EFFICACY OF COMPRESSIVE ISCHEMIC PRESSURE RELEASE ON PECTORAL’S TRIGGER POINTS ON RT SIDE CARDIAC OUTPUT FOLLOWING OPEN HEART SURGERY: RANDOMIZED CLINICAL TRIAL

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ABSTRACT

**Background:** Every open heart surgery (OHS) presents a great risk for complications according to the type of procedure being performed. This is a widespread significant health problem with a huge burden on the individual and economy. Finding a noninvasive effective treatment that's non exhaustive for the therapist and non painful for the patient is highly needed.

**Aim of Study:** This study investigated the efficacy of compressive ischemic pressure releases on pectoral’s Trigger Points (TrPs) on chest pain, Pressure Pain Threshold (ppt) and Cardiac Output (CO) following OHS.

**Methods:** Forty patients with OHS performed sternal-approach maneuver participated in this study. They were recruited from Kasr Al-ainy, between 20: 50 years old were assigned into two equal groups, the experimental group (A) received compression ischemic pressure release of pectoral’s muscles TrPs and diaphragmatic deep breathing exercise. The control group (B) received diaphragmatic deep breathing exercise. Pain and CO measurements were used to evaluate patients before and after treatment.

**Results:** there was a significant improvement in the Pain pressure thresholds (p<0.0001) after ischemic pressure release of pectoral’s muscles TrPs and significant improvement in the Rt side CO TAPSe thresholds (p<0.0001), using mixed MANOVA test between the two groups. Conclusion: compressive ischemic pressure release of trigger points in pectoral muscles post open heart surgery was effective in reducing pain and improving cardiac output in open heart patients.

**Key Words:** OHS – Trigger point release – Mechanical pain – CO.

I. INTRODUCTION

According to the World Health Organization (WHO), the most leading cause of death over world is cardiovascular disease. The treatment for these diseases is through surgery, medications, changes in eating habits and physical activity. (1)

This in addition to the other risks associated with the surgery itself which including pacemaker placement, congenital defect repair, valve repairs and vascular repair, and may be higher if the heart is stopped and blood is pumped by a cardiopulmonary bypass machine rather than by the heart during the procedure. (2)
Post-surgery is one of the most critical therapeutic courses in patients undergoing cardiovascular surgery (CS). Complications such as bleeding, heart failure, arrhythmias, organ failure, neurological disorders, respiratory failure, infection, low Cardiac output (CO) and hemodynamic disorders are some of the most prominent and life-threatening events in this period which is one of the most challenging acute life-threatening situations. Many deaths of patients undergoing heart surgery occur at the time of admission to the CCU or ICU. (3)

Acute post-thoracotomy pain (PTP) can be disabling and lead to many complications because of splinting of the chest wall leading to decreased postoperative respiratory efforts, retention of secretions, and pulmonary complications. The International Association for the Study of Pain definition of chronic pain after thoracotomy is “Pain that recurs or persists along a thoracotomy scar at least 2 months following surgical procedure.” The reported prevalence of chronic PTP varies widely, from 11%to 80% with approximately 50% reporting even 1 year after surgery. This pain can be severe in intensity, is distressing to the patient, is difficult to treat, decreases quality of life, and can interfere with respiratory function. (4)

Lawrence et al., (2011) reported that surgery-associated pain persisted in patients 12 months following cardiac surgery. Sternal wound pain was present in 61% of the patients with 18% describing the pain as severe and that pain was associated with a poor quality of life. The chest incisional pain was reported by 25% of women and 60% of men 3 weeks following cardiac surgery. (5)

Continuous or dynamic cardiac function monitoring plays a crucial role in the diagnosis, assessment, treatment, and prognosis of critically ill patients. CO measurement is one of the most important parameters in cardiac function monitoring. CO = (LVEDV - LVESV) × heart rate. (6)

Trigger points (TP) are small, localized muscle cramps due to disruption of the sarcoplasmic reticulum, leading to excess calcium in the muscle. It has been suggested as an underlying factor and energy supplies are diminished and metabolic activity is high. TP s presented because of a variety of causes as excessive loads, direct trauma, uneven intramuscular pressure distribution, or repetitive or prolonged muscle contractions in form of low-level muscle contractions, unaccustomed eccentric contractions, eccentric contractions in unconditioned muscle, and maximal or sub maximal concentric contractions. (9)

So this study was conducted to establish the efficacy of compressive ischemic pressure release of trigger points in pectoral muscles on chest pain and cardiac output in patient post open heart surgery. To overcome the clinical nature of the study for the subjective criteria the same therapist applied the pressure force and respiratory exercise for all patients.

Open heart surgery has become very popular between cardiac patients. The incisional pain of the sternum inforce the patient to take rounded shoulder posture post-operatively which develop TP s in pectoral muscles this limits chest expansion and increases the risk of cardiopulmonary complications. (7)

Pain following median sternotomy is common and has been termed Post-Coronary Artery Bypass Pain Syndrome. The incidence of this syndrome reported by patients was high (46%). Post-sternotomy chest pain and paresthesia may be due to neuropathic pain and recently reported that pharmacological intervention (gabapentin and diclofenac) targeted towards this type of pain improved patient symptoms. Also, early postoperative pain has been shown to be lower when the pleural integrity is preserved during median sternotomy (5).

Pain treatment after thoracic operations is particularly important because the postoperative recovery of patients undergoing thoracic surgery is dependent on the maintenance of respiratory function. Respiratory depression is one of the disadvantages of opioids commonly used for postoperative pain treatment. The incidence of chronic post thoracotomy (CPT) (sternal type) was 80% at 3 months, 75% at 6 months and 61% one year after surgery. The incidence of severe pain was 3 – 5%. Chronic PTP interfered with normal daily life in more than half of the patients. (8)

Trigger point has a predictable places in the muscle and cause predictable patterns of referred pain. This makes it possible to make up a catalog of TP s and show for each muscle the TP s it usually has together with the sites of the referred pain it causes. As a note, it is good to know that many muscles, a feathered fiber orientation, may develop multiple TP s. Typically, a TP will develop in the middle of a muscle. But since muscles are made up of many fibers, sometimes with different orientations, TP s can occur at multiple sites within a single muscle. (9)
The systemic inflammatory response in form of tissue edema leads to Shortened sarcomeres which are the key part of the cause of muscle TP’s symptoms which cause more muscle spasm and pain leading to limitation of thoracic wall movement causing diminished air entry limiting cardiopulmonary capacities of the patient. (7)

The pectoralis major is a large, flat muscle of the pectoral girdle of the upper limb. It has a thick fan triangular shaped appearance with three heads or portions: the clavicular, the sternocostal and the abdominal head.(10)

In general, the pectoralis major is a robust adductor, which participates in the internal rotation and flexion in the glenohumeral joint. This muscle is significant for the “dynamic stabilization” of the arm and shoulder and respiration with fixed arms.(10)

The pathophysiology of muscle trigger points is still the subject of debate, but there is growing research’s that implicates a disturbance of the neuromuscular motor endplate. Excessive amounts of acetylcholine, results in the formation of contraction knots (areas of localized sarcomere shortening). It is in a state of continuous contraction, resulting in local ischemia and hypoxia. The combination of increased energy demand in the face of energy supply loss causes the release of sensitizing noxious substances, which are proposed to be responsible for the pain associated with muscle trigger points (11).

Shortened sarcomeres are the key part of the cause of muscle trigger point’s symptoms. The possible mechanism behind the effectiveness of progressive pressure release in increase pain threshold is the restoration of uniform sarcomere length in the affected muscle fibers. Gradual pressure applied downward on the trigger point tends to lengthen (normalize) the shortened sarcomeres and the contraction knots (or contraction discs) will flatten and lengthen, which is effective in reducing muscle tension. As their tension releases, digital pressure is increased. This local stretch reduces actin and myosin overlap, which reduces, the release of noxious substances, contractile activity, energy consumption, and ischemia-all of which tend to break the trigger point feedback cycle (12).

II. METHODOLOGY

Group (A): consisted of 20 patients who underwent OHS (median sternotomy). They received ischemic pressure release on five TP of pectoral muscles Use the thumb or four fingers and apply sustained gentle pressure for 90 Sec. to 120 Sec. moving inward toward the center of the (TrPs) once tissue resistance is felt, stop and wait until resistance dissipates (melting away). A 90-second rest was given between compressions to allow blood reperfusion into the treatment site. This cycle was repeated 3 times. At the end, either further relaxation of the tissue will be felt or no new gains will be achieved. (13) plus deep costal and diaphragmatic breathing exercises.

Group (B): Consisted of 20 patients who underwent OHS(median sternotomy).They received only deep costal and diaphragmatic breathing exercises.

Statistical analysis

Subject characteristics forty subjects participated in this experimental study of which 24 were males and 16 females patients within the first 24 hours post open heart surgery were participated. They were assigned randomly into two groups experimental group and control group: 20 patients in each. In control group 7 females and 13 males, whereas in study group it was 9 females and 11 males. The average age of subjects in control group is 40.55± 5.21 and in experimental group is 41.45 ±7.51. In both groups the duration of symptoms of pain was from the first day post operative. The total numbers of trigger points located in pectoral muscles were found to be almost similar in both groups (Control group - 5.16±0.96 and study group- 5.09±1.10). Pain was assessed using digital Pressure algometry and ECHO testing for cardiac output.

Statistical analysis was conducted using IBM SPSS statistics, version 23 (SPSS, Inc., Chicago, IL). Prior to final analysis, data were screened for normality assumption, and presence of extreme scores. This exploration was done as a pre-requisite for parametric calculation of the analysis of difference and analysis of relationship measures. Paired “t” test was used to analyze and detect changes within groups.

III. RESULTS

Statistical analysis was conducted using IBM SPSS statistics, version 23 (SPSS, Inc., Chicago, IL). Prior to final analysis, data were screened for normality assumption, and presence of extreme scores. showed that The effect of
CIPR on trigger point pain threshold was recorded. The mean value of pain measured by Newton in the 1st TrP Rt Exp group changed from (6.03) before CIPR to (27.62) after treatment with stander deviation (±1.75±2.03) while in 1st TrP Rt cont group changed from (6.51) to (13.68) with stander deviation (±2.32±5.20) and in the 1st TrP Lt Exp group changed 5.86) before CIPR to (27.61) after treatment with stander deviation (±2.11±2.35) while 1st TrP Lt cont group changed from (7.44) to (14.06) with stander deviation (±4.02±4.02) with Paired t test showed high statistical significant increase between before and after treatment in experimental group the t value was (40.6) RT, P value was less than (0.0001) and (35.3) Lt and P value was less than (0.0001) and in control group static significance was (6.3) Rt, and P value was (0.0001) and (4.9) LT, and, P value was less than (0.0001).

While in the 2nd TrP Rt Exp group changed from (4.46) before CIPR to (26.02) after treatment with stander deviation (±1.12±3.43) while in 2nd TrP Rt cont group changed from (4.21) to (11.27) with stander deviation (±1.54±5.69) and in the 2nd TrP Lt Exp group changed from (4.58) to (25.58) after treatment with stander deviation (±1.26±3.29) while in 2nd TrP Lt cont group changed from (5.18) to (11.57) with stander deviation (±2.89±5.48) with Paired t test showed statistical increase between before and after treatment in experimental group the t value was (30.988) RT, (29.612) Lt and P value was less than (0.0001), while in control group the t value was (5.707) Rt and (4.919) LT, and P value was less than (0.0001).

While in the 3rd TrP Rt Exp group changed from (8.7) before CIPR to (25.34) after treatment with stander deviation (±2.39:±5.51) while in 3rd TrP Rt cont group changed from (8.97) to (13.17) with stander deviation (±3.12:±5.76) and in the 3rd TrP Lt Exp group changed from (8.23) to (26.87) after treatment with stander deviation (±2.71:±4.1) while in 3rd TrP Lt cont group changed from (9.13) to (13.91) with stander deviation (±3.1:±5.7) with Paired t test showed statistically significant increase between before and after treatment in experimental group the t value was (14.482) RT, (22.925) Lt and P value was less than (0.0001), while in control group the t value was (3.708) Rt, P value was equals (0.001) and (3.953) Lt and P value was less than (0.001).

The mean value of TAPSE, an assessment of the excursion of the lateral tricuspid annulus toward the RV apex, is a commonly used echocardiographic tool for RV assessment measured by (mm) changed from (15.98) before ischemic pressure release to (20.62) after treatment program in experimental group,with stander deviation (±1.46:±1.33) and from (15.57) to (17.7) in control group with stander deviation (±1.09:±1.86). Paired t test showed extreme statistical significant between before and after treatment in experimental group the t value was (16.082) and P value was less than (0.0001), while in control group the t value was (6.073) and P value was less than (0.0001) By conventional criteria, this difference is considered to be very statistically significant.

Table (1) Posttreatment inter-group difference:-

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean pre- ttt</th>
<th>Mean Post - ttt</th>
<th>SD ±</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st TrP Rt Exp group</td>
<td>6.03</td>
<td>27.62</td>
<td>±1.75±2.03</td>
<td>&gt;0.0001*</td>
</tr>
<tr>
<td>1st TrP Rt cont group</td>
<td>6.51</td>
<td>13.68</td>
<td>±2.32±5.20</td>
<td>&gt;0.0001*</td>
</tr>
<tr>
<td>1st TrP Lt Exp group</td>
<td>5.86</td>
<td>27.61</td>
<td>±2.11±2.35</td>
<td>&gt;0.0001*</td>
</tr>
<tr>
<td>1st TrP Lt cont group</td>
<td>7.44</td>
<td>14.06</td>
<td>±4.02±4.02</td>
<td>&gt;0.0001*</td>
</tr>
<tr>
<td>2nd TrP Rt Exp group</td>
<td>4.46</td>
<td>26.02</td>
<td>±1.12±3.43</td>
<td>&gt;0.0001*</td>
</tr>
<tr>
<td>2nd TrP Rt cont group</td>
<td>4.21</td>
<td>11.27</td>
<td>±1.54±5.69</td>
<td>&gt;5.71</td>
</tr>
<tr>
<td>2nd TrP Lt Exp group</td>
<td>4.58</td>
<td>25.85</td>
<td>±1.26±3.29</td>
<td>&gt;0.0001*</td>
</tr>
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<td>2nd TrP Lt cont group</td>
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</tr>
</tbody>
</table>

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With this study, it was observed that compressive ischemic pressure release of trigger points in pectoral muscles in cardiac patient post open heart surgery seemed to be effective in decrease somatic chest pain and improve cardiac output.

Celik and Yeldan 2011 demonstrated significantly lower muscle strength for flexion and scaption in subjects with at least 2 TrPs in neck/shoulder muscles, compared with subjects with no TrPs. Also Wytrazeck et al. 2011 demonstrated that the presence of TrPs was accompanied by decreased muscle strength. To the best of our knowledge, studies investigating the effect of IC on TrPs are lacking. The results of this study show a statistically significant improvement of the muscle strength of different neck and shoulder muscles. (14,15)

Dowling and co-workers (2012) who investigated the effect of a continuous regional infusion of a local anesthetic delivered to the operative site would result in decreased levels of postoperative pain and narcotic requirements for patients who undergo a standard median sternotomy for cardiac surgery concluded that Continuous delivery of local anesthetics significantly improved postoperative pain control while decreasing the requirements for patients who undergo a standard median sternotomy. There was also a significant decrease in hospital length of stay, which is likely to result in significant cost reductions. (16)

V. CONCLUSION

Compressive ischemic pressure release of trigger points in pectoral muscles post open heart surgery was effective in reducing pain and improving cardiac output in open heart patients. Conflict of interest

There is no conflict of interest.

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