29. Changes in blood gases observed in this study are concordant with the findings of the previous studies.

The limitations of our study were that length of the incision could not be measured in all patients, and hence could not be correlated with the findings and that spirometry was carried out in the supine position rather than the erect posture due to patient compliance and ethical issues. In conclusion our study showed that pulmonary functions were decreased following a restrictive pattern after open abdominal surgeries.

References