Chest Physiotherapy in Prevention of Hospital Acquired Pneumonia after Liver Transplantation

MAHMOUD I. MOHAMED, M.Sc.*; AISHA A. HAGAG, Ph.D.*; MONA M. TAHA, Ph.D.* and AHMED N. AHMED, M.D.**
The Departments of Physical Therapy for Cardiovascular/Respiratory Disorder & Geriatrics* and General Surgery**, Cairo University

Abstract

Purpose: Of this study was to find out the effect of chest physiotherapy on the prevention of early onset hospital acquired pneumonia after liver transplantation.

Method: Thirty male patients post liver transplantation, their ages ranged from 50 to 60 years old were recruited in this study. The patients were selected from ICU of liver transplantation unit in Elmanial specialized hospital, faculty of medicine Cairo university. The patients divided into two group, study group (A) included 15 patients who received chest physiotherapy (percussion, vibration, suction, diaphragmatic breathing exercise, cough education and active cycle of breathing), positioning and limb exercises and control group (B) included 15 patients who received limb exercises, positioning and suctioning.

Results: Showed improvement in PaO2, TLC, SO2, Respiratory rate, decreased incidence of chest infection and decreased intensive care unit stay in the study group than the control group. While no significant difference in pH, PaCo2, HCO3, temperature and heart rate.

Conclusion: The results of this study support the importance of adding chest physiotherapy to prevent early onset hospital acquired pneumonia after liver transplantation and decrease intensive care unit stay.

Key Words: Chest physiotherapy – Hospital acquired pneumonia – Liver transplantation.

Introduction

THE liver is the largest gland in the body and, after the skin, the largest single organ. It weighs approximately 1500g and accounts for approximately 2.5% of adult body weight [1]. Patients with advanced liver disease often have decreased muscle mass and strength, low bone mineral density, malnutrition, increased levels of fatigue, and decreased aerobic capacity. At this stage, dysfunctions in glycogen storage and gluconeogenesis lead to a breakdown of muscle protein and fat to use energy, resulting in weight loss and muscular weakness [2]. Orthotopic liver transplantation (OLT) is currently the only definitive treatment for patients with acute liver failure and end-stage liver cirrhosis. Due to recipients’ generally poor preoperative clinical conditions, the extensive surgical field, and lengthy operating times, postoperative respiratory disorders are very common after OLT and significantly contribute to the related morbidity and mortality both in the acute postoperative stage and in the long term [3]. Liver recipients accumulate risks factors for pneumonia, such as immunosuppression, alveolar edema, blood product transfusion, prolonged postoperative mechanical ventilation, and postoperative diaphragmatic dysfunction related to upper abdominal surgery. The incidence of these infections has been shown to vary from 5% to 48%, whereas estimates of the related mortality rate range from 36.6% to 53% [4]. Many patients who undergo liver transplantation (LT) probably the majority spend some time in the intensive care unit (ICU) during the postoperative period. The expectations for an immediate postoperative ICU stay have changed markedly as the specialty has progressed [5].

Early extubating is the key element to reduce Postoperative pulmonary complications and ICU stay and to speed patients’ recovery. There is a substantial body of evidence proving that patients who undergo OLT can be extubated immediately after surgery, with few pulmonary complications and a lower risk of postoperative infection [3].

Hospital acquired pneumonia (HAP) is defined as pneumonia that occurs 48 hours or more after admission, which was not incubating at the time
of admission HAP increases hospital stay by an average of 7 to 9 days per patient and has been reported to produce an excess cost of stay. Hospital acquired pneumonia (HAP) onset was often classified as early or late depending on days of hospitalization, Early-onset HAP, defined as occurring within the first 4 days of hospitalization, Late-onset HAP (5 days or more) are more likely to be caused by multidrug-resistant (MDR) pathogens, and are associated with increased patient mortality and morbidity [6].

The incidence of post-LT pneumonia has been shown to vary from 5%-38%. Pirat et al., reported an incidence of 22.7% and a mortality rate of 40%. These authors found that individuals who developed pneumonia had longer times to extubation and higher mortality [3]. HAP is usually caused by bacteria, is currently the second most common nosocomial infection in the United States, and is associated with high mortality and morbidity [6]. Pneumonia was associated with a prolonged use of mechanical ventilation, a prolonged stay in the ICU, the creation of a tracheostomy, primary graft dysfunction. The mortality rate of patients with early-onset pneumonia was 25.7%. Delayed-onset pneumonia was significantly associated with graft dysfunction and resulted in a higher mortality rate (73.3%) than did early-onset pneumonia [6].

Although the incidence of pneumonia among liver transplant recipients was relatively low, once it developed, the mortality rate was high. High-risk patients undergoing liver transplantation thus require early diagnosis and intensive treatment to diminish the morbidity and mortality associated with pulmonary complications [7]. Applied clinical criterias for HAP diagnosis associated with the presence of new lung infiltrate on chest radiography plus at least two of the following: Fever ≥38°C, leukocytosis or leukopenia, or purulent secretions [6].

The physiotherapy treatment is addressed to prevent and reduce potential pulmonary complications such as hypoventilation, hypoxemia and infection in order to restore muscular and pulmonary function as fast as possible, the occurrence of complications can be influenced by the quality of care provided as well as to the amount of care given for ICU patients [8]. Physiotherapists are involved in the management of patients with acute, subacute and chronic respiratory conditions and in the prevention and treatment of the sequelae of immobility and recumbence, Respiratory dysfunction is one of the most common causes of critical illness necessitating ICU admission. Failure of either of the two primary components of the respiratory system i.e., the gas-exchange membrane and the ventilatory pump can result in a need for mechanical ventilation to maintain adequate gas exchange and to assume some, if not all, of the work of breathing. The aims of physiotherapy in respiratory dysfunction are to improve global and/or regional ventilation and lung compliance, to reduce airway resistance and the work of breathing, and to clear airway secretions [9].

There is an evidence confirming that various combinations of chest physiotherapy have played respective significant roles to manage lung re-expansion and confer short term improvement in total lung-thorax compliance and expiratory flow rates [10]. Chest physiotherapy is one such common preventive strategy where chest physiotherapists routinely treat most of the ICU patients with various chest physiotherapy techniques such as Manual hyperinflation (MH), suctioning, patient positioning, chest vibrations, chest percussions, various coughing techniques in combination or individually to prevent pulmonary complications in the ICUs [11].

Patients and Methods

This is a randomized controlled study that was carried on thirty male patients post liver transplantation, their ages ranged from 50 to 60 years old. The patients were selected from ICU of liver transplantation unit in El-Manial Specialized Hospital, Faculty of Medicine, Cairo University. During the period between May 2016 and April 2017. The patients were randomly divided into two equal group, study group (A) included 15 patients who received chest physiotherapy (percussion, vibration, suction, diaphragmatic breathing exercise, cough education and active cycle of breathing), positioning and limb exercises and control group (B) included 15 patients who received limb exercises, positioning and suctioning.

Inclusion criteria:

All patients from the first day of ICU admission post liver transplantation between the age of 50-60 years old and patient had the modified Makuuchi incision.

Exclusion criteria:

All patients had the following criteria were excluded:

Younger than 50 and older than 60 years, acute respiratory distress syndrome, acute myocardial infarction, cardiac arrhythmias, hemodialysis, community acquired pneumonia, unstable cardio-
vascular or neurological function or injury preventing positioning for chest physiotherapy. And with Open heart surgery or Human immunodeficiency virus (HIV) positive acute pulmonary edema, untreated pneumothorax, and admission with tracheostomy.

**Methods:**

Outcome measures as indicator for detection of early onset HAP:

- **Clinical evaluation:**
  - A- Respiratory rate.
  - B- Temperature.

- **Monitoring:**
  - A- Heart rate.
  - B- Oxygen saturation: by pulse oximetry

- **Laboratory investigation:**
  - A- Arterial blood gases: For measurement of pH and oxygen partial pressure (PaO2), carbon dioxide partial pressure (PaCO2) and bicarbonate (HCO3).
  - B- Total leukocyte count (TLC) test: To assess inflammation.
  - C- Sputum culture.

- **Imaging evaluation:**
  - A- Chest X-ray: To assess infiltrations (clear or consolidated).
  - B- Therapeutic equipment: 1- Mechanical vibrator. 2- Suction apparatus.

**Procedures:**

- The procedures was done during the first 3 days of patient admission in ICU.
- Each patient was given 2 sessions every day.
- Each session lasted for 40 minutes.

**Treatment procedures:**

**Group A (study group):** The program was designed as follows,

1. **Percussion:** Was done for 5 minutes performed manually (using cupped hands) by clapping the chest wall over of the lung. Chest vibrations: Was done for 5 minutes all over the lung from distal to proximal and from lateral to medial direction. Suctioning (during intubation): Duration of endotracheal suctioning was limited to 15sec. Positioning: At the end of the treatment session and after suctioning, the head end was arranged to be positioned at an angle of elevation in the range of 30-45°, this positioning was maintained for minimum of 30min to improve the ventilation.

2. **Limb exercises:** In the form of passive or active assisted movement for the 4 limbs (2 sets for each limb and each set 10 repetitions) for 15 minutes. Limb exercises (passive, active assisted or active) were performed according to patient's status. Diaphragmatic Breathing exercise (after extubating): It was repeated throughout the session, and the program consisted of diaphragm breathing, sustained maximal inspiration, and fractional inspiration. Instruction was focused on bilateral basal expansion, and avoiding upper chest and shoulder elevation, and maximizing expansion of the lower chest diameters during inspiration, with a three second end inspiratory hold, followed by relaxed expiration. Cough and Huff education (after extubating): The manually assisted cough consisted of the manual compression of the abdomen's epigastric region. It was performed by the placement of both hands on the abdomen or with one hand on the thoracic region and the other on the abdomen. Or using a pillow over the incision site and applying gentle pressure while coughing. Active cycle of breathing, it consists of 3 steps: Subjects were in comfortable position.

3. **Breathing control:** Patients were instructed to breathe at a normal rate and depth using the lower chest.

4. **Chest expansion:** By resting one hand on the epigastrium allowing the patients to breathe in slowly and deeply using the lower chest (Pause) then breathe out fully but not forcefully. Was Repeated 2 to 3 times. Then return to breathing control.

5. **Sputum removal:** Patients were instructed to take a slightly bigger than normal breath in, then open the mouth and keep it O shaped. Breathing out more forcefully by contracting the abdominal muscles while keeping the mouth and throat open. It should sound like a forced sigh as huffing.

Then Return to breathing control till the patient was ready to begin another cycle (each cycle lasted for 2min). The patients were advised to start coughing any sputum if necessary.

**Group B (control group):** Received suctioning, positioning and limbs exercises as prescribed before.

**Statistical analysis:**

Descriptive statistics and t-test were conducted for comparison of pre and post treatment mean values between study and control groups. Paired t-test was conducted for comparison between pre and post treatment mean values in each group. Chi-squared test was conducted for comparison of Sputum culture and X-ray finding between study and control groups. The level of significance for all statistical tests was set at p<0.05. All statistical
measures were performed through the statistical package for social studies (SPSS) version 19 for windows.

Results

There was no significant difference in the pre-treatment mean values of all variables in both groups.

There was a significant increase in the mean values of PaO2, SO2 and Respiratory rate of the study group compared with that of the control group post treatment.

There was a significant decrease in the mean values of T.L.C. and ICU staying of the study group compared with that of the control groups.

There was a significant decrease in number of cases that had bacterial growth and lung consolidation in study group compared with that in control group.

There was no significant difference in the mean values of pH, PaCO2, HCO3, Heart rate and temperature between the study and control groups post treatment.

Table (1): Comparison between pre-treatment mean values of the study and control groups variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre-treatment study X±SD</th>
<th>Pre-treatment control X±SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>54.6±3.66</td>
<td>53.13±2.82</td>
<td>0.22</td>
</tr>
<tr>
<td>PH</td>
<td>7.4±0.06</td>
<td>7.38±0.09</td>
<td>0.54</td>
</tr>
<tr>
<td>PaO2</td>
<td>70.38±7.96</td>
<td>69.6±7.72</td>
<td>0.78</td>
</tr>
<tr>
<td>PaCO2</td>
<td>43.15±7.74</td>
<td>42.61±9.06</td>
<td>0.85</td>
</tr>
<tr>
<td>HCO3</td>
<td>27.4±6.25</td>
<td>24.78±3.36</td>
<td>0.16</td>
</tr>
<tr>
<td>TLC</td>
<td>14.4±4.3</td>
<td>14.33±3.02</td>
<td>0.95</td>
</tr>
<tr>
<td>RR</td>
<td>17.06±2.28</td>
<td>17.2±1.01</td>
<td>0.83</td>
</tr>
<tr>
<td>HR</td>
<td>94.13±8.63</td>
<td>92.93±6.95</td>
<td>0.67</td>
</tr>
<tr>
<td>SaO2</td>
<td>95.73±1.75</td>
<td>94.73±3.34</td>
<td>0.31</td>
</tr>
<tr>
<td>Temperature</td>
<td>37.26±0.44</td>
<td>37.38±0.36</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Table (2): Comparison between pre-treatment and post-treatment mean value of the study and control groups variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre-treatment study X±SD</th>
<th>Post-treatment study X±SD</th>
<th>P-value</th>
<th>Pre-treatment control X±SD</th>
<th>Post-treatment control X±SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td>7.4±0.06</td>
<td>7.41±0.04**</td>
<td>0.57</td>
<td>7.38±0.09</td>
<td>7.43±0.07*</td>
<td>0.13</td>
</tr>
<tr>
<td>PaO2</td>
<td>70.38±7.96</td>
<td>82.13±4.83**</td>
<td>0.0001</td>
<td>69.6±7.72</td>
<td>76.46±8.25**</td>
<td>0.0001</td>
</tr>
<tr>
<td>PaCO2</td>
<td>43.15±7.24</td>
<td>39.06±7.47**</td>
<td>0.002</td>
<td>42.61±9.06</td>
<td>41.76±7.51*</td>
<td>0.8</td>
</tr>
<tr>
<td>HCO3</td>
<td>27.4±6.25</td>
<td>27.95±5.58*</td>
<td>0.66</td>
<td>24.78±3.36</td>
<td>26.38±3.77*</td>
<td>0.14</td>
</tr>
<tr>
<td>TLC</td>
<td>14.4±4.3</td>
<td>9.56±3.7**</td>
<td>0.002</td>
<td>14.33±3.02</td>
<td>12.27±2.49**</td>
<td>0.001</td>
</tr>
<tr>
<td>RR</td>
<td>17.06±2.28</td>
<td>14.4±1.18**</td>
<td>0.0001</td>
<td>17.2±1.01</td>
<td>16.46±2.06**</td>
<td>0.2</td>
</tr>
<tr>
<td>HR</td>
<td>94.13±8.63</td>
<td>84.13±5.13*</td>
<td>0.0001</td>
<td>92.93±6.95</td>
<td>87.66±9.78*</td>
<td>0.01</td>
</tr>
<tr>
<td>SO2</td>
<td>95.73±1.75</td>
<td>97.6±0.82**</td>
<td>0.005</td>
<td>94.73±3.34</td>
<td>94.13±3.04**</td>
<td>0.21</td>
</tr>
<tr>
<td>Temperature</td>
<td>37.26±0.44</td>
<td>37.3±0.47**</td>
<td>0.42</td>
<td>37.38±0.36</td>
<td>37.46±0.4**</td>
<td>0.47</td>
</tr>
<tr>
<td>ICU staying</td>
<td>–</td>
<td>3.93±0.88**</td>
<td>0.42</td>
<td>–</td>
<td>6.86±2.58**</td>
<td>–</td>
</tr>
</tbody>
</table>

Table (3): Frequency distribution and chi squared test for comparison of Sputum culture, X-ray finding of both groups.

<table>
<thead>
<tr>
<th></th>
<th>Study group</th>
<th>Control group</th>
<th>X²</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial growth</td>
<td>5 (33%)</td>
<td>11 (73%)</td>
<td>4.82</td>
<td>0.02</td>
</tr>
<tr>
<td>Consolidation</td>
<td>6 (40%)</td>
<td>12 (80%)</td>
<td>5</td>
<td>0.02</td>
</tr>
</tbody>
</table>

χ²: Chi-squared value.  
P-value: Probability value.

Discussion

Pneumonia is the most common infectious complication following heart and lung transplantation, and the second most common infection after liver transplantation, but it occurs less frequently among kidney transplant recipients [12].

Within the limitation of this study, it showed improvement in PaO2, TLC, Respiratory rate,
decreased incidence of chest infection and decreased intensive care unit stay in the study group when compared to the control group. While there is no significant difference in PH, PaCO2, HCO3, and heart rate between both groups. The results of the current study showed that there were significant differences between both groups in role of chest physiotherapy in prevention of early onset hospital acquired pneumonia.

The mean length of the chest physical therapy sessions was 20 minutes/2 sessions every day for 3 days, and intervention for each patient was administered using a few techniques aimed to improve lung ventilation. Bronchial hygiene techniques such as assisted coughing and expiratory airflow technique were used to reduce or prevent patient's airway secretions while lung re-expansion techniques such as respiratory exercise therapy associated with maximum sustained inspiration and fractional inspiration were used to maintain lung open. In addition, patients were also motivated to mobilize as soon as possible.

Guidelines for the management of hospital-acquired pneumonia in the UK [13] recommend that coughing and early mobilization during the post-operative recovery period should be encouraged in all patients in order to reduce the risk of pulmonary complications, and positional strategy should be adapted to prevent HAP by using the semi-recumbent position and concluded that chest physiotherapy may be of value to patients suffering from or at risk of HAP and it might be appropriate to consider it as a therapeutic option in this broader context. There are only a few trials that support the usefulness of prophylactic respiratory physiotherapy. The routine use of respiratory physiotherapy after abdominal surgery does not seem to be justified [14]. However the benefits of chest physical therapy for patients undergoing upper abdominal surgery have been evaluated by many studies, most of them aimed either to assess the preventive effects of chest physical therapy or to compare the postoperative effectiveness of different techniques, including incentive spirometry, continuous positive airway pressure ventilation, deep breathing exercises and recovery of ambulation [15]. In general, distinct chest physical therapy techniques have been shown to have equivalent effects to prevent postoperative respiratory complications in upper abdominal surgery [16].

Chen et al., studied the effect of early chest physiotherapy on blood gas and circulatory function in old patients after thoracotomy. They found that PaO2, SaO2 were significantly increased and PaCO2 were decreased at 30 minutes after treatment compared with it before treatment [17], while Zeyu et al., investigated the clinical effect of the chest physiotherapy for the postoperative sputum excretion in lung transplantation patients after chest physiotherapy, the improvement difference of PaO2, PaCO2, and SaO2 were significant higher than before (p<0.05); after three days, 7 cases of lung transplantation patients in which 8 cases of patients with chest radiograph improved markedly, double lung auscultation without obvious rale, patients can cough by themselves, lung signs good [18]. Similar to this, our current study finding within the study group there were significant increase in the mean value of PaO2 from (70.3 $\pm$ 7.96 mmHg to 82.13 $\pm$ 4.83 mmHg) (p=0.0001) and SO2 from (95.73 $\pm$ 1.75% to 97.6 $\pm$ 0.82%) (p=0.005) and significant decrease in PaCO2 (43.15 $\pm$ 7.24 mmHg to 39.06 $\pm$ 7.47 mmHg) (p=0.002). But comparing to control group all those had significant increase except PaCO2, which was not significant different.

In our study, Study group received chest physiotherapy plus suctioning, positioning and limb exercises while control group received suctioning, positioning and limb exercises only. Dean [19] commented that 'most studies evaluating conventional chest physiotherapy are confounded by the physiologic effects of body positioning and mobilization' and advocated the use of changing body position and mobilization as a primary treatment intervention.

Chumillas and associate [20] Stated that there were many Studies on the efficacy of the different forms of pulmonary physical therapy in preventing postoperative pulmonary complications and they were not conclusive, because variability exists in the rehabilitation techniques employed, the definitions used, and in the incidence of postoperative pulmonary complications. However they concluded that Respiratory rehabilitation protects against postoperative pulmonary complications and is more effective in moderate- and high-risk patients who had upper abdominal surgery, but does not affect surgery-induced functional alterations.

In disagreement with the results of our study, macaky and associate [21] had two groups, subjects in the non-Deep breathing and coughing (DB&C) Group participated in a standardized program of early mobilization while DB&C Group subjects received exactly the same program of early mobilization and leg exercises with the addition of coached lateral basal expansion exercises and sputum clearance techniques, referred to as deep breathing and coughing (DB&C) exercises. Found
that, three subjects in the non-DB&C Group (14%) and five subjects in DB&C Group (17%) developed clinically significant postoperative pulmonary complications concluded that chest physiotherapy had no additional benefit in reducing the incidence of postoperative pulmonary complications after open abdominal surgery in high-risk subjects. However, our findings do not support such an explanation as there were significant decreases in postoperative pulmonary complication (early onset pneumonia). That may be due to different age range used with mean (69 ± 15) in non (DB&C) and (63 ± 13) in (DB&C), while this study had (54.6 ± 3.66) in study group and (53.13 ± 2.82) in control group and in addition the previous study assessed pulmonary complication for 14 days while ours only for the first three postoperative days and we added in this study mechanical viberator and percussion.

A systematic review and meta-analysis of six studies that were used, three studies of good and moderate quality showed that breathing exercises are likely to have a beneficial effect on maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP) of patients in the post-upper abdominal surgery phase. Interestingly, these findings are related to breathing exercises without resistance commonly used in muscle training, therefore the increase in respiratory pressures may be related to the characteristics of the exercises. In the studies that found improved MIP and MEP in the groups that performed breathing exercises, the programs consisted of diaphragm breathing, sustained maximal inspiration, and fractional inspiration aimed at increasing diaphragm mobility, improving respiratory muscle synergism, and maintaining muscle trophism by using the diaphragm and reducing the action of accessory muscles [22].

It was stated that the physiotherapy effects are exclusively short-term and therefore there is no evidence that chest physiotherapy reduce complications and mortality in an ICU setting. On the other hand, there are several studies that shows the benefits of chest physiotherapy in ICU patients [23-27]. However none of them regards the prevention of pulmonary complications with the use of chest physiotherapy. In our study it was found a significant reduction of time ICU length of stay, pulmonary infection rate and mortality in ICU staying. Further studies need to evaluate treatments with a larger number of patients on both sex and for a longer period.

Conclusion:

The encouraging results of the this study showed that the initiation of the chest physiotherapy based on packages of interventions immediately following liver transplantation in the intensive care unit not only decrease incidence of early onset hospital acquired pneumonia but also decrease the length of ICU staying. Further studies need to evaluate treatments with a larger number of patients on both sex and for a longer period.

References


العلاج الطبيعي للصدر للوقاية من الالتهاب الرئوي المكتسب من المستشفى بعد زرع الكبد

الفرض: تهدف هذه الرسالة لدراسة تأثير العلاج الطبيعي للصدر للوقاية من الالتهاب الرئوي المكتسب من المستشفى ذات البداية المبكرة بعد زرع الكبد.

الأشخاص والأساليب المستخدمة: ثلاثين مريض من الذكور بعد عملية زرع الكبد متراوح اعمارهم بين 50 إلى 60 سنة تم اشراكهم في الدراسة وقد تم اختيارهم من وحدة الرعاية الحجرة لزراعة الكبد مستشفى المنيل التخصصي، كلية الطب جامعة القاهرة. وتم تقسيمهم إلى مجموعتين. مجموعة الدراسة (أ) تحتوى على 15 مريض و تلقى علاج طبيعي للصدر ويتوقف على (شيفيفنش) نفر و اتزار على الصدر، ثمرين تنفس الحجاب الحاجز. تعليم الكحة و تمرير الدورة التنفسية (لتلطف). وتعديل الوضع. وتمارين الالطرف، المجموعة الضابطة (ب) تحتوت على 15 مريض ولققو شيفيفنش وتعديل الوضع. وتمارين الالطرف فقط. وتلقى المريض جلستين في اليوم لمدة ثلاث اعوام متتالية بعد العملية.

النتائج: أظهرت النتائج تحسن في ضغط الأوكسجين الجزئي. عدد كرات الدم البيضاء الكلي نسبة تشبع الدم باللوكسيجين، معدل التنفس وتقليل حضور الدورةAFF للدماء في الرعاية الحجرة في مجموعة الدراسة مقارنة بال مجموعة الضابطة بينما أظهرت الدراسة عن عدم وجود فروق كبيره في معدل الهيدروجين، ضغط ثاني أكسيد الكربون في الدم، النيتروجين، معدل ضربات القلب ودرجة الحرارة بين المجموعتين.

الأستنتاج: نتائج هذه الدراسة تدعم أهمية اضافة العلاج الطبيعي الصدرى لمنع البداية المبكرة للالتهاب الرئوي المكتسب من المستشفى بعد عملية زرع الكبد وتقليل مدة الاقامة في الرعاية الحجرة.

الكلمات الدالة: العلاج الطبيعي الصدرى - عملية زرع الكبد - الالتهاب الرئوي المكتسب.