

# The Impact of Chest Physiotherapy Technique (CPT) on Respiration, Pain and Quality of Life Post Thoracic Wall Fixation Surgery among Flail Chest Patients (FC)

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**Abstract Background:** FC is the most extreme type of blunt chest wall casualty with death rate up to 20%. These patients may require prolonged days of mechanical ventilation for ongoing respiratory dysfunction, leading to high rates of pulmonary complications. This study aimed to assess the impact of CPT on respiration, pain and quality of life post thoracic wall fixation surgery in Flail Chest Patients. It followed a quasi-experimental, pretest-posttest comparison. The study was carried out in cardiothoracic surgery intensive care unit (ICU) at Qena university hospital. A convenience sample comprised of 30 adult patients from both sexes with flail chest and no contusion. They were given pharmacological epidural and oral analgesic medications to reduce pain during physiotherapy practice post chest stabilization surgery. **Tool 1:** A self-reporting Assessment Questionnaire were comprised pain rating index scores pre and post CPT and prior epidural analgesic administration, and symptoms associated with pain, Health-related quality of life and Dyspnea scale. Sociodemographic characteristics were attached to the tool 1. **Tool 2:** A clinical data base assessment were taken pre and post CPT, included: **Part I:** Laboratory investigation of a Standardized lung function tests which Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1) and Peak Expiratory Flow (PEF) were recorded and ABGs includes PaO<sub>2</sub>, PaCO<sub>2</sub>, SO<sub>2</sub>, and PH in addition to vital signs ( Part II) and Diagnostic test assessment includes Chest x-ray, and chest tomography CT was done before chest stabilization surgery to confirm the diagnosis in accordance of study criteria(Part III). Tool 3: CPT include, breathing and coughing exercise and IPPB., secretion mobilization techniques like chest wall percussion, and vibration and incentive spirometer. **Results/conclusion:** the majority of the studied sample was male and were from 50 - 60 years and illiterate. The effect of CPT on the symptoms associated pain, and pain intensity were still persistent in decrease post discharge at late follow up till 6<sup>th</sup> month. The majority of subjects had no dyspnea on 3<sup>rd</sup> and 6<sup>th</sup> month of follow up. so, their HRQOL scores improved with a high significance in the area of mobility, self-care, anxiety and depression, the performance of usual activities and pain and discomfort on 6 months of late follow-up. Also, it was noticed that the mean of Pulmonary Function Test (PFT), and ABGs improved in the late follow-up. This improvement has been definitively shown in all outcomes parameter post chest physiotherapy performed after surgical fixation of FC. **Recommendation:** Moreover, this study recommended that all the physiotherapy approaches should be planned and applied as an individual programs tailored to the FC patients following a comprehensive evaluation.

**Keywords:** flail chest, physiotherapy, pain, Health-related quality of life, Dyspnea

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## 1. Introduction

Flail chest (FC) occurs when it is not less than three consecutive ribs fractured in at least two points and

becomes detached from the rest of the chest wall [1,2]. This anatomical separation may cause a flail segment moving incomprehensibly with breath [3]. The most widely recognized explanation behind FC is a chest wall injury which happens after vehicle impacts, assaults, fall from height [1,3]. FC is the most extreme type of blunt

chest wall casualty with death rate up to 20% [4,5]. These patients may require prolonged days of mechanical ventilation for ongoing respiratory dysfunction, leading to high rates of pulmonary complications [5]. On the other hand, FC injuries were followed by a poor prognosis in the past because each additional rib fracture could expand the danger of mortality, pneumonia, acute respiratory distress, serious alteration of the chest shape and persistent chest pain that affects normal life [4]. A study described techniques of internal pneumatic stabilization with mechanical ventilation are being replaced by internal stabilization surgery for patients with flail chest injuries that provides an early restoration of chest wall contour and result in a reduction in the ventilator supportive duration [6]. Long-term pulmonary function and disability seem to be better than preserved post chest stabilization surgery [5,7].

Respiratory complications are the most common problems after surgery. Moreover, flail chest-related symptoms and problems such as dyspnea, fatigue, pain, and physical inactivity may occur that result in poor physical functioning, psychosocial, and quality of life status. Based on the management of symptoms and problems, chest physiotherapy techniques (CPT) can be used post chest stabilization surgery following a comprehensive evaluation. In addition, the pain associated with rib fracture impairs ventilation with a resultant increase in pulmonary morbidity [8]. Splinting as a reaction to pain leads to a reduction in tidal volume and functional residual capacity leading to atelectasis and hypoxemia [9,10]. Administration of analgesia is not only ethical but, it also allows improved chest wall excursion and alveolar ventilation, decreasing the incidence of pulmonary complications and frequently encountered hypoxia [11].

Therefore, management of these patients is centered on achieving aggressive pain control, catheter-based analgesia and pulmonary toilet to maintain respiration by decrease the incidence of pneumonia [8]. So, with the improvement in intensive care facilities, non-operative management in the form of intermittent positive pressure ventilation has gained a popularity that acts as a form of internal splintage helping to prevent paradoxical breathing [9]. In addition to postoperative chest physiotherapy technique (CPT) which is an aspect of bronchial hygiene may include breathing and direct coughing exercise as well as secretion removal techniques as percussion and vibration [11]. Any or all of these techniques may be performed in conjunction with medicinal aerosol therapy as a bronchodilators or mucolytic parallel with the use of optimal analgesia [8]. Also, the incentive spirometer is a medical device used individually to help patients improve the functioning of their lungs and provide to patients who have had any surgery that might jeopardize respiratory function, particularly surgery to the chest and lungs themselves [10].

As well as, mobilization in the upright position coordinated with breathing and coughing exercise and supported maneuvers is encouraged in order to reduce atelectasis and impaired mucociliary transport associated with surgery. These beneficial effects are enhanced by improved chest wall motion, improved gut mobility, and reduced intra-abdominal pressure [12]. Also, a study stated that early mobilization has a good physiological and psychological effect on stable and beneficial breathing

potentially leading to lung expansion and recovery of pulmonary function and ABGs after surgery and then maintain quality of life (QOL) [13,14].

Chronic pain is significant contributors to diminished QOL following injury [12,13]. Moreover, lifestyle changes should modify things that we have control over and involves factors that may bring on symptoms or make them worse, such as usual daily activities or changes in daily routine [14]. Some lifestyle changes can be taken to help in managing patient with FC as stop smoking which is the top priority in preventing infection and focus on restoring physical activities and promote sleep [15].

Caring for a patient with a FC poses a significant challenge to the nurse, it requires performing a serial evaluation, pain management, and diligent pulmonary hygiene [16]. It is imperative that the nurses realize that the first priority in trauma care is to maintain and support the respiratory system [17]. The nurse must be able to perform rapidly and effectively a primary survey, recognize the clinical manifestations of life-threatening as a result of thoracic injuries, and intervene in the care of the patient to help stabilize and maintain patient's respiratory function, not only be able to assess, but they must also be able to intervene rapidly and effectively [18].

So, the nurses are engaged in the holistic care of patients with FC while working in collaboration with other members of a healthcare team, they play a crucial and specific role in the health care, education and self-management of such patients as the surgeon, and physiotherapist. They also have specific tasks as evaluating, monitoring, ensuring that patients adhere to the agreed therapy, preventive measures for complications and act as a link between the hospitals and the community as a rehabilitative role [19].

## 1.1. The Significance of the Study

FC is one of the important factors for morbidity and mortality in traumatized emergency patients. The number of patient with Flail chest admitted in intensive care unit (ICU) for thoracic surgery in Qena University Hospital in the last year was 190 cases according to the Hospital Statistical Record, 2016. However, FC injuries carried a poor prognosis, it often led to more serious complications due to a prolonged recumbent, the prolonged loss of time from hospital employment and causes hospital cost. Nurses have closed and continuous contact with the patient, therefore, uniquely placed to incorporate preventive, caregiver, evaluator and promote teaching guidance in the day-to-day care they provide which help such group of a patient to improve their respiratory function, feeling of pain and farther faster recovery with good QOL after surgical chest wall stabilization. So, this study will explore the impact of CPT on quality of life, respiration and pain outcomes post thoracic wall stabilization for patients with flail chest.

## 1.2. Aim of the Study

This study aimed to assess the impact of CPT among patients with flail Chest on their respirations, pain intensity and quality of life post thoracic wall fixation surgery.

### 1.3. Research-Hypothesis

- Patients with flail chest post thoracic stabilization surgery who will exhibit less pain and dyspnea scores post-practice CPT than before.
- Patients with flail chest post thoracic stabilization surgery will exhibit improvement in their QOL after practice of CPT than before.
- Mean of pulmonary function, ABGs tests and vital signs for patients with Flail chest post thoracic stabilization surgery will be improved post CPT.

## 2. Subjects and Method

### 2.1. Research Design

A quasi-experimental pretest-posttest comparison study design was used to fulfil the aim of the study.

### 2.2. Setting

The study was carried out in cardiothoracic surgery intensive care unit (ICU) at Qena university hospital.

### 2.3. Sampling and Sample Size

All available admitted patients in intensive care unit post-cardiothoracic surgery at Qena university hospital who recruited in January 2016. It was according to power analysis using the epi-info program to estimate the sample size using the following parameters:

- Population size 95
- Expected frequency 50%
- Maximum error 10%
- Confidence Coefficient 95%.

A convenience sample comprised of 30 adult patients from both sexes and was confirmed with flail chest. They were given pharmacological epidural and oral analgesic medications to reduce pain and encouraged to do CPT post chest stabilization surgery. They were assessed by the researcher.

#### The Subjects inclusion criteria were:

Adults (18-60 years) and conscious patients with Flail chest (four or more adjacent ribs fractured in more than one location).

- Abnormal chest wall expansion.
- No associated severe head trauma or spine injuries
- No associated pulmonary contusion.

### 2.4. Tools of Data Collection

#### Tool 1: Self-reports Assessment Questionnaire:

It developed by the researchers to study participants and was comprised of four parts

**Part I: Patients' Socio-demographic and smoking pattern** (age, gender, level of education and smoking lifestyle).

#### Part II: Subjective Expressed Pain:

This part was modified by the researchers through the review of the literature. It aimed to assess the condition increases and symptoms associated pain among patients with FC post thoracic wall stabilization surgery. The researcher asked the patient, which conditions increase the

pain? and how does the pain effect? It included pain at rest, pain on breathing, local discomfort, breathlessness, and difficulty moving on pain. This part comprised questions answered by "yes" or "No". This assessment was done at pre (within 48 hours of postoperative) and post CPT on three consecutive days pre-discharge include: immediate post CPT within 2nd, 4th and 6th days of postoperative at early follow up and post-discharge on four consecutive days 2nd week and 1st, 3rd and 6th month at late follow up.

#### Part III-Pain rating index scores pre and post physiotherapy technique

This scale was developed by Dauphin et al., 1999 [20]. It aims to evaluate the effectiveness of CPT on flail chest patients' pain intensity post thoracic wall stabilization surgery. It is a self-reported instrument, consisting of a 10 cm straight line, which represents a continuum of intensity and has verbal anchors at opposite ends representing to no pain to worst pain, where 0 is having no pain, 1-3 Mild pain, 4-6 Moderate and 7-10 Severe pain. This utilized assessment was for patients in post thoracic wall stabilization surgery at pre (within 48 hours of post-operative) and post CPT on three consecutive days pre-discharge 2nd. (immediate CPT), 4th and 6th days of postoperative and post CPT at early follow up and post-discharge on 2nd week and 1<sup>st</sup>, 3rd and 6th month at late follow-up.

#### Part IV: Dyspnea Scale:

This tool was adopted by Fletcher, 2015 [21]. It aims to measure the degree of breathlessness related to activity and includes five grades from 1 to 5 which as follow G1= 0, G2= 1, G3= 2, G4= 3, G5=4. Where 0 having no dyspnea, 1= slight dyspnea, 2-3= moderate and 4= severe dyspnea. The patient was assessed at pre and post CPT on three consecutive days of pre-discharge on 2nd, 4th and 6th days of post-operative and CPT at early follow up and post-discharge on 2nd week and 1st, 3rd and 6th month at late follow up.

#### Part V: Health-related quality of life (HRQOL) self-administrated questionnaire (EQ5D5L):

This questionnaire is a generic instrument for describing and evaluating health status that adopted by Herman et al, 2011 [22]. It was collected by face-to-face an interview that takes approximately 15 minutes to complete. The questionnaire acts as a qualitative assessment of the patient's health, it describes health in terms of five dimensions (EQ5D5L): mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension can be graded on 5 levels including 1= no problems, 2=slight problems, 3=moderate problems, 4= severe problems, and 5=extreme problems. A score 5 means that the patient able to act self-care and score 25 means maximum inability to act self-care. This utilized assessment was for patients in post thoracic wall stabilization surgery on four consecutive days of post-discharge, at 2<sup>nd</sup> weeks as a baseline assessment of the patients' QOL which was compared with the assessment was done on 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> month of follow up to evaluate the effect of CPT on the patients' QOL.

**Tool 2: Clinical data base:** It includes the following:

**Part I: laboratory investigations assessment (pre/post):** Standardized lung function tests [23]. were recorded included: Forced Vital Capacity (FVC), Forced Expiratory

Volume in one second (FEV1) and Peak Expiratory Flow (PEF) using an Easy one Spiro meter pre and post CPT and post thoracic wall stabilization surgery. As well as Arterial Blood Gases (ABGs), includes PaO<sub>2</sub>, PaCo<sub>2</sub>, SO<sub>2</sub>, PH were investigated [24]. It aimed to evaluate the effect of chest physiotherapy technique for patients with FC on their lung function and Arterial Blood Gases on 2<sup>nd</sup>, 4<sup>th</sup>, and 6<sup>th</sup> days of postoperative and pre-discharge at early follow up and lasts on 2<sup>nd</sup> week, 1<sup>st</sup> and 3<sup>rd</sup> and 6<sup>th</sup> month of post-discharge at late follow up.

**Part II: Vital Signs Assessment:** respiratory rate, body temperature and heart rate were investigated pre and post physiotherapy technique.

**Part III: Diagnostic Studies assessment** included a chest x-ray and chest tomography CT were done for patients with FC before chest stabilization surgery to confirm the diagnosis in accordance with the study criteria.

#### **Tool 3: Chest physiotherapy Technique (CPT.)**

This program was adopted from Joseph (2003) [25], Senthil (2010) [26] for the purpose of reducing pain experience, maintain breathing pattern and promote quality of life. It was started after pretest assessment (within 48 hours of postoperative), includes:

- A psychological preparation was done by explaining the purpose and effects of chest physiotherapy.
- The medical aerosol was administered [bronchodilator medication (5ml NaCl 0.9% added 2ml farcolin + 2 drops of Atrovent)] in nebulizer face mask in addition to mucolytic.

## **2.5. Procedure**

**A-Diaphragmatic Breathing exercise:** It was done during existence the patient in the hospital (pre-discharge) and post-discharge. The frequency of breathing was from 20-30 times and every 5 breaths the patient must take rest about 30-60 sec. to avoid hyperventilation. Ask the patient to avoid forced expiration to prevent gasping in breathing. Place the patient relaxed half lying or sitting. The researcher put both hands over the epigastric area. Ask the patient gently breaths in, concentrating on allowing the abdominal wall to swell, under the slight pressure of the researcher's hands. On breathing out he feels his abdomen slowly sinking back to rest. The patient practices by resting both hands over the abdomen. The upper chest and shoulder should remain relaxed through it. The expiratory phase is completely passive.

**B-Coughing exercise:** It was done during existence the patient in the hospital (predischarge) and post-discharge. Ask the patient to take deep breathing from the nose, close the epiglottis, contract abdominal muscles, open the epiglottis, cough forcefully and expectorate secretions into tissue. During this process, the researchers should splint the patient's abdomen and chest as he or she coughs. Discomfort reduced by using a folded towel or pillow to support patients' chest while coughing. Before the coughing process patient should be asked to make 3-5 huffing.

**C-Intermittent Pressure Breathing (IPPB):** The position of the patient depends on the condition for which the IPPB is being given. It is effectively used in the sitting, high side lying or side lying positions. Comfort the patient and relax the upper chest and shoulder girdle. Ask the patient

to close his lips firmly around the mouthpiece and breathe in through his mouth and relax during inspiration allowing air from the ventilator to inflate his lungs. The patient relaxes his upper chest and shoulder girdle and the researcher (physiotherapist) places his hands on the anterior costal margins to encourage the gentle movement of the lower chest. Practical time is likely to be between 10 to 20 minutes. It was done during existence the patient in the hospital (predischarge) by the researchers.

**D-Secretion mobilization techniques:** It was done during existence the patient in the hospital (predischarge) and post-discharge.

**1-Chest wall percussions:** It is done by cupping the hand so as to allow a cushion of air to come between the researcher's hand and the patient. There should be a towel between the patient and the precursor's hand in order to prevent irritation of the skin. Percussions applied during inspiration and expiration.

**2-Chest wall vibration:** Vibration/shaking is a movement used to move loose secretions to larger airways so that they can be coughed up or removed by suctioning. Vibration involves the rapid shaking of the chest wall during exhalation. The percusses and vibrates the thoracic cage by placing both hands over the percussed areas and vibrating into the patient, isometrically contracting or tensing the muscles of their arms and shoulders.

**E-Incentive spirometer:** Ask the patient to sit on the edge of bed if possible, or sit up as far as he can in bed. Then hold the incentive spirometer in an upright position, then place the mouthpiece in his mouth and seal his lips tightly around it. Breathe in slowly and as deeply as possible. Notice the yellow piston rising toward the top of the column. The yellow indicator should reach the blue outlined area, hold his breath as long as possible. Then exhale slowly and allow the piston to fall to the bottom of the column. Rest for a few seconds and repeat steps one to 5 at least 10 times every hour. After each set of 10 deep breaths, cough up to be sure the patients' lungs are clear. Support the patients' incision when coughing by placing a pillow firmly against it. It was done during the existence of the patient in the hospital (predischarge) by the researchers.

## **2.6. Patients and Methods**

### **1-Administrative approval:**

-An official was forwarded from the dean of the faculty of Nursing, requesting a permission to conduct the study.

-A written approval was obtained from the director of the intensive care unit for cardiothoracic surgery at Qena university hospital to carry out the study.

### **Ethical consideration:**

An informed consent was taken oral from each participant in the study after full explanation of the aim of the study. They were informed that their participation in this study was voluntarily and was given the opportunity to refuse their participation. The studied sample also assured that any information collected would be confidential and used for the research purpose only.

### **2-Tools development:**

The study tools were developed by the researchers after an extensive review of the relevant literature.

### Validity and reliability:

The **tool 1- 2** were tested for content validity by 7 experts in academic medical and nursing staff at Qena and Benha University. Modifications were done accordingly, and then the tools were designed in its final format and test-retest of reliability for **tool 1-2** was done by Cronbach's alpha 0.80.

### A pilot study

It was done on (5) patients who were included in the sample to test the clarity, and applicability of the tools (Tool 1) and to estimate the time required to fill the sheet. Modifications were done as needed by the researchers.

### 3-Data Collection:

- Each interview took a time of about one hour. The data were collected in 9 months, from January to 30 September 2016. The data collection was done through the following phases:

#### Assessment phase: (Pretest)

After all the participants confirming the diagnosis and criteria of the study using anterior-posterior chest X-ray, chest computed tomography (CT) scans pulmonary contusion (preoperative only) (**tool 2-part III**), the researcher interviewed with each patient individually and gets their oral consent.

An interview questionnaire (**tool 1**) was applied which is concerned by patients' socio-demographic (**part I**). Then the researchers assessed the patients within 48 hours of the postoperative and pre-CPT using a standardized questionnaire concerning pain assessment (**part II and III**) and dyspnea scale (**Part IV**). Then Standardized pulmonary tests were performed for all the participants to assess the lung functions using Diagnostic Spiro metric, as well as ABGs investigation (**tool 2 –part I**) and vital signs were recorded (**tool 2 part II**). As well as patients' Health-related quality of life (**tool 1part V**) was assessed on 2<sup>nd</sup> week of post discharge as a baseline assessment to comparing with the follow up on 1<sup>st</sup>, 3<sup>rd</sup>, and 6<sup>th</sup> month of post-discharge. Epidural analgesics were prescribed and administered by the researcher (anesthesiologist) three times daily before pain assessment and CPT on 3 consecutive days to reduce the thoracic pain before beginning CPT.

#### Implementation phase

Once the pretest assessment was applied and then Epidural analgesics was administered by the researcher (anesthesiologist), the chest physiotherapy program was planned and implemented utilizing **tool 3** to meet the aim of the study, it was started on the 2<sup>nd</sup> post-operative day. Physiotherapy sessions were prescribed and administered by the researchers. Daily sessions were done individually, and each session ranged from half hour to one hour depending on individual patients' condition, needs and environmental circumstances. Enforcement and reinforcement of the physiotherapy were done during patients' hospital stay using **tool 3**. It was ensured in collaboration with nurses and medical personnel throughout the afternoon and night shift. Physiotherapy sessions were administered in the presence of one of the patients' family members to help and guide him to follow instruction and practice at home post-discharge. All participants were instructed to return back to the outpatient clinic for follow up on 2<sup>nd</sup>.week and first, third, and sixth month after discharge to evaluate the effectiveness of CPT.

Epidural analgesics were prescribed and administered by the researcher (anesthesiologist) three times daily for three consecutive days before beginning chest physiotherapy practice to reduce the thoracic pain. It was inserted before induction of general anesthesia and activated using 6 ml 0.125% bupivacaine and 2 mg/ml fentanyl, which followed by continuous infusion of 6 ml/hour for 48 hours. before chest physiotherapy. Then activating dose was given before chest physiotherapy. Removal of epidural catheter 4 days of postoperative. All participants had prescribed oral analgesics before beginning chest physiotherapy practice at home, it was prescribed by the researcher (anesthesiologist). Oral analgesics in the form of ketorolac 10 mg tablets every 8 hours was prescribed before physiotherapy practice at home after removal of the epidural catheter. The researchers were instructing the patients to follow the CPT by telephone.

#### Evaluation Phase (Post Test)

Evaluate the effectiveness of CPT on patients' health outcomes was done on three consecutive days on 2<sup>nd</sup>, 4<sup>th</sup>.and 6<sup>th</sup> day of post postoperative and post CPT pre-discharge as an early follow up and on 2<sup>nd</sup>.week, 1<sup>st</sup>, 3<sup>rd</sup>, and 6<sup>th</sup> month post discharge as a late follow up by referred the patients in the out patient's clinic. This effectiveness was based on finding of differences or not between pretest and posttest ascertaining changes of subjective expressed pain and pain intensity index scores (**Tool 1 part II, III**), dyspnea score (**Tool 1part IV**), as well as pulmonary function test, ABGs and vital signs using **tool 2, Part I and II**. Patients' HRQOL was evaluated on 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> months of post-discharge at late follow up and compare with the baseline assessment that was done on 2<sup>nd</sup> week of post-discharge (**Tool 1-part V**).

## 2.7. Statistical Analysis

The data obtained were reviewed prepared for computer entry, coded, analyzed and tabulated. Descriptive statistics as number and percentage, mean scores and standard deviation were done using computer program SPSS version (18). Chi-square, P-value and t-value used to compare differences in the distribution of frequencies between the pre/post study subjects.

## 3. Results

Table 1: Shows the distribution of the studied sample according to their sociodemographic Characteristics. It revealed that the majority of the studied sample was male and more than half were from 50 - 60 years with a mean  $45.43 \pm 11.67$ . Regarding their level of education 43% of the studied sample were illiterate, around one third (33.3 %) of them were married and 36.67 % had enough economic status for medication.

Table 2: illustrates the lifestyle of the flail chest patient regarding the smoking. It revealed that most of the studied subjects (86.67%) were smokers and the years of smoking for 73% of them were from 10- 20 years. Around two-thirds of studied subjects were smoke cigarettes only and 58.8 % of who gave up smoking was from 1-3 years and back again. It was caused by social and financial factors for 17.65% and 82.35 of the studied subjects, respectively.

**Table 1. Frequency distribution of the studied patients according to their Socio-demographic data (N= 30)**

| Items   | No            | %     |
|---|---------------|-------|
| <b>1-Age</b>                                  |               |       |
| 20->30  | 4             | 13.33 |
| 30->40  | 7             | 23.33 |
| 40->50  | 3             | 10.00 |
| 50 – 60                                       | 16            | 53.33 |
| <b>Mean ± SD</b>                              | 45.43 ± 11.67 |       |
| <b>2-Gender</b>                               |               |       |
| Male  | 26            | 86.67 |
| Female  | 4             | 13.33 |
| <b>3-Level of education</b>                   |               |       |
| Illiterate                                    | 13            | 43.33 |
| Basic education                               | 10            | 33.33 |
| University education                          | 7             | 23.33 |
| <b>4-Marital status</b>                       |               |       |
| Married                                       | 10            | 33.33 |
| Widow   | 7             | 23.33 |
| Single  | 5             | 16.67 |
| Divorced                                      | 8             | 26.67 |
| <b>5- Occupation</b>                          |               |       |
| Worker  | 15            | 50.00 |
| Employee                                      | 4             | 13.33 |
| Privet job                                    | 2             | 6.67  |
| No work                                       | 9             | 30.00 |
| <b>6- Economic Status for medical outlay:</b> |               |       |
| Satisfy Enough                                | 9             | 30.00 |
| Enough for medication outlay only             | 11            | 36.67 |
| Not enough                                    | 10            | 33.33 |

**Table 2. Frequency distribution of the studied patients' Life style of smoking status (N=30)**

| Variables  | No =30    | %            |
|--|-----------|--------------|
| <b>Smoking:</b>  |           |              |
| Non smoker   | 4         | 13.33        |
| Smoker   | 26        | 86.67        |
| <b>Years of smoking</b>                                      | <b>26</b> | <b>86.67</b> |
| - > 10 years   | 7         | 26.92        |
| - 10- 20 years   | 19        | 73.08        |
| <b>Types of smoking*</b>                                     | <b>26</b> | <b>86.67</b> |
| - Cigarettes   | 17        | 65.38        |
| - Shesha   | 2         | 7.69         |
| - Cigarettes and Shesha                                      | 7         | 26.92        |
| <b>Numbers of cigarettes / day</b>                           | <b>24</b> | <b>80.00</b> |
| - 20/ day  | 10        | 33.33        |
| - > 20/ day  | 14        | 53.33        |
| <b>Give up smoking and back years of give up of smoking:</b> | <b>17</b> | <b>56.67</b> |
| 1-3 years:   | 10        | 58.82        |
| > 4 years:   | 7         | 41.18        |
| <b>1-Causes for who give up and back:</b>                    | <b>17</b> | <b>56.67</b> |
| - Social causes  | 3         | 17.65        |
| - Financial causes   | 14        | 82.35        |
| - Health factors   | 0         | 0            |

Table 3: shows a comparison between pre and post CPT concerning subjects' expressed symptoms associated pain among patients with flail chest post thoracic stabilization surgery. It revealed that all the patients complained of pain

at rest, on breathing, local discomfort, and breathlessness and difficult moving on pain by **100, 93.3, 100, 96.7** and **100%**, respectively during pretest assessment postoperatively. There was statistical significant decreased in the persistence problems associated with pain at post chest physiotherapy practice (**P= 0.007, 0.005, 0.005, 0.005, and 0.006\*\***) respectively during the 2<sup>nd</sup> (immediate CPT), 4<sup>th</sup>, 6<sup>th</sup> of postoperative days and post CPT at early follow-up. Also, the finding revealed that all problems associated with pain improved with highly significant differences from pretest assessment to post-discharge at late follow up regarding pain at rest, pain on breathing, local discomfort, and difficulty moving on pain (**P= 0.0001,0.005,0.0001 and 0.005**), respectively. On the other hand, the minority of patients still had breathlessness on 3<sup>rd</sup>. and 6<sup>th</sup> month of late follow up (**13.33% and 6.66%**), respectively.

Table 4: exploring significant differences between pre and post CPT regarding pain intensity among patients with flail chest post thoracic stabilization surgery. It revealed that all the studied subjects had a significant difference in decrease pain intensity between pre (**mean= 9.31±3.91**) and post (**5.00±0.01**) CPT before discharge on post immediate CPT (2<sup>nd</sup> day of post-operative), 4<sup>th</sup> and 6<sup>th</sup> days of CPT at early follow up (**F= 3.85\***). Also, it was still improved post discharge at late follow up (2<sup>nd</sup> week, 1<sup>st</sup> month, 3<sup>rd</sup> and 6<sup>th</sup> month) with total mean pain score **4.03±1.45 (F= 4.12 \*)**.

Table 5: Illustrates Mean, Standard deviation and Significant differences between pre and post CPT according to dyspnea score among patients with flail chest post thoracic stabilization surgery. It revealed that all the entire studied sample had severe dyspnea within 48 hrs. of postoperative and before chest physiotherapy practice with mean score **4.00±0.01**. It was improved with statistical significant post CPT on 2<sup>nd</sup>, 4<sup>th</sup>, and 6<sup>th</sup> days of post-operative and CPT (**P= <0.005\*\***) at early follow up with total mean score **2.30±0.63**. Also, the finding revealed that the majority of patients (93.33%) had no dyspnea at late follow up on the 6<sup>th</sup> month that highly significant improvement was observed between pre and CPT (**P=<0.0001\*\***, respectively).

Table 6: Illustrates the effects of CPT on the HRQOL among patients with flail chest post thoracic stabilization surgery at post-discharge follow up. It revealed that, the mean of HRQOL scores significantly improved in the late follow up on 1<sup>st</sup> and 3<sup>rd</sup> months of post discharge with mean score **19.09±5.64 and 7.59±2.93 (P= 0.05\* and 0.001\*\*)**, respectively and high significant improvement on 6<sup>th</sup> month (**0.088±0.05 (P= 0.00001\*\*\*)**) comparing with baseline assessment on 2<sup>nd</sup> week of post discharge with total mean score from **23.78±6.21 to 9.19± 3.13** with high significant differences (**P= 0.0001\*\***). But, it was insignificant changes on 1<sup>st</sup> month comparing with baseline assessment on 2<sup>nd</sup> week of post discharge regarding to anxiety and depression, usual activities, and pain and discomfort (**P= 0.32, 0.31 and 0.34**) with mean score = **4.20± 1.03, 4.24±1.03 and 4.23±1.01**, respectively.

Table 7: Represents the physiological status concerning Pulmonary Function Test (PFT), ABGs and Vital signs pre and post CPT among patients with flail chest post thoracic stabilization. It revealed that in the pretest assessment, the mean of FVC was **58.24±5.8** and changed

with high significant to **67.55±5.5**, **79.58±5.8**, and **88.55±5.1** at the early follow-up and pre-discharge on 2<sup>nd</sup>, 4<sup>th</sup>, and 6<sup>th</sup> day of post CPT (**P= 0.0001\*\***). Whereas in the late follow up (post-discharge), it was still significant improved till 6<sup>th</sup> month (**104.44±11.2**) at late follow up (**P=0.0001\*\***). Regarding the SVC, it changed with high

significant at the early and late follow up (**p= 0.0001\*\***), respectively. The highly significant difference was also found between pretest (**71.67±4.3** and **82.25±4.3**) and post-test on 6<sup>th</sup> month at late follow up (**100.52±7.2** and **104.44±11.2** (**P = 0.0001\*\***) concerning FEV1/ 1sec. and FEV1/FVC, respectively.

**Table 3. Comparison between the pre and post chest physiotherapy (CPT) according to subjects' expressed pain among patients with flail chest post thoracic stabilization surgery. Total no.= 30**

| Variables                              | Pretest Postoperative |      | Post test                      |      |                       |      |                       |       |                            |      |                    |      |                    |       |                    |      |
|--|-----------------------|------|--------------------------------|------|-----------------------|------|-----------------------|-------|----------------------------|------|--------------------|------|--------------------|-------|--------------------|------|
|  | Within 48 hrs.        |      | Postoperative ( Pre discharge) |      |                       |      |                       |       | Follow up (Post discharge) |      |                    |      |                    |       |                    |      |
|  |                       |      | 2 <sup>nd</sup> d ay           |      | 4 <sup>th</sup> . day |      | 6 <sup>th</sup> . day |       | 2 <sup>nd</sup> .ws        |      | 1 <sup>st</sup> ms |      | 3 <sup>rd</sup> ms |       | 6 <sup>th</sup> ms |      |
|  |                       |      | Immediate post CPT             |      |                       |      |                       |       |                            |      |                    |      |                    |       |                    |      |
| No.                                    | %                     | No.  | %                              | No.  | %                     | No.  | %                     | No.   | %                          | No.  | %                  | No.  | %                  | No.   | %                  |      |
| <u>Symptoms associated with pain*:</u> |                       |      |                                |      |                       |      |                       |       |                            |      |                    |      |                    |       |                    |      |
| Pain at rest                           | 30                    | 100  | 17                             | 56.7 | 12                    | 40   | 9                     | 30.00 | 5                          | 16.7 | 0                  | 0.00 | 0                  | 0.00  | 0                  | 0.00 |
| pain on breathing                      | 28                    | 93.3 | 14                             | 46.7 | 10                    | 33.3 | 7                     | 23.3  | 7                          | 23.3 | 5                  | 16.7 | 2                  | 6.66  | 0                  | 0.00 |
| Local discomfort                       | 30                    | 100  | 18                             | 60   | 13                    | 43.3 | 9                     | 30.00 | 9                          | 30   | 0                  | 0.00 | 0                  | 0.00  | 0                  | 0.00 |
| Breathlessness                         | 29                    | 96.7 | 14                             | 46.7 | 15                    | 50   | 10                    | 33.3  | 8                          | 26.7 | 8                  | 26.7 | 4                  | 13.33 | 2                  | 6.66 |
| difficult moving                       | 30                    | 100  | 30                             | 100  | 15                    | 50   | 11                    | 36.7  | 7                          | 23.3 | 0                  | 0.00 | 0                  | 0.00  | 0                  | 0.00 |

| Variables                              | Comparison             |         |                        |         |  |           |  |  |  |  |
|--|------------------------|---------|------------------------|---------|--|-----------|--|--|--|--|
|  | Pretest with posttest. |         | Pretest with follow up |         | Posttest pre discharge with Follow up post discharge |           |  |  |  |  |
| <u>Symptoms associated with pain*:</u> | $\chi^2$               | P.V     | $\chi^2$               | P.V     | $\chi^2$   | P.V       |  |  |  |  |
| Pain at rest                           | 10.18                  | 0.007 * | 10.17                  | 0.007 * | 15.40  | 0.0001 ** |  |  |  |  |
| pain on breathing                      | 11.66                  | 0.005 * | 12.66                  | 0.005 * | 12.7   | 0.005*    |  |  |  |  |
| Local discomfort                       | 11.76                  | 0.005 * | 12.75                  | 0.005 * | 15.40  | 0.0001 ** |  |  |  |  |
| Breathlessness                         | 11.27                  | 0.005 * | 11.26                  | 0.005 * | 5.33   | 0.047*    |  |  |  |  |
| difficult moving                       | 9.52                   | 0.006 * | 10.16                  | 0.006 * | 12.7   | 0.005*    |  |  |  |  |

(ns) Non significant P= < 0.05, \* Significant P= > or equal 0.05, \*\* Highly Significant P= > 0.001, \*The participants may select more than one choice.

**Table 4. Comparison between the pre and post CPT according to pain intensity index scale among patients with flail chest post thoracic stabilization surgery**

| Variable             | Pre test                 | Posttest ( Postoperative)                         |                               |                               |   |                      |                                 |                                 |
|----------------------|--------------------------|---|-------------------------------|-------------------------------|---|----------------------|---------------------------------|---------------------------------|
|                      | Within 48 hrs. Mean ± SD | Postoperative ( Pre discharge)                    |                               |                               | Follow up (Post discharge)                  |                      |                                 |                                 |
|                      |                          | 2 <sup>nd</sup> d ay Immediate post CPT Mean ± SD | 4 <sup>th</sup> day Mean ± SD | 6 <sup>th</sup> day Mean ± SD | 2 <sup>nd</sup> w. Mean ± SD                | 1st. month Mean ± SD | 3 <sup>rd</sup> month Mean ± SD | 6 <sup>th</sup> month Mean ± SD |
| Total Pain Intensity | 9.31±3.91                | 9.26± 3.91  | 7.86± 3.12                    | 5.15 ± 2.45                   | 4.59 ± 2.40                                 | 3.06±1.45            | 1.97±0.8                        | 1.03±0.1                        |
| (F- ratio)           | -                        | 6.82±3.20<br>F=3.85* P=0.05*                      |                               |                               | 4.03±1.45<br>F= 4.12* P=0.001**             |                      |                                 |                                 |
| Variable             | Comparison               |   |                               |                               |   |                      |                                 |                                 |
|                      | Pretest with posttest.   | Pretest with follow up post discharge             |                               |                               | Pre discharge with post discharge follow up |                      |                                 |                                 |
| (F- ratio)           | F= 3.44*<br>P=0.05*      | F= 4.12 * P=0.001**                               |                               |                               | F= 3.88 * P= 0.001**                        |                      |                                 |                                 |

\*Significant F= 3.32 for unequal numbers, ns= not significant F< 3.32 for unequal numbers, \*Significant P= 0.05, \*\* highly significant p=0.001.

**Table 5. Comparison between the pre and post CPT according dyspnea assessment scale among patients with flail chest post thoracic stabilization**

| Variables             | Pretest        |      | Post test                                     |                     |                     |                      |                            |                     |                      |       |    |       |    |       |    |       |
|-----------------------|----------------|------|---|---------------------|---------------------|----------------------|----------------------------|---------------------|----------------------|-------|----|-------|----|-------|----|-------|
|                       | Postoperative. |      | Post-operative (Pre discharge)                |                     |                     |                      | Post discharge (follow up) |                     |                      |       |    |       |    |       |    |       |
|                       | Within 48hrs.  |      | 2 <sup>nd</sup> d ay<br>Immediate<br>post CPT | 4 <sup>th</sup> day | 6 <sup>th</sup> day | 2 <sup>nd</sup> week | 1 <sup>st</sup> . m.       | 3 <sup>rd</sup> .m. | 6 <sup>th</sup> .Ms. |       |    |       |    |       |    |       |
|                       | No             | %    | No  | %                   | No                  | %                    | No                         | %                   | No                   | %     | No | %     |    |       |    |       |
| Dyspnea Grades :      |                |      |   |                     |                     |                      |                            |                     |                      |       |    |       |    |       |    |       |
| (G <sub>1</sub> ) = 0 | 0              | 0.00 | 0   | 0.00                | 6                   | 20.00                | 9                          | 30.00               | 10                   | 33.33 | 12 | 40.00 | 22 | 73.33 | 28 | 93.33 |
| (G <sub>2</sub> ) = 1 | 0              | 0.00 | 0   | 0.00                | 4                   | 13.33                | 3                          | 10.00               | 4                    | 10.00 | 3  | 10.00 | 4  | 13.33 | 2  | 6.66  |
| (G <sub>3</sub> ) = 2 | 0              | 0.00 | 1   | 3.33                | 5                   | 16.67                | 8                          | 26.67               | 8                    | 26.67 | 15 | 50.00 | 4  | 13.33 | 0  | 0.00  |
| (G <sub>4</sub> ) = 3 | 0              | 0.00 | 29  | 96.6                | 15                  | 50.00                | 10                         | 33.33               | 8                    | 26.67 | 0  | 0.00  | 0  | 0.00  | 0  | 0.00  |
| (G <sub>5</sub> ) = 4 | 30             | 100  | 0   | 0.00                | 0                   | 0.00                 | 0                          | 0.00                | 0                    | 0.00  | 0  | 0.00  | 0  | 0.00  | 0  | 0.00  |
| Total Mean± SD        | 4.00±0.01      |      | 2.30±0.63                                     |                     |                     |                      | 1.78±0.05                  |                     |                      |       |    |       |    |       |    |       |
| P- value              | -              |      | 0.05 *  |                     |                     |                      | 0.001 **                   |                     |                      |       |    |       |    |       |    |       |

Chi square test, \* Significant p ≤ 0.05, \*\* Highly Significant p = ≤ 0.001.

**Table 6. Comparison between baseline assessment and follow up post CPT according to HRQOL among patients with flail chest post thoracic stabilization surgery**

| Variables                                  | Posttest( post discharge) |                    |                       |                    |           |       | Comparison  |  |  |
|--|---------------------------|--------------------|-----------------------|--------------------|-----------|-------|---|--|--|
|  | Baseline assessment.      |                    | Follow up             |                    |           |       | 2 <sup>nd</sup> week. and<br>1 <sup>st</sup> . month                | 2 <sup>nd</sup> week. and<br>3 <sup>rd</sup> month | 2 <sup>nd</sup> week. and<br>6 <sup>th</sup> . month |
|  | 2 <sup>nd</sup> week      | 1 <sup>st</sup> m. | 3 <sup>rd</sup> m.    | 6 <sup>rd</sup> .m |           |       |   |  |  |
| No   | %                         | No                 | %                     | No                 | %         | No    | %   |  |  |
| <b>MOBILITY</b>                            |                           |                    |                       |                    |           |       |   |  |  |
| -I have no problems in walking about       | 0                         | 0.00               | 9                     | 30.0               | 30        | 100   | 30  | 100  |  |
| -I have slight problems in walking about   | 0                         | 0.00               | 18                    | 60.0               | 0         | 0.00  | 0   | 0.00   |  |
| -I have moderate problems in walking about | 25                        | 83.3               | 1                     | 3.33               | 0         | 0.00  | 0   | 0.00   | t=2.22<br>0.05*                                      |
| -I have severe problems in walking about   | 3                         | 10.00              | 1                     | 3.33               | 0         | 0.00  | 0   | 0.00   | t= 3.45<br>0.05*                                     |
| -I'm unable to walking about               | 2                         | 6.7                | 1                     | 3.33               | 0         | 0.00  | 0   | 0.00   | t= 13.33<br>0.0001**                                 |
| Mean± SD                                   | 4.70±2.03                 |                    | 3.35±1.06             |                    | 0.00±0.00 |       | 0.00±0.00   |  |  |
| Mean± SD                                   | P- value                  |                    | 0.01±0.00 P= 0.0001** |                    |           |       | 2 <sup>nd</sup> week with overall follow up<br>t= 10.22 p=0. 0001** |  |  |
| <b>SELF-CARE</b>                           |                           |                    |                       |                    |           |       |   |  |  |
| I have no problem washing /dressing        | 0                         | 0.00               | 3                     | 10.0               | 25        | 83.33 | 28  | 93.33  |  |
| I have slight problem washing / dressing   | 0                         | 0.00               | 9                     | 30.0               | 1         | 3.33  | 1   | 3.33   |  |
| I have moderate problem washing / dressing | 0                         | 0.00               | 10                    | 33.3               | 2         | 6.7   | 1   | 3.33   | t=2.22<br>0.05*                                      |
| I have severe problem washing / dressing   | 0                         | 0.00               | 4                     | 13.3               | 1         | 3.33  | 0   | 0.00   | t= 3.33<br>0.001**                                   |
| I'm unable to wash/ dressing myself        | 30                        | 100                | 4                     | 13.3               | 1         | 3.33  | 0   | 0.00   | t= 7.38<br>0.00001**                                 |
| Mean± SD                                   | 5.00±0.00                 |                    | 3.01±1.51             |                    | 1.17±0.46 |       | 0.82±0.02   |  |  |
| Mean± SD                                   | P- value                  |                    | 1.18±0.45 P= 0.001**  |                    |           |       | 2 <sup>nd</sup> week with overall follow up<br>t=6.02 p=0. 0001**   |  |  |
| <b>ANXIETY / DEPRESSION</b>                |                           |                    |                       |                    |           |       |   |  |  |
| I'm not anxious/depressed                  | 0                         | 0.00               | 0                     | 0.00               | 8         | 26.67 | 30  | 100  |  |
| I'm slight anxious/depressed               | 0                         | 0.00               | 0                     | 0.00               | 10        | 33.33 | 0   | 0.00   |  |
| I'm moderately anxious/depressed           | 9                         | 30.00              | 12                    | 40                 | 4         | 13.33 | 0   | 0.00   | t=1.02<br>P= 0.31ns                                  |
| I'm severely anxious/depressed             | 12                        | 40.00              | 12                    | 40                 | 4         | 13.33 | 0   | 0.00   | t= 3.51<br>P= 0.0001                                 |
| I'm extremely anxious/depressed            | 9                         | 30.00              | 6                     | 20                 | 4         | 13.33 | 0   | 0.00   | t= 8.22<br>0.00001**                                 |
| Mean± SD                                   | 4.50±2.04                 |                    | 4.20±1.03             |                    | 2.18±0.86 |       | 0.02±0.01   |  |  |
| Mean± SD                                   | P- value                  |                    | 0.78±0.02 P= 0.0001** |                    |           |       | 2 <sup>nd</sup> week with overall follow up<br>t= 6.27 P= 0.0001**  |  |  |

| Variables  | Post test (Post discharge)  |                   |                      |                  |                       |       |                       |   | Relation  |   |  |                                  |                                    |                                      |
|--|-----------------------------|-------------------|----------------------|------------------|-----------------------|-------|-----------------------|---|---|---|--|----------------------------------|------------------------------------|--------------------------------------|
|  | Baseline assessment         |                   | Follow up            |                  |                       |       |                       |   | 2 <sup>nd</sup> week with 1 <sup>st</sup> month                               | 2 <sup>nd</sup> week with 3 <sup>rd</sup> month | 2 <sup>nd</sup> week with 6 <sup>th</sup> m. |                                  |                                    |                                      |
|  | 2 <sup>nd</sup> week No     | %                 | 1 <sup>st</sup> m No | %                | 3 <sup>rd</sup> .m No | %     | 6 <sup>th</sup> .m No | %   |   |   |  |                                  |                                    |                                      |
| <b>USUAL ACTIVITIES:</b><br>- I have no problems doing my usual activities<br>- I have slight problems doing my usual activities<br>- I have moderate problems doing usual activities<br>- I have severe problems doing my usual activities<br>- I am unable to do my usual activities | 0                           | 0.00              | 0                    | 0.00             | 2                     | 6.67  | 30                    | 100   | <b>t=1.03</b><br><b>P= 0.31ns</b>   | <b>t =4.32</b><br><b>P= 0.001**</b>             | <b>t = 9.12</b><br><b>P=0.0001**</b>         |                                  |                                    |                                      |
| Mean± SD   | <b>5.00±0.00</b>            | <b>4.24±1.03</b>  | <b>2.13±0.81</b>     | <b>0.02±0.01</b> |                       |       |                       | <b>2<sup>nd</sup> week with overall follow up</b><br><b>t= 4.91 p= 0.0001**</b> |   |   |  |                                  |                                    |                                      |
| <b>Mean± SD P value</b>  | <b>1.17±0.46 p= 0.001**</b> |                   |                      |                  |                       |       |                       |   |   |   |  |                                  |                                    |                                      |
| <b>PAIN / DISCOMFORT</b><br>- I have no pain or discomfort<br>- I have slight pain or discomfort<br>- I have moderate pain or discomfort<br>- I have severe pain or discomfort<br>- I have extreme pain or discomfort  | 0                           | 0.00              | 0                    | 0.00             | 4                     | 13.33 | 28                    | 93.34   |   |   |  | <b>t=1.03</b><br><b>p=0.34ns</b> | <b>t =3.87</b><br><b>p=0.001**</b> | <b>t = 8.52</b><br><b>P=0.0001**</b> |
| Mean± SD   | <b>4.48±2.14</b>            | <b>4.23±1.01</b>  | <b>2.11±0.80</b>     | <b>0.02±0.01</b> |                       |       |                       | <b>2<sup>nd</sup> week with overall follow up</b><br><b>t= 5.57 p= 0.0001</b>   |   |   |  |                                  |                                    |                                      |
| <b>Mean± SD P- value</b>   | <b>1.23±0.48 p= 0.001**</b> |                   |                      |                  |                       |       |                       |   |   |   |  |                                  |                                    |                                      |
| <b>Total Mean± SD for HRQOL</b><br><b>Total Mean Scores (TMS) ±SD</b>  | <b>23.78±6.21</b>           | <b>19.09±5.64</b> | <b>7.59±2.93</b>     | <b>0.88±0.05</b> |                       |       |                       | <b>P=0.05*</b><br><b>P= 0.001*</b><br><b>P= 0.0001***</b>                       |   |   |  |                                  |                                    |                                      |
|  | <b>9.19± 3.13</b>           |                   |                      |                  |                       |       |                       |   | <b>2<sup>nd</sup> week with overall follow up</b><br><b>t= 6.18 p= 0.0001</b> |   |  |                                  |                                    |                                      |

Table 7. Mean, standard deviations, paired differences and paired 't' and p values of physiological status pre and post chest physiotherapy among patients with flail chest post thoracic stabilization

| Variables   | Pretest Mean± SD  | Post test   |   |   |  |   |   |   |
|---|---|---|---|---|--|---|---|---|
|   |   | Post-op. (Pre discharge)                                      |   |   | Follow up ( Post discharge)                                    |   |   |   |
|   |   | 2 <sup>nd</sup> ay Mean± SD                                   | 4 <sup>th</sup> day Mean± SD                                  | 6 <sup>th</sup> day Mean± SD                                  | 2nd Ws Mean± SD  | 1st. m. Mean± SD  | 3rd.Ms Mean± SD   | 6th.Ms. Mean± SD  |
| <b>Pulmonary function test</b><br>-FVC(forced vital capacity)<br>-SVC(slow vital capacity)<br>- PEF(peak expiratory flow)<br>-FEV <sub>1</sub> (forced expiratory volume /1 sec.)<br>- FEV <sub>1</sub> / FVC ratio | 58.24±5.8<br>65.22±5.6<br>74.69±4.7<br>71.67±4.3<br>82.25±4.3 | 67.55±5.5<br>70.97±3.9<br>79.97±4.1<br>79.23±4.3<br>90.23±5.7 | 79.58±5.8<br>79.98±4.2<br>80.97±4.9<br>85.22±4.6<br>95.43±6.9 | 88.55±5.1<br>89.91±5.9<br>89.91±5.9<br>89.23±5.1<br>99.59±6.9 | 95.43±6.9<br>90.23±5.7<br>99.59±6.9<br>99.58±6.9<br>100.52±7.2 | 104.44±11.2<br>100.52±7.2<br>103.50±10.9<br>100.52±7.2<br>104.44±11.2 | 104.44±11.2<br>100.52±7.2<br>103.50±10.9<br>100.52±7.2<br>104.44±11.2 | 104.44±11.2<br>100.52±7.2<br>103.50±10.9<br>100.52±7.2<br>104.44±11.2 |
| <b>t test P- value</b>  | -   | <b>t=2.24 p= 0.5 *</b>  |   |   | <b>t=4.45 p= 0.001 **</b>                                      |   |   |   |
| <b>ABGs:</b><br>- PaO <sub>2</sub> (partial pressure of O <sub>2</sub> )<br>- PaCo <sub>2</sub> (partial pressure of CO <sub>2</sub> )<br>- SO <sub>2</sub> (O <sub>2</sub> saturation)                             | 13.17±5.46<br>7.78±1.25<br>16.47±1.39                         | 20.37±1.48<br>5.33±3.33<br>25.51±4.21                         | 25.51±4.21<br>3.33±1.55<br>28.88±4.24                         | 26.45±2.72<br>3.33±1.55<br>29.61±2.52                         | 29.61±2.52<br>1.31±0.20<br>29.61±2.52                          | 45.17±4.01<br>0.29±0.63<br>45.17±4.01                                 | 45.17±4.01<br>0.29±0.63<br>45.17±4.01                                 | 45.17±4.01<br>0.29±0.63<br>45.17±4.01                                 |
| <b>T test P- value</b>  | -   | <b>t=6.78 P=0.001 **</b>                                      |   |   | <b>t=3.4 P=0.01 *</b>  |   |   |   |
| <b>Pulse Rate (Total Mean± SD)</b><br><b>Respiratory Rate (Total Mean± SD )</b><br><b>Temperature (Total Mean± SD )</b>   | 105±45.7<br>35.6±12.3<br>39.8±17.3                            | 85.2±22.6<br>22.4±10.3<br>37.00± 14.7                         |   |   | 60.95±11.01<br>18.0±6.22<br>37.00± 14.7                        |   |   |   |
| <b>Variables</b>  | <b>Comparison</b>   |   |   |   |  |   |   |   |
| <b>Pulmonary function test</b><br>-FVC(forced vital capacity)<br>-SVC(slow vital capacity)<br>- PEF(peak expiratory flow)<br>-FEV <sub>1</sub> (forced expiratory volume /1 sec.)<br>- FEV <sub>1</sub> / FVC ratio | 10.22<br>9.13<br>9.11<br>10.57<br>8.93                        | 0.0001**<br>0.0001**<br>0.0001**<br>0.0001**<br>0.0001**      | 9.35<br>8.21<br>8.11<br>9.24<br>6.67                          | 0.0001**<br>0.0001**<br>0.0001**<br>0.0001**<br>0.0001**      | 2.11<br>2.23<br>3.12<br>2.22<br>2.51                           | 0.5*<br>0.5*<br>0.5*<br>0.5*<br>0.5*                                  |   |   |
| <b>t test P- value</b>  | <b>0.0001** T=12.03</b>                                       |   | <b>0.0001** T=11.43</b>                                       |   | <b>0.05 * T=2.33</b>   |   |   |   |
| <b>ABGs:</b><br>- PaO <sub>2</sub> (partial pressure of O <sub>2</sub> )<br>- PaCo <sub>2</sub> (partial pressure of CO <sub>2</sub> )<br>- SO <sub>2</sub> (O <sub>2</sub> saturation)                             | 2.61<br>3.33<br>3.12  | 0.01*<br>0.01*<br>0.01*                                       | 3.91<br>4.95<br>4.95  | 0.001**<br>0.001**<br>0.001**                                 | 9.12<br>10.14<br>9.16  | 0.0001**<br>.0001**<br>.0001**  |   |   |
| <b>T test P- value</b><br>Pulse Rate (Total Mean± SD )<br>Respiratory Rate (Total Mean± SD )<br>Temperature (Total Mean± SD )   | 0.001*<br>0.001**<br>0.001**<br>0.001**                       |   | 0.0001**<br>0.0001**<br>0.0001**<br>0.0001**                  |   | 0.0001**<br>0.001**<br>0.001**<br>0.001**                      |   |   |   |

\* Significant P = < 0.05, \*\* High significant P = < 0.001.

**Table 8a. Relation between Health related QOL Dspnea with Subjective pain experience, Pain intensity and Pain disabilities among flail chest patient pre and post- test**

| Variables                            | Subjective pain experience |            | Pain intensity VAS |            | Dyspnea    |            |
|--------------------------------------|----------------------------|------------|--------------------|------------|------------|------------|
|                                      | Pretest                    | posttest   | Pretest            | posttest   | Pretest    | posttest   |
| <b>Health quality of life (HQOL)</b> | 13.03±1.75                 | 8.86± 0.81 | 16.00± 2.12        | 14.03±1.77 | 13.76±0.49 | 9.31±1.32  |
| <b>T-test P- Value</b>               | 3.52                       | 0.0001 **  | 2.9                | 0.001 **   | 3.65       | <0.0001 ** |
| <b>Dyspnea</b>                       | 15.66±0.69                 | 10.43±1.65 | 11.93±0.25         | 8.36±1.3   | -          | -          |
| <b>T-test P- Value</b>               | 5.22                       | 0.0001 **  | 2.76               | 0.001 **   | -          | -          |

\* Significant P = < 0.05, \*\* High significant P = < 0.001.

**Table 8b. Health related QOL, pain, and dyspnea with pulmonary function tests, ABGS and smoking among flail Chest patient pre and post test (Con.)**

| Variables                  | Subjective pain experience |             | Pain intensity VAS |            | Dyspnea     |            | Health quality of life (HQOL) |            |
|----------------------------|----------------------------|-------------|--------------------|------------|-------------|------------|-------------------------------|------------|
|                            | Pretest                    | posttest    | Pretest            | posttest   | Pretest     | posttest   | Pretest                       | posttest   |
| <b>Pulm. Function Test</b> | 21.53±3.92                 | 14.37±1.97  | 16.00±2.12         | 14.03±1.77 | 16.03 ±2.12 | 9.43± 1.13 | 17.3 ±2.38                    | 9.43± 1.13 |
| <b>T-test P- Value</b>     | 7.97                       | <0.0001 **  | 2.9                | 0.001 *    | 7.94        | <0.0001 ** | 8.2                           | <0.0001 ** |
| <b>ABG<sub>s</sub></b>     | 17.5 ±2.6                  | 14.03±1.877 | 16.56±2.17         | 12.23±0.85 | 16.03± 2.12 | 5.9±0.39   | 20.53±3.92                    | 9.49± 1.17 |
| <b>T-test P- Value</b>     | 2.92                       | 0.01 *      | 2.71               | 0.01 *     | 9.76        | <0.0001 ** | 9.97                          | <0.0001 ** |
| <b>Smoking</b>             | 5.9±0.39                   | 4.9±0.8     | 6.7±0.44           | 4.9±0.8    | 16.03± 2.12 | 8.93± 1.12 | 14.03±1.77                    | 9.43± 1.13 |
| <b>T-test P- Value</b>     | 2.22                       | 0.001 **    | 2.27               | 0.001 **   | 8.2         | <0.0001 ** | 7.89                          | <0.0001 ** |

\* Significant P = < 0.05, \*\* High significant P = < 0.001.

**Table 8c. Health related QOL, pain, and dyspnea with pulse, respiratory rate and body temperature among flail Chest patient Pre and Post test**

| Variables              | Subjective pain experience |             | Pain intensity VAS |            | Pain disabilities VAS |            | Dyspnea     |            | Health quality of life (HQOL) |            |
|------------------------|----------------------------|-------------|--------------------|------------|-----------------------|------------|-------------|------------|-------------------------------|------------|
|                        | Pretest                    | posttest    | Pretest            | posttest   | Pretest               | posttest   | Pretest     | posttest   | Pretest                       | posttest   |
| <b>Temperature (T)</b> | 3.33±3.82                  | 2.37±1.87   | 6.03±2.72          | 4.03±1.27  | 4.63±1.09             | 2.26±0.73  | 6.03± 2.12  | 4.43± 1.13 | 7.3 ±2.38                     | 3.43± 1.13 |
| <b>T-test P- Value</b> | 6.99                       | <0.0001 **  | 2.7                | 0.01 *     | 3.5                   | 0.01 *     | 5.94        | <0.0001 ** | 7.2                           | <0.0001 ** |
| <b>Pulse (P)</b>       | 16.5 ±2.6                  | 13.03±1.877 | 16.56±2.17         | 13.23±0.85 | 13.26±0.96            | 8.93± 1.12 | 15.06± 2.12 | 5.9±0.39   | 19.53±3.92                    | 9.49± 1.17 |
| <b>T-test P- Value</b> | 2.96                       | 0.01 *      | 3.71               | 0.01 *     | 3.56                  | 0.01*      | 8.76        | <0.0001 ** | 9.77                          | <0.0001 ** |
| <b>Respiration (R)</b> | 6.9±0.89                   | 4.9±0.8     | 7.7±0.94           | 3.9±0.8    | 8.93± 1.12            | 4.9±0.39   | 14.03± 2.12 | 8.93± 1.12 | 14.03±2.12                    | 9.43± 1.13 |
| <b>T-test P- Value</b> | 2.25                       | 0.001 **    | 2.29               | 0.001 **   | 3.47                  | 0.001 **   | 8.25        | <0.0001 ** | 7.79                          | <0.0001 ** |

Significant changes also emerged in the late follow up (post discharge) from pretest assessment before CPT regarding PaO<sub>2</sub> (partial pressure of O<sub>2</sub>), PaCo<sub>2</sub> (partial pressure of CO<sub>2</sub>) and SO<sub>2</sub>(O<sub>2</sub> saturation) where P= **0.001\*\* and 0.0001\*\***, respectively. The table also revealed that mean of pulse rate, respiratory rate and body temperature were **105±45.7, 35.6±12.3, and 39.8±17.3**, respectively and changed with high significant improved from pretest assessment phase to late follow-up post-discharge on 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> month (P=**0.0001\*\***) respectively.

Table 8 a: Shows relation between HRQOL and Dyspnea with Subjective pain experience, pain intensity and Pain disabilities among flail chest patient pre and post-test. It revealed clearly that the subjective expressed pain, pain intensity, and dyspnea had highly significant affect the patients' QOL concerning changes between pre and posttest (P= **0.0001\*\***, **0.001\*\***, **0.001\*\*and 0.0001\*\***) respectively. Similarly, a highly significant relationship existed between the subjective expressed pain, pain intensity, pain caused disabilities and dyspnea (P= **0.0001 \*\***, **0.001 \*\***, and **0.001\*\***), respectively.

**Table 8 b: Demonstrates the relation between HRQOL, pain, and dyspnea with pulmonary function tests, ABGs and smoking among flail Chest pre and**

**posttest.** There was a high significant relation between patients' subjective expressed pain, dyspnea and quality of life and their pulmonary tests regarding pre and posttest (P= **<0.0001\*\***) respectively. Concerning ABGs, it was found that each of the dyspnea and HRQOL scores had high significant affected by ABGs (P= **<0.0001\*\***) respectively.

Table 8 c: It was also noticed that body temperature and respiration had a highly significant effect on the patients' QOL and, dyspnea, as well as subjective expressed pain (P= **<0.0001\*\* and 0.001\*\***), respectively. Similarly, a highly significant relation between the patients' pulse and dyspnea, and HRQOL were found (P=**<0.0001\*\***).

#### 4. Discussion

FC is an uncommon consequence of blunt chest trauma, but it continues to be an important injury and can carry a high morbidity and mortality [27,28,29]. Respiratory complications are the most common complications after surgery. Based on the management of the symptoms and problems, such as dyspnea, fatigue, pain, and physical inactivity that result in poor physical functioning, psychosocial, and quality of life status, it is thought that

CPT can be used post chest stabilization surgery following a comprehensive evaluation [30,31,32].

The aim of the current study was to evaluate the impact of postoperative chest physiotherapy practice in improving pain intensity, quality of life (QoL), respiration and oxygen uptake in patients with FC post chest stabilization surgery. Long-term studies concerning lung function, pain and HRQOL after surgery are lacked. In this work, 30 patients with FC were studied; they were encouraged to do physiotherapy post chest stabilization surgery. Chest physiotherapy sessions included breathing and coughing exercises, Secretion mobilization techniques as chest wall percussion and vibration as well as IPPV and incentive spirometer.

The primary end-point in the previous study of surgical treatment of flail chest has mainly focused on aspects associated with respiratory insufficiency. They stated that use of aggressive CPT should be started postoperatively to minimize the likelihood of respiratory problems [33].

The results of this study showed that the majority of the studied sample was illiterate male from 50 - 60 years old, they were married and had enough economic status for medication. This was in agreement with similar studies who reported in their studies that the subjects' age was from 50-65 and they were married [34,35,36]. The most of the subjects were smokers and their years of smoking were from 10 to 20 years. Around two-thirds of them were smoke cigarettes only. As a result of social and financial factors, they gave up of smoking were from 1-3 years and back again. Omar et al (2017) [37] stated that active or passive smoking may increases secretion, leading to impair ciliary function, which in turn may cause prolonged the recovery phase as a result of the respiratory complications.

It was found in this study that the progressive improvement in pain, respiration, QoL, lung function and ABGs within 6 months at late follow up. Concerning impact of chest physiotherapy on subjects' expressed symptoms associated pain among patients with flail chest post thoracic stabilization surgery, it was noticed that statistical significant decreased in the persistence problems associated pain at early follow up on 4<sup>th</sup> and 6<sup>th</sup> days of post-operative and post CPT and high significant improvement at late follow up post-discharge regarding pain at rest, pain on breathing, local discomfort, and difficulty moving on pain comparing with pretest assessment before CPT. This finding is supported by Galvagno et al (2016) [38], who stated that symptoms associated with pain significantly decreased from 6 weeks to 1 year following surgery and post CPT.

Pain may cause strong distressing sensation whereas local discomfort meant as an unpleasant or abnormal sensitivity to touch by CPT. There are studies reported that all trauma patients with acute pain upon discharge should receive a routine practice of prescribed analgesic, which may cause poor restricted movement, and inability to breath and participate in normal activities [39,40,41]. In the current study, all patients who were encouraged to carry out physiotherapy practice up to 6 months, they were taking the prescribed oral analgesics post discharge and immediate pre CPT. In addition, the anaesthologist researcher administered of epidural pain control on three

consecutive days of postoperative assessment and before the practice of chest physiotherapy.

Concerning pain causing disabilities, which may prevent the patients from doing what they would normally do with severe pain. This study illustrated that patients were reported to have experienced severe pain, decreased their usual daily activities and lung function alteration, in addition, that all entire studied sample had severe dyspnea in postoperative and before practicing CPT. The effect of pain and dyspnea on QOL and work life was noticed pre-chest physiotherapy in this study. In recent studies, the acute pain can contribute to respiratory problems, and chronic pain can be debilitating lead to decreased QoL among these patients [42,43]. FC causes chest pain breathlessness (dyspnea), cough and results in paradoxical chest movements, in addition, it results in infrequent their access to usual daily activities.

In Similarity, a study was conducted to find out an aggressive chest physiotherapy facilitating deep breathing and effective cough that helping in the recovery of lung functions and chest expansion [44]. Relaxation therapy and the diaphragmatic breathing technique are beneficial strategies to reduce pain, dyspnea and optimally augment peak oxygen consumption which leads to markedly decreases anxiety [45].

These patients in this study had benefited from multidisciplinary therapy which includes, breathing and coughing exercise, percussion and vibration as well as IPPB and incentive spirometer which aimed to reduce the perceived severity of dyspnea and pain in which increased their physical functioning and QOL. It revealed that all studied subjects had a significant difference in improvement of pain intensity between pre and post practicing of CPT pre-discharge, it was persisting in the improvement post discharge at late follow up till 6<sup>th</sup> month. Also, it revealed that the majority of patients had no dyspnea at late follow up on the 6<sup>th</sup> month and highly significant improvement between pre and post CPT.

So, it was noticed that the improvement of HRQOL significantly improved at late follow up on 3<sup>rd</sup> months of post-discharge and highly significant improvement on 6<sup>th</sup> month comparing with baseline assessment on 2<sup>nd</sup> week of post-discharge. Although overall follow up was high significantly improved from 2<sup>nd</sup> week of post-discharge regarding "Mobility", "self-care", "anxiety and depression", "usual activities" and "pain and discomfort" but, it was insignificant changes on 1<sup>st</sup> month comparing with baseline assessment on 2<sup>nd</sup> week of post-discharge. These may as a result of their improvement in lung function and ABGs that they were followed regularly in outpatient clinics and pulmonary function test (PFT), ABGs were investigated post chest physiotherapy and during CPT, this study revealed that the mean of FVC, SVC and PEF changed with high significant improvement in the early and late follow up, pre and post discharge. However, it was still significantly improved, this was in agreement with the results of many series [46,47].

Also, a study has reported significantly better lung function in surgically-managed patients one month after surgery receiving chest physiotherapy, whereas surgically treated patients had a less restrictive pulmonary function [48]. Obviously, intermittent positive pressure helped in

the prevention of paradoxical breathing as reported by Ranasinghe (2001) [9]. In addition, incentive spirometry increased the volume of air inspired and has been used to prevent the alveolar collapse in postoperative conditions [26].

In recent studies, Epidural analgesia is shown to provide superior pain relief and improvement in pulmonary function tests in various studies [49,50,51]. Its use has been associated with an increase in tidal volume, functional residual capacity (FRC), lung compliance, vital capacity and PO<sub>2</sub> with a reduction in airway resistance and chest wall paradox of flail segments [51].

Regarding FEV<sub>1</sub>/ 1sec. and FEV<sub>1</sub>/FVC, a statistically significant difference was found in pre-discharge at early and late follow up from pretest assessment. Significant changes also emerged in the late follow up (post discharge) from pretest assessment before chest physiotherapy practice regarding PaO<sub>2</sub> (partial pressure of O<sub>2</sub>) PaCo<sub>2</sub> (partial pressure of CO<sub>2</sub>) and SO<sub>2</sub> (O<sub>2</sub> saturation). Hypoxia as the result of respiratory insufficiency was the most physiological disturbance after chest trauma. In FC injuries, the paradoxical movement and the pain originating from the movements of spiky fractured ribs resulted in shallow tidal volumes which led to the collapse of alveoli, arteriovenous shunting and hypoxemia [47]. In this study, the ABGs showed improvement after practice CPT, this was similar to other reports [45].

The finding of this study revealed clearly that the subjective expressed pain, pain intensity and dyspnea had a high significant effect on patients' QOL concerning changes between pre and posttest. Similarly, a highly significant relationship existed between the subjective expressed pain, pain intensity, pain and dyspnea. Also, the significant relation between HRQOL, pain, and dyspnea with pulmonary function tests, ABGS and smoking among flail chest patient were found pre and posttest. Also, there was a highly significant relation between patients' subjective expressed pain, dyspnea and QOL and their pulmonary tests regarding pre and posttest.

Concerning ABGs, it was found that each of the dyspnea and HRQOL scores had high significant affected by ABGs. From a review concluded that the three CPT as breathing exercises, inspiratory muscle training and physical training can have beneficial effects in FC patient on their pulmonary function, cardiopulmonary fitness and maximal inspiratory pressure, therefore, symptoms of chest pain were reduced and specific QOL improved [52,53].

## 5. Conclusion

This study concluded that, the effect of chest physiotherapy on the symptoms associated pain, and pain intensity were still persistent in decrease post discharge at late follow up till 6<sup>th</sup> month, therefore pain caused disabilities decreased by high statistically significant post-practice of chest physiotherapy at early and late follow up. All entire subjects had no dyspnea on 3<sup>rd</sup> and 6<sup>th</sup> month of late follow-up. So, their HRQOL scores improved with a high significance in the area of mobility, self-care, anxiety and depression, the performance of usual activities and (pain and discomfort). Also, it was noticed that, the mean of Pulmonary Function Test

(PFT), and ABGs improved at the late follow-up. This improvement has been definitively shown in all outcomes parameter post physiotherapy performed after surgical fixation of FC. The current study included the schedule of the breathing and coughing exercises, percussion and vibration, incentive Spirometry and IPPV for the purpose of reducing pain experience, promote QOL and maintain breathing pattern. Post-operative physiotherapy is therefore indispensable. It helps to bring back the patient to the optimum normal condition. It is, therefore, the duty of the nurse and physiotherapist to reduce and prevent postoperative morbidity as well as to make the patient lead a normal life.

## 6. Recommendations

Based on the current study result, we recommended that:

- All the physiotherapy approaches should be planned and applied as individual programs tailored to FC patients following a comprehensive evaluation.
- Nurses working in the Cardiothoracic surgery unit and deal with chest injury patients, should update their knowledge and practice through attending in-service training program and workshop periodically and regularly to improve the standard of nursing care given to flail chest patients post thoracic stabilization surgery.

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