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COMPARISON OF POST OPERATIVE PULMONARY FUNCTION BETWEEN OPEN SURGERIES AND LAPAROSCOPIES

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ABSTRACT

Background: Respiratory function is depressed after abdominal surgery. Less trauma to the abdominal wall results in early postoperative recovery. **Aim**: The study was planned to compare recovery of postoperative respiratory functions between open surgeries and laparoscopic surgeries in the Indian population. **Materials and Methods**: 50 patients undergoing open surgery and 50 patients undergoing laparoscopy underwent tests on pulmonary functions (Forced Vital Capacity [FVC], Forced Expiratory Volume in first second [FEV1], Forced Expiratory Flow between 25% and 75% [$FEF_{25\%-75\%}$]), Peak Expiratory Flow [PEF]and capillary blood gas analysis (paO_2, $paCO_2$) before surgery and after two days following surgery using RMS MEDSPIROR® and blood gas analysis of capillary blood. **Results**: Change in FVC, FEV1, $FEF_{25\%-75\%}$, PEF, pO_2 and pCO_2 to 65.9%, 66.9%, 66%, 64.9%,92% and 99% respectively of the preoperative value following open surgery and to 82.5%, 84%, 86%, 82.5%,97.5% and 102% respectively of the preoperative value following laparoscopic surgery. **Conclusions**: Respiratory function recovery is better in laparoscopic surgery compared to open surgery.

INTRODUCTION

Respiration is carried out by movements of thorax and abdominal wall. Abdominal surgery involves division of abdominal muscles which results in pain and restriction of movements. This also associated with changes in diaphragmatic function and atelectasis of the lung[1,2]. A fall in oxygen tension without significant change in carbon dioxide tension has been reported by recent studies[3,4].These changes are common in open surgeries. Laparoscopic surgeries employ smaller incisions, inflation of gas and are now replacing some procedures which were done with open surgeries. As the incisions are small, there is less pain and early recovery of respiratory functions. With computerized spirometry it is possible to measure several parameters in a relatively short procedure.

Aim: The aim of our study was to compare recovery of postoperative pulmonary function between open surgeries and laparoscopic surgeries in the Indian population, as few studies have been done in this region.

MATERIAL AND METHODS

Study design: The study was analytical, carried out prospectively.

Inclusion criteria: Inclusion criteria were subjects of both genders with age between 20 to 60 years, negative history of respiratory illness, negative history of smoking habits, and negative history of occupational exposure to irritants, normal preoperative respiratory function and elective surgery.

Exclusion criteria: Exclusion criteria were emergency surgery, history of pulmonary disease and smoking habits.

Sample size: on a total of 100 patients going for elective abdominal surgery at Gandhi Hospital, Secunderabad between January 2011 and July 2011.

Ethical approval: Ethics Committee of Gandhi Medical College, Secunderabad approved the proposed study, consent was obtained from the participants

Grouping: The subjects consisted of two groups. Group I consisted of 50 patients scheduled for elective laparotomy and Group II consisted of 50 patients scheduled for elective laparoscopy.

Methodology

Both groups were tested for respiratory functions using MEDSPIROR® (RMS systems – Chandigarh) with the subject lying in the supine posture as postoperative pain prevented the patients in assuming the erect posture. The patients were instructed to breathe out forcibly into the spirometer after taking a deep breath. A demonstration was given by the examiner before recording the readings. Values were noted down after taking three readings [5]. Blood gas analysis was carried out using capillary blood obtained from the fingers or toes after warming the area to approximately 45 degrees Celsius [6]. The tests were performed preoperatively and after 48 hours of surgery. All measurements on the subjects were done after taking informed consent.

Statistical analysis: Mean and standard deviation values of all parameters were calculated. Student's t test was used to compare Group I with Group II.

RESULTS

The demographic data of the 100 subjects is given in Table 1. There was no significant difference between the groups in age and weight. There were significantly more females in Group 2 ($p<0.05$). Group 1 subjects were significantly higher than their counterparts in Group 2 ($p<0.05$).

Table 1: Anthropometric data

Parameter	Group 1, (Laparotomy)	Group 2, (Laparoscopy)
Number	50	50
Sex (M,F)	28, 22	19, 31
Age (years)	33.86±9.25	34.04±8.73
Height (cms)	159.42±9.15	156.22±6.71
Weight (kg)	54.92±8.62	53.98±6.25
Last 3 values as Mean±SD		

Preoperative respiratory functions and capillary blood gas analysis were normal. There was a decrease in respiratory functions in the postoperative period in both groups (Table 2). On the second postoperative day a decrease was seen in FVC, FEV1, PEF and $FEF_{25\%-75\%}$ in Group I (laparotomy) to 65.9%, 66.9%, 64.9% and 66% respectively of the preoperative value and in Group II (laparoscopy) to 82.5%, 84%, 82.5% and 86% respectively of the preoperative value. Postoperative change in all parameters when compared to preoperative values was highly significant ($p<0.001$). Difference in all parameters between the groups was significant ($p<0.05$) (Table 2).

Blood gas analysis showed a fall in pO_2 level in the postoperative period that was highly significant ($p<0.001$) in Group I and significant ($p<0.05$) in Group II, when compared to preoperative values. Rise in pCO_2 level in the postoperative period was significant ($p<0.05$) in Group I but was insignificant in Group II. Difference between the groups was not significant. (Table 2)

Table 2: Pulmonary function tests and blood gas analysis preoperative and on second postoperative day

Parameter	Group 1 (Laparotomy)		Group 2 (Laparoscopy)	
	Preoperative	D2	Preoperative	D2
FVC (L)	2.38±0.6	1.57±0.4	2.12±0.41	1.75±0.36**
FEV_1 (L)	1.9±0.5	1.3±0.35	1.7±0.35	1.42±0.30*
FEV_3 (L)	2.27±0.57	1.52±0.40	2.02±0.39	1.69±0.35**
PEF (L/s)	6.36±1.27	4.13±0.83	5.55±1.11	4.58±0.92**
$FEF_{25\%-75\%}$ (L/s)	3.10±0.60	2.05±0.40	2.84±0.35	2.44±0.46***
$FEF_{0.2-1.2}$ (L/s)	5.29±1.29	3.50±0.86	4.82±0.88	4.17± 0.77***
FEV_1/FVC (%)	80.1±2.04	81.8±2.07	79.38±2.9	80.44±3.36**
FEV_3/FVC (%)	95.3±1.33	96.5±1.22	95.2±1.44	95.3± 1.44***
paO_2 (mmHg)	89.68±4.9	82.88±4.9	88.6±4.25	86.34±4.36***
$paCO_2$ (mmHg)	41.2±3.18	41.0±3.11	40.04±3.2	41.02±2.75
pH	7.39±0.03	7.38±0.03	7.4±0.03	7.39±0.03
Bicarbonate (mEq/L)	24.06±2.4	24.8±2.11	24.08±2.4	24.48±2.24
D2: 2nd postoperative day; Values as Mean±SD * p<0.05,**p<0.01,***p<0.001				

DISCUSSION

Our study indicates that there is a significant decrease of lung volumes and expiratory flow rates along with a substantial degree of hypoxemia after abdominal surgery and these changes are more with open surgeries in comparison to laparoscopic surgery. In patients undergoing laparoscopic surgery the values recorded on the second postoperative day were near normal. All the patients who took part in the study had normal respiratory functions before surgery according to the norms set for the Indian population [7,8,9,10]. Post operative decrease in FVC in Group I and II was 65.9% and 82.5% respectively. Karayiannakis et al reported a decrease to 67% and 79% from preoperative values in Group I and II respectively [11]. Change in mid expiratory flow rates was similar to the findings of Karayiannakis et al for Group I [11]. Decrease in respiratory functions after abdominal surgeries is well documented from previous studies [11-18]. Upper abdominal surgery especially laparotomy is followed by a restrictive pulmonary change [19]. This is due to longer incisions, division of respiratory muscles, and disturbance in diaphragmatic function and atelectasis. With laparoscopic surgery there is less pain and less trauma to the abdominal wall resulting in early recovery of respiratory functions. However gas used for creating pneumoperitoneum can result in increased CO_2 levels in the postoperative period. Gas pockets can also interfere with respiratory movements [20,21,22]. Changes in lung volumes and flow rates in the open surgery group to about 60%-70% and in the laparoscopy group to about 80%-90% of the preoperative value is concordant with the previous studies. A fall in arterial oxygen saturation has been noted in many studies, even without pulmonary complications [23,24]. Arterial carbon dioxide, pH and bicarbonate do not show any change in the postoperative period. Changes in blood gases are confirmed with the previous studies [25,26]. **Limitations**: The limitations were that we could not measure the length of the wound, spirometry had to be done in the supine rather than erect posture due to ethical reasons and capillary blood gas analysis was done instead of arterial blood gas analysis due to ethical constraints.

CONCLUSION

Abdominal surgery is followed by reduced respiratory functions evident from reduced volumes and capacities and decreased oxygen tension. Post operative changes in lung volumes and capacities are mostly restrictive. Minor obstructive changes are seen with laparotomy. Hypoxemia and all changes in spirometry are greater with laparotomy. We conclude that laparoscopic surgery is followed by earlier recovery of pulmonary functions in comparison to laparotomy.

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Conflict of Interest: Nil

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