Acute Hemodynamic Response To Acapella In Phase I Cardiac Rehabilitation Post Mitral Valve Replacement

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ABSTRACT

Purpose: The purpose of this study was to evaluate the acute hemodynamic response to Acapella in patients underwent mitral valve replacement surgery. Methods: Twenty (n=20, mean age: 20 ±3.2years) post mitral valve replacement patients were selected for this study from cardiothoracic unit of Elorman Hospital, Assuit, Egypt. All patients used Acapella during their phase I cardiac rehabilitation program. They were asked to breath from diaphragm taking in a larger than normal breath, hold breath for 2 to 3 seconds and exhale actively but not forcefully, through the device, exhalation lasted approximately 3 to 4 times longer than inhalation. It was performed 10 to 20 PEP breaths. Patients were instructed to remove the mouthpiece and perform 2 to 3 ‘huffs and coughs to raise secretions as needed. These procedures had been repeated 3 to 4 times. Measurements of systolic blood pressure, diastolic blood pressure, heart rate, rate pressure product, arterial oxygen saturation and respiratory rate were taken before, during, immediately after and 30 minutes after using Acapella. Rate of perceived exertion and sputum amount were taken after using Acapella. Results: As a result of use of Acapella during cardiac rehabilitation, a significant improvement was observed in the sputum volume mean (6.4ml), respiratory rate (p<0.001) and SPO2 (p<0.001). Acapella caused no significant hemodynamic response such as systolic blood pressure (p=0.312), diastolic blood pressure (p=0.433), heart rate (p=0.59) and rate pressure product. Conclusion: Use of Acapella during phase I cardiac rehabilitation looks to be safe, without alteration on hemodynamic variables; in addition, it seems an effective adjunct for the removal of bronchial secretions in patients underwent mitral valve replacement surgery.

Keywords: Acapella; hemodynamic; cardiac rehabilitation; Mitral valve replacement.

I-INTRODUCTION

Cardiovascular diseases have gotten to be the driving cause of morbidity and mortality in Egypt through the final three decades. Rheumatic heart diseases (RHD), hereditary inclination and procurement of conventional hazard calculate at a quick rate as a result of urbanization appears to be the major cause. The mitral valve (MV) plays an imperative part in conveying oxygenated blood from the heart to the rest of the body. When the mitral valve comes up short to shut legitimately, oxygenated blood may stream back into one of the heart chambers. This backflow of blood is called mitral valve regurgitation. [1]

Under these circumstances, the heart has to work much harder to supply the body’s organs with oxygenated blood. Symptoms of a leaking mitral valve (MV) can include shortness of breath, excessive tiredness and leg swelling. The appearance of three-dimensional imaging has allowed removed better; a much better; a higher; a stronger; an improved >a more grounded representation of the valve life frameworks. Rheumatic disease is still the number one cause of mitral stenosis around the world and percutaneous swell mitral valvuloplasty remains the treatment of choice when illustrated and in anatomically qualified patients. Mitral regurge (MR) is classified as fundamental (i.e., damage
inside the mitral leaflet) or assistant (caused by cleared out ventricular geometrical alterations). While surgery, in a perfect world repair, is still the recommended treatment for extraordinary basic mitral valve (MR), percutaneous approaches to repair and/or supplant the mitral valve are being broadly investigated. [2]

Rheumatic heart disease (RHD) is the most common cause of mitral valve stenosis (MS) worldwide. It is more common and progresses more rapidly in developing countries. It is thought to be related to an exaggerated immune response initiated by cross-reactivity between a streptococcal antigen and the valve tissue [3].

Patients with repetitive bouts of intense rheumatic fever coming about in carditis are especially inclined to create rheumatic heart diseases (RHD). In spite of the fact that any cardiac valve may be included, the mitral valve is nearly continuously influenced. Characteristic rheumatic changes include: Commisural combination, “Fish-mouth” appearance of the MV hole, Flyer thickening, particularly at the free edges, shortening and combination of the chordae, the last mentioned two changes are dependable for the characteristic hockey-stick appearance of the flyer, especially the front, on echocardiography. [4]

Rheumatic heart disease may be a systemic safe handle that's sequelae to a beta-hemolytic streptococcal disease of the pharynx. It is most common in creating nations. Be that as it may, it is capable for 250,000 passings in youthful individuals around the world each year. Over 15 million individuals have proven of rheumatic heart disease. Morphological Highlights of Rheumatic Heart Infection on Mitral Valve are: Front mitral valve pamphlet thickening more noteworthy than or rise to 3 mm (age-specific), Chordal thickening, Confined flyer movement and Intemperate pamphlet tip movement amid systole [5].

Until as of late, valve substitution was the as it were surgical treatment for mitral retching forward. At that point, mitral valve repair advanced to expel repetitive tissue and supplant burst chordae, hence protecting most of the local valve tissue without having to put a manufactured valve. Most as of late, less meddling percutaneous strategies have advanced by which the mitral valve annulus can be choked by a gadget put within the coronary sinus, or the spilling valve pamphlets can be sutured or clipped together. [6]

In spite of the victory of these endeavors, postoperative pneumonic complications (PPC) account for a significant extent of horribleness and mortality related to surgery and anesthesia and lead to longer clinic remains. Relating to cardiac surgery are the impacts of anesthesia, middle sternotomy cut. [7]

Cardiac rehabilitation programs are by and large partitioned into three fundamental phases’ inpatient, early outpatient, and long term outpatient cardiac recovery. Phase 1 conveys preventive and restoration administrations to hospitalized patients and final for one to two weeks. At this early stage, the center of physiotherapy is medicine to dodge inertia, and to preserve or move forward aspiratory capacities and strong quality. The viability of standard chest physiotherapy (CPT) has been affirmed by numerous ponders. Aviation route CPT is considered the base of physiotherapy and is characterized as “gold standard” of physiotherapy. [8].

Chest physiotherapy may be a routinely utilized treatment to avoid post-operative respiratory complications after cardiac surgery. The procedures utilized make strides respiratory mechanics, aspiratory re-expansion and bronchial cleanliness. Chest physiotherapy is given to preserve or move forward alveolar ventilation. In cases where alveolar ventilation is diminished secondary to held discharges, different procedures are accessible to the advisor to help with discharge evacuation. This incorporate gravity helped waste, situating, percussion and vibrations, manual hyperinflation and aviation route suctioning. [9]

In later a long time, modalities of respiratory physiotherapy have developed which offer choices to standard CPT which are less time-consuming and offer more noteworthy freedom to the quiet with lung infection. Concurring to later writing, modalities of respiratory physiotherapy are presented as elective treatment strategies [10] in arrange to encourage and move forward mobilization of bodily fluid from aviation routes, through which superior lung ventilation and made strides pneumonic work can be accomplished. These modalities are Secure and offer satisfactory aviation route clearance to ordinary CPT. Patients utilize gadgets of respiratory physiotherapy since of their benefits, such as the autonomous application and the decreased fetched of therapy. One of the current devices of respiratory physiotherapy is positive expiratory pressure. [11]

Energy gadget may grant freedom to patients because it can be carried out without a partner and is simple and helpful in utilize. Little clinical thinks about have detailed moved forward tracheobronchial clearance and understanding consolation with Zip gadgets compared to standard chest physiotherapy (CPT). Diminishment in pneumonic infections/antibiotic courses and progressed bronchodilation is additionally detailed. [12] In expansion, there has too been detailed advancement in compliance and shorter healing center remains. Other ponders report Zip as a satisfactory and viable treatment regimen to lung work. There are distinctive sorts of gadgets utilized to provide energy but one of the foremost commonly utilized is Acapella. The Acapella (Smiths Restorative Inc, Carlsbad,
California, USA) may be a handheld aviation route clearance gadget that works on the same rule as the Vacillate, i.e. a valve hindering expiratory flow producing swaying energy. Utilizing a counterweighted plug and magnet to realize valve closure, the Acapella isn't gravity subordinate just like the Shudder. The Acapella comes in three models, a moo stream (blue) (<15 L/min), tall stream (green) (>15 L/min) and the Acapella Choice. The tall and moo stream models have a dial to set expiratory resistance whereas the Choice demonstrate features a numeric dial to alter recurrence. All models can be utilized with a veil or mouthpiece and can be utilized in line with a nebulizer. [13].

The need of prove alongside inconsistency reactions of Acapella on hemodynamic were the necessities of this ponder. To our information there's no investigated portraying the intense impact of Acapella on hemodynamic taking after mitral valve substitution surgery.

The present study therefore investigates the acute hemodynamic effect of Acapella in phase I cardiac rehabilitation following mitral valve replacement surgery.

II- MATERIALS & METHODS

The Study conducted in Elorman Hospital for cardiology, Assiut University. Signed consent of patient prior to surgery considered as willingness to participate in study.

- **Inclusion criteria**
  
  We selected post-operative mitral valve replacement procedure, age of between 10 to 25 years, candidates for early extubation (6-8 hours after surgery), Temperature < 35C.

- **Exclusion criteria**
  
  Current smoking, Aspiratory embolism, Pneumothorax and hemothorax, Hemodynamic precariousness- Patients having cruel blood vessel weight less than 60 mm Hg and more than100 mm Hg, cardiac arrhythmias, heart rate more than 160 beats per diminutive, Ventricular tachycardia ventricular fibrillation, Crisis surgery, Cerebral edema, drag out ventilation > 24 hours, Cleared out ventricular launch division less than 35%, Intraoperative or postoperative CVA. Eligible patients allocated to receive Acapella during their phase 1 cardiac rehabilitation.

  The following pre-operative risk factors will be assessed: patient age, sex, and body mass index, history of smoking, lung function, and functional capacity

- **Study design**
  
  The study is single group pre and post-test experimental design. Independent variables are Acapella and Phase 1 cardiac rehabilitation. The dependent variables are heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), oxygen saturation (SpO2), respiratory rate (RR), Rate pressure product (RPP), Sputum amount (ml), Rate of perceived exertion (RPE) and Hospital stay.

  To ponder the intense hemodynamic impact of Acapella in stage 1 cardiac recovery taking after mitral valve substitution, 20 patients are arbitrarily chosen after point by point cardiovascular and respiratory appraisal; reasonable patients are included after incorporation and prohibition criteria. Perusing of heart rate, blood vessel oxygen immersion, systolic blood weight, diastolic blood weight, respiratory rate, rate weight item, rate of seen effort and sputum sum will be taken

- **Procedures**
  
  Acapella device was selected depending upon the patient’s ability to maintain an expiratory flow of 15 liters per minute (LPM) or greater for three seconds. All patients enrolled for the study (n=20), green Acapella was used for all of them. At initial setting of the device frequency adjustment dial was turned counter-clockwise to the lowest frequency-resistance setting, then frequency/ resistance increase clockwise. Proper resistance range will be selected to produce the desired I: E ratio of 1:3 to 1:4.

  Patients were inquired to breath from stomach taking in a bigger than ordinary breath. Hold breath for 2 to 3 seconds. Patients breathed out effectively but not commandingly, through the gadget, exhalation ought to final roughly 3 to 4 times longer than inward breath. At that point Perform 10 to 20 Get up and go breaths and after that evacuate the mouthpiece and perform 2 to 3 ‘huffs’ hacks to raise discharges as required. This strategy rehashed 3 to 4 times. All the subordinate factors were taken pre-test some time recently utilizing Acapella, amid test at the time utilizing
Acapella, post-test instantly after utilizing Acapella and 30 minutes after utilizing acapella.

- **Statistical analysis**
  
  Twenty patients (n=20), five females and fifteen males who had undergone mitral valve replacement surgery, were finally enrolled in the study. The demographic and operative characteristics of the patients shown in table (1). A one-way repeated measures ANOVA was conducted to compare the hemodynamic effect of Acapella on systolic blood pressure, diastolic blood pressure, heart rate, rate pressure product, respiratory rate and SpO2 in post CABG patient during phase 1 cardiac rehabilitation at before, during, immediately after and 30 minutes after using Acapella.

### III- RESULTS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Before</th>
<th>During</th>
<th>Immediately after</th>
<th>30 minutes after</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP Mean+SE</td>
<td>111.7±5.3</td>
<td>115.0±5.2</td>
<td>111.0±4.5</td>
<td>111.6±5.7</td>
<td>1.46</td>
<td>0.312</td>
</tr>
<tr>
<td>DBP Mean+SE</td>
<td>74.0±2.7</td>
<td>75.3±2.6</td>
<td>73.7±1.6</td>
<td>72.3±1.7</td>
<td>1.10</td>
<td>0.433</td>
</tr>
<tr>
<td>HR Mean+SE</td>
<td>84.3±3.1</td>
<td>83.5±3.4</td>
<td>83.7±3.1</td>
<td>82.9±3.3</td>
<td>0.62</td>
<td>0.594</td>
</tr>
<tr>
<td>RPP Mean+SE</td>
<td>9473.1±483.8</td>
<td>9681.1±525.2</td>
<td>9321.8±371.3</td>
<td>9227.8±501.6</td>
<td>2.13</td>
<td>0.11</td>
</tr>
<tr>
<td>RR Mean+SE</td>
<td>19±0.5</td>
<td>19.2±0.5</td>
<td>17.6±0.5</td>
<td>17.7±0.5</td>
<td>17.36</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SPO2 Mean+SE</td>
<td>94.3±0.4</td>
<td>95.0±0.3</td>
<td>96.3±0.2</td>
<td>96.6±0.1</td>
<td>18.02</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Repeated measure ANOVA could not find any difference between the readings of systolic blood pressure (F=1.46, p=0.239), diastolic blood pressure (F=1.10, p=0.360), heart rate (F=0.62, p=0.608) and rate pressure product (F=2.13, p=0.110) in response to Acapella. However, there were significant improvement in respiratory rate which was 18.2±0.5 before using Acapella and 16.9±0.5 after using Acapella (F=17.36, p<0.001), and SpO2 (F=18.5, p<0.001).

Mean amount of sputum collected after using Acapella is 10.3 ml. Mean of rated perceived exertion after using Acapella is 2.8 and the mean of hospital stay of twenty patients were 15.3 days.

The result suggests that Acapella really does not have any abnormal hemodynamic effect in post mitral valve replacement patients. Specifically, our results suggest that Acapella can safely be used in post mitral valve replacement patients without any abnormal hemodynamic changes. Additionally, there were a substantial improvement in oxygenation, respiratory rate and expectorated sputum volume (10.3 ml) this further suggest that...
Acapella is effective in removing bronchial secretion and improving oxygenation in post mitral valve replacement patients.

IV- DISCUSSION

The impact of Acapella on hemodynamic execution was assessed in a bunch of patients who experienced mitral valve substitution. The result appears that in mitral valve substitution patients there were negligible changes in systolic blood weight, diastolic blood weight, heart rate, rate weight item amid treatment, instantly after treatment and 30 minutes after treatment. In any case, there were measurably critical enhancement in respiratory rate and SPO2 taking after instantly after utilizing Acapella and 30 minutes after utilizing Acapella.

This study considered a clinically significant change one that was greater than 10 percent. When examining the systolic blood pressure, diastolic blood pressure, heart rate, rate pressure product was no significant (p > 0.05). This can possibly be explained that Acapella could not demonstrate any change in these hemodynamic variables. Rate pressure product (RPP) is the best non-invasive index which results from multiplying systolic blood pressure by heart rate, has been recognized as a relevant parameter in evaluating ventricular function. It has been speculated that high values at peak exertion thus reflecting cardiac work are more likely related to good ventricular function and no ischemia. [14-16] Low rate pressure product value before using Acapella denotes normal myocardial oxygen consumption. As the values of rate pressure product during, immediately after and 30 minutes after using Acapella provide no significant changes in values denotes that the use of Acapella do not increase myocardial oxygen demand.

As per our knowledge there is no study available to date to demonstrate the hemodynamic changes specifically in coronary artery bypass surgery patients. Most of the studies done on the patients with pulmonary diseases; however, the results of these studies are in accordance of present study. The present study demonstrated an improvement in SPO2 and respiratory rate (p<0.05) after using Acapella. As per our knowledge there is no study available to date to demonstrate the hemodynamic changes specifically in coronary artery bypass surgery patients. Most of the studies done on the patients with pulmonary diseases; however, the results of these studies are in accordance of present study. The present study demonstrated an improvement in SPO2 and respiratory rate (p<0.05) after using Acapella. This result is in accordance with the studies of Darbee et al in 2005[17] in which the research evaluated the physiological reactions to two aviation routes clearance mediation tall recurrence chest divider swaying and moo positive expiratory weight breathing in subjects who have direct to extreme cystic fibrosis illustrated change in ventilation conveyance, gas blending and increment in SPO2 amid positive expiratory weight breathing Think about done by Padkao et al in 2010. [18] Illustrated that the funnel shaped Energy gadget diminishes lung hyperinflation, is secure to utilize and patterns to extend the length of work out in unremitting obstructive aspiratory malady patients compared to ordinary breathing. This think about is in understanding with the ponders of Thompson et al in 2002 [19] who concluded that the daily use of flutter device is effective as active cycle of breathing in patients with non-cystic fibrosis bronchiectasis and has high level of patients acceptability. This study is in accordance done by MAH Abu-Rayyan et al in 2009[20] demonstrated that Acapella is the good representative of all conventional multimodality chest physiotherapy procedures resulted in significant improvement in oxygenation.

V- CONCLUSION

In general, comes about of the ponder lead us to the conclusion that the employments of Acapella amid stage 1 cardiac restoration appears to be secure, without change on hemodynamic factors, in expansion, it appears a compelling aide for the evacuation of bronchial discharges in patients experienced mitral valve substitution surgery. It can be concluded that Acapella may be considered secure and successful in mitral valve substitution patients amid stage 1 cardiac restoration.

Authors Contributions

THM designed and performed the experiment and also wrote the manuscript. SAM, MYG, EMG and MAG performed continuous guidance and suggestions during the performance of the experiment, data analysis and reviewed the manuscript. All authors read and approved the final version.

REFERENCES
