Aerobic Exercise Training and Incentive Spirometry Can Control Postoperative Pulmonary Complications after Laparoscopic Cholecystectomy


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Abstract: The revolution in laparoscopic surgery has began three decades ago when laparoscopic cholecystectomy (LC) was introduced. The aim of the present study was to detect the beneficial effect of aerobic exercise training and incentive spirometry in controlling postoperative pulmonary complications after laparoscopic cholecystectomy. Twelve patients who had undergone laparoscopic cholecystectomy were participated in the present study. Their ages ranged from 29 to 50 years. Patients were divided into two experimental groups: - (A) Aerobic walking training and incentive spirometry in addition to the traditional physical therapy, where (B) was traditional physical therapy group. The results obtained in the present investigation indicated that, there was a significant reduction in values of HR and a significant decrease in SaO\textsubscript{2} and IC of both groups. There were significant differences between both groups at the end of the study. Conclusion: Association of aerobic exercise to incentive spirometry helped in controlling postoperative pulmonary complications after laparoscopic cholecystectomy.

Key words: Aerobic Exercise % Incentive Spirometry % Postoperative Pulmonary Complications % Laparoscopic Cholecystectomy

INTRODUCTION

The gall bladder is the second, only to the appendix, as the intra-abdominal organ most commonly requiring surgical intervention. In 1990, laparoscopic cholecystectomy (LC) has replaced open surgery as the standard treatment for symptomatic gallbladder diseases and stones [1].

Since its introduction, laparoscopic cholecystectomy (L.C.) has become the treatment of choice for symptomatic gall bladder disease. Rapid recovery after L.C and increasing experience with its postoperative course has led to progressively shorter postoperative hospital stay [2].

Laparoscopic cholecystectomy has replaced open cholecystectomy (OC) as the preferred therapeutic modality in the treatment of symptomatic cholelitheasis. Because of perceived difficulties in dissection and the premise of unacceptably high complication rates, the presence of acute cholecystitis was once considered an absolute contraindication to the performance of L.C. [3].

One of the most important putative advantages of Laparoscopic surgery is the reduction of the extent of surgical trauma, postoperative metabolic, inflammatory and immunologic changes are proportional to the degree of surgical trauma, elimination or reduction of these changes has been shown to decrease the incidence of postoperative complications and improve survival [4].

Pulmonary complications are common after abdominal surgery and result in increased patient morbidity, prolonged hospital stay and greater cost. Strategies aimed at reducing the incidence of postoperative pulmonary complications depend largely upon the aggressive application of preventative measures to high - risk patients [5]. Pulmonary complications (reduced lung volumes, chest infection and hypoxia) are most frequently occurring after upper abdominal surgery, with reported occurrence frequencies of up to 75 % of all patients. Pulmonary complications continue to be an important cause of postoperative morbidity and mortality [6].

Pulmonary function is commonly altered after surgery, particularly in patients who have had chest or upper abdominal surgery. The physiological changes are
directly related to anesthesia (general or regional) and to
the type of incision and surgical technique employed and
are reflected by decreases in total pulmonary capacities
and volumes [7]. Impairment of pulmonary function is one
of the most significant postoperative complications of
upper abdominal surgery (UAS) [8, 9].

The main purpose of this study was to detect the
beneficial effect of aerobic exercise training and incentive
spirometry in controlling postoperative pulmonary
complications after laparoscopic cholecystectomy.

MATERIALS AND METHODS

Subjects: Twelve patients who had undergone
laparoscopic cholecystectomy participated in the present
study. These patients were selected randomly from
General Surgery Department, King Abdulaziz Teaching
University Hospitals. Their ages ranged from 29 to 50
years. A brief medical history of each participant was
obtained to ensure that non had previous cardiopulmonary or musculoskeletal complications that
might restrict their activity and influence the results.
Patients were divided into two experimental groups: (A )
received free-paced walking exercise training, incentive
spirometry in addition to the traditional postoperative
chest physical therapy and (B ) received the traditional
postoperative chest physical therapy.

This study was approved by the Scientific Research
Ethical Committee, Faculty of Applied Medical Sciences
at King Abdulaziz University. All participants were free to
withdraw from the study at any time. If any adverse
effects had occurred, the experiment will be terminated
and the Human Subjects Review Board would be
informed. However, no adverse effects occurred and so
the data of all the participants were available for analysis.

Equipments and Measurements: Pulse oximeter
(Model8500, Nonin Medical): an earlobe sensor was used
to measure heart rate (HR) and arterial oxygen saturation
(SaO2) noninvasively.

Incentive spirometry (Voldyne Volumetric
manufactured by Sherwood Medical Company U.S.A.): It
is a respiratory therapy device that provides visual
feedback in term of volumetric success as a patient
performs a deep breath. Incentive spirometry is consider
as a guideline for progression of treatment. Also incentive
spirometer was used in measurement of inspiratory
capacity (IC).

Procedures of the Study

Routine Chest Physiotherapy Program for Patients after
Laparoscopic Cholecystectomy: Patients of the two
groups received the routine chest physiotherapy program
for patients after laparoscopic cholecystectomy which
was started on the morning of the first post operative day,
a physiotherapist supervised and assisted the treatment
twice a day in the first two post operative days and once
a day from the third to the tenth days. During any
session, the patients performed three to five deep breaths
interspersed with periods of quiet breathing followed by
two or three coughs or huffs (with wound support by a
pillow or his/her hands). This maneuver was carried out at
least 10 times over a 15 minutes period. Additional
techniques such as positioning and chest wall percussion
were applied if breathing and coughing exercises alone
were not effective in clearing excessive or retained
pulmonary secretions. Patients were instructed to perform
breathing and coughing exercise independently every
hour [10].

Breathing Exercise with Incentive Spirometry:
Patients of group (A) received breathing exercise training
with IS (Voldyne Volumetric manufactured by Sherwood
Medical Company U.S.A.) in addition to the routine chest
physiotherapy program for patients after CABG up to the
ten post operative day. Application of breathing
training with incentive spirometry was applied for five
minutes, five times a day [11,12].

Walking Training Procedure: Warming up phase
consisted of active range of motion exercises, pelvic
tilting exercises and isometric quadriceps exercises for 15
minutes daily and before each training.

Exercise Phase Started at the Third Day as the
Following:

C  - 3rd - 5th day, 3 minutes free paced walking,
C  - 6th - 7th day, 6 minutes free paced walking,
C  -8th - 9th day, 9 minutes free paced walking,
C  -10th - 12th day, 12 minutes free paced walking,
C  -13th - 14th day, 15 minutes free paced walking.

Group (A): Six patients who had laparoscopic
cholecystectomy and received free-paced walking exercise
training, incentive spirometry in addition to the traditional
postoperative chest physical therapy.
Group (B): Six patients who had laparoscopic cholecystectomy and received the traditional postoperative chest physical therapy.

Statistical Analysis: Paired -t-test was used to compare between pre-test and post-test values of the investigated parameters in both groups. While the unpaired -t-test was used to compare between results of both groups (p<0.05).

RESULTS

The results obtained in the present investigation indicated that, there was a significant reduction in values of HR and a significant decrease in SaO2 and IC of both groups. There were significant differences between both groups at the end of the study (P <0.05) (Tables 1, 2 and 3).

DISCUSSION

The main purpose of this study was to detect the beneficial effect of aerobic exercise training and incentive spirometry in controlling postoperative pulmonary complications after laparoscopic cholecystectomy. The results obtained in this study indicated that, there was a significant reduction in values of HR and a significant decrease in SaO2 and IC of both groups. There were significant differences between both groups at the end of the study. These results were approved and confirmed by many previous studies.

Table 1: Mean and significance of the pre and post values of heart rate, inspiratory capacity and arterial oxygen saturation in group (A).

<table>
<thead>
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<th></th>
<th>Mean ± SD</th>
<th>t-value</th>
<th>Significance</th>
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<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td></td>
</tr>
<tr>
<td>HR (Beat/Min.)</td>
<td>103.67±3.981</td>
<td>75.85±3.792</td>
<td>-4.176</td>
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<tr>
<td>SaO2(%)</td>
<td>86.32±3.651</td>
<td>98.15±2.815</td>
<td>3.45</td>
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<tr>
<td>IC(L.)</td>
<td>415.83±68.34</td>
<td>1759.83±160.25</td>
<td>4.63</td>
</tr>
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</table>

HR = Heart rate SaO2 = Arterial oxygen saturation IC = Inspiratory capacity

Table 2: Mean and significance of the pre and post values heart rate, inspiratory capacity and arterial oxygen saturation in group (B).

<table>
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<th>Significance</th>
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<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td></td>
</tr>
<tr>
<td>HR (Beat/Min.)</td>
<td>103.58±4.152</td>
<td>81.23±3.975</td>
<td>-3.428</td>
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<tr>
<td>SaO2(%)</td>
<td>85.59±3.370</td>
<td>94.14±3.115</td>
<td>2.88</td>
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<tr>
<td>IC(L.)</td>
<td>422.45±72.641</td>
<td>1545.72±138.52</td>
<td>3.827</td>
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HR = Heart rate SaO2 = Arterial oxygen saturation IC = Inspiratory capacity
Table 3: Mean and significance of the post values of heart rate, inspiratory capacity and arterial oxygen saturation in group (A) and group (B).

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Group (A)</th>
<th>Group (B)</th>
<th>t-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (Beat/Min.)</td>
<td>75.85±3.792</td>
<td>81.23±3.975</td>
<td>2.597</td>
<td>P &lt; 0.05</td>
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<tr>
<td>SaO2(%)</td>
<td>98.35±2.815</td>
<td>94.14±3.115</td>
<td>2.245</td>
<td>P &lt; 0.05</td>
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</tr>
<tr>
<td>IC(L.)</td>
<td>1759.83±160.25</td>
<td>1545.72±138.52</td>
<td>2.266</td>
<td>P &lt; 0.05</td>
<td></td>
</tr>
</tbody>
</table>

HR = Heart rate  SaO2 = Arterial oxygen saturation  IC = Inspiratory capacity

of total lung and thoracic compliance may be contributed to increase arterial oxygen saturation (SaO2) [16].

Application of treadmill walking exercise three times weekly for 8 weeks resulted in increased exercise endurance, less dyspnea, improved vital capacity (V.C), maximum voluntary ventilation (MVV) and twelve minute walking test. Improvements may be due to one or more of the following factors: improved aerobic capacity, or muscle strength or both, increased motivation and improved ventilatory muscle function [17].

After exercise training an older individual is able to show some improvement in the pulmonary response to exercise. Most of the improved pulmonary function results from greater efficiency of ventilatory and skeletal muscle performance. This is evidence by the decreased production of lactate and carbon dioxide when undertaking a given workload. The individual is able to work at a lower percentage of maximal voluntary ventilation and has an increased ventilatory response for a given oxygen uptake and less perceived dyspnea. Ventilatory muscle training in addition to lower extremity exercise training resulted in reduction in dyspnea, improved respiratory muscle strength and endurance, increased exercise ability and improved health related quality of life [18].

CONCLUSION

Association of aerobic exercise to incentive spirometry helped in controlling postoperative pulmonary complications after laparoscopic cholecystectomy.

ACKNOWLEDGMENT

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REFERENCES


