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Short term effectiveness of Structured Exercise Therapy Protocol on Cardio-respiratory parameters in subjects with COVID

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ABSTRACT

Introduction: *It is already proved that COVID subjects are known to have symptoms like breathless at rest, fever, sore throat and other pneumonia like symptoms. Few studies have demonstrated Physiotherapy intentionally enhances invulnerability towards infection by different exercises on the stipulated part, thus increasing the strength of that part. Cardio-Pulmonary Rehabilitation is known to be useful in treating subjects with cardio-respiratory symptoms. Few studies have already demonstrated exercises have strong significant effect for managing subjects with COVID on High flow nasal cannula as well as Mechanical ventilation. According to authors knowledge there are very less number of studies demonstrating the effectiveness of the Structured Exercise Therapy Protocol for COVID subjects in both types of Oxygen therapy, hence this study is been undertaken.*

Objective: *To investigate the Short term Effectiveness of Structured Exercise Therapy Protocol in subjects diagnosed with COVID on High flow nasal cannula versus Structured Exercise Therapy Protocol on Mechanical ventilation.*

Methodology: *This is a randomized clinical trial conducted on 124 subjects. Subjects were randomly divided into two groups, Group A: 62 subjects with High flow nasal cannula who were given Structured Exercise therapy protocol and Group B: 62 subjects with Mechanical ventilation who were given Structured Exercise Therapy Protocol.*

Results: *Both the groups showed significant improvement with respect to Structured Exercise therapy protocol. On comparison Group A showed high significant results in improvement among modified Borg's scale of dyspnea, $SP0_2$, Respiratory rate, X-ray changes, Heart rate and number of active cough extraction demonstrated significant changes with p value <0.001, <0.05, <0.05 and <0.001 respectively. Whereas Group B showed significant improvement with p value <0.05 for all the parameters.*

Conclusion: *The treatment showed significant improvement in all the outcome measures in group A that is subjects with High flow nasal cannula. Hence, the conclusion is that, Structured Exercise Physiotherapy protocol in*

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subjects with High flow nasal cannula showed early and most significant improvement in subjects with COVID in all the respiratory parameters against subjects with Mechanical Ventilation.

Keywords: *COVID, Structured exercise protocol, Cardiac, Respiratory, Randomized clinical trial*

I. Introduction:

The first outbreak of an international pandemic COVID-19 caused by the Coronavirus occurred in 2019, hence the name COVID-19. The disease first and foremost manifests in respiratory system with its key manifestations being interstitial and alveolar pneumonia which gradually turns into Severe acute respiratory syndrome and in brutal cases of COVID-19 the infection spreads to all the vital organs like heart, digestive tract, kidney, nervous system, vascular system.[1]

Few published theories have shown that the subjects with COVID have confirmed signs and symptoms parallel to pneumonia. The blood analysis showed noticeable intensification in eosinophil count showing persisting infection, the D-dimer value, S. Ferratin values showing: low immunity due to in-house degradation[2].

Medical therapy along with oxygen support is recognized to be very triumphant in supervising subjects with COVID.[3] Theories have stated that High Flow Nasal Cannula is significantly effective in subjects with COVID. But not all COVID subjects require High Flow Nasal Cannula system, hence few studies have demonstrated that Mechanical ventilation also have significant effect.

Physiotherapy techniques and exercises have been statistically proven to be effective in improving the cardiovascular and respiratory parameters in subjects with COVID. Few of the techniques and exercises already proven are: maintenance of Prone lying position, Qigong exercises which includes deep breathing exercises, diaphragmatic breathing exercises, pursed lip breathing exercises. Some articles prove these studies to have both positive and negative effect on subjects with COVID.

According to author's knowledge there is paucity of literature related to Structured Exercises Therapy Program in subjects with High Flow Nasal Cannula and the same protocol in subjects with Mechanical ventilation among COVID fighters Hence this randomized clinical trial is been undertaken.[4]

II. MATERIALS AND METHODS

Participants:

Ethical approval was taken from Institutional Ethics Committee KIMSDU Karad. It is a randomized clinical trial including 124 subjects who were diagnosed as COVID positive. Subjects were enrolled in to study by convenience sampling technique and Study population was selected from the Intensive Care Unit of KRISHNA HOSPITAL- Karad India, diagnosed with COVID. All participants were informed about the procedures and the written informed consent was taken preceding to the commencement of the study. The enrolled subjects were

subjected to inclusion and exclusion criteria. Inclusion criteria for recruitment were; COVID positive, Modified Borg's scale of dyspnea grade: 3 and above, respiratory rate not below 40 and above, both the genders, subjects willing to participate in study and age: above 18 years. Exclusion criteria were: fever, unconscious subjects, subjects with neurological or cardio-respiratory instability, subjects with surgical history, neoplasia, and known case of sever static and dynamic balance issues. Subjects were selected on the basis of the criteria system and the therapy was administered.

Experimental Procedure:

Demographic details and outcome measures like: age, gender, height, weight, BMI, modified Borg's scale of dyspnea, $SP0_2$, Respiratory rate, Heart rate, number of active cough extraction, X-ray reading were recorded pre-therapy. Subjects were divided into two groups depending on the type of ventilation system. Both the groups received same therapy protocol given below

Structured exercise therapy protocol was delivered every day for seven days with frequency twice daily. Morning session was given at 10 am: which consisted of ; Session 1: Deep breathing exercises, chest expansion exercises and prone lying for 45 minutes, Session 2: Ankle toe movements, hand pumps and heel sides along with prone lying for 45 minutes, Session 3: Shoulder abduction movements, hip abduction movements, and diaphragmatic breathing along with prone lying for 45 minutes again and Session 4: Deep breathing exercises, chest expansion exercises and prone lying for 45 minutes. Evening session was repeated in the same way as morning session at 4pm. Total duration of morning and evening session was 3 hours and 20 minutes respectively. The subjects were on High flow nasal cannula and mechanical ventilation through-out the protocol for 7 days as prescribed.

On 7^{th} day the outcome measures were noted again and tallied statistically using 16.0 version for the results.

III. CONSORT

Ethical approval was taken from institutional ethical committee KIMSDU-Karad

Written Informed consent was taken to enroll the subjects in the study: 200

The enrolled subjects were subjected for screening purpose with respect to inclusion and exclusion criteria.

Subjects who met with inclusion criteria were enrolled in the study (N=124) and those who did not meet were discarded.

The subjects were divided into Group A(n=62) and Group B(n=62) randomly using envelope method.

Group A: consisted of Structured exercise program along with Prone lying position for 3 hours with High flow nasal canula

The entire exercise therapy were divided into 4 session with frequency twice daily.

Group B: consisted of Structured exercise program along with Prone lying position for 3 hours with Mechanical ventilation

The entire exercise therapy were divided into 4 session with frequency twice daily.

Outcome measures were taken on first day and after 7th day of the program

The reading of the outcome measures were tabulated and subjected to statistical analysis

Statistical analysis was performed using statistical version 16.0 and results were noted down

Outcome Measures:

Outcome measures taken into consideration were: Modified Borg's scale of dyspnea (a 11 point scale to measure rate of breathlessness which ranges from 0 to 10.),[5] $SP0_2$ (measure of amount of oxygen-carrying hemoglobin in the blood relative to the amount of hemoglobin not carrying oxygen), Respiratory rate and Heart rate(recorded from the pulse Oximetry),[6] Number of active cough extraction and X-ray changes: ground glass opacification, Bilateral alveolar consolidation, air space consolidation and crazy paving appearnace[7]. The outcome measure readings were taken on pre-therapy and immediately post-therapy.

IV. RESULTS:

Statistical analysis was done using 16.0 version. Parametric tests were used to assess the results for within and between groups for numeric data and Chi Square test was used to analyze the qualitative data changes (X-ray) within and between groups.

I. Demographic Characteristics of Participants: the details were identical among the groups.

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II. SPO2, Respiratory rate, modified Borg's scale and number of active cough extraction:

Table 1 demonstrates that both the groups showed significant improvement in all the parameters. But, Between group analysis demonstrated high significance in all the parameters of group A against group B thus, showing its high significance.

Table 1: Within and between analysis of SPO2, Respiratory rate, modified Borg's scale and number of active cough extraction using t test and unpaired t test respectively

Parameters	Group A		p value	Group B		p value
	Pre therapy	Post therapy		Pre therapy	Post therapy	
SP02	85 ±5	98 ±2	<0.001*	85 ±2	95 ±2	<0.05*
RR	45±3	20±2	<0.001*	50±3	26±2	<0.05*
HR	112±5	72±5	<0.001*	110±5	75±5	0.815
Modified Borg's scale grade	7±3	0±1	<0.001*	8±2	5±2	<0.05*
Number of active cough extraction	0±1	5±2	<0.001*	0±1	1±2	<0.05*
p Value	0.891	<0.001*		0.910	<0.05*	

***p* value less than 0.05 was considered to be significant**

III. X-ray changes: Chi square analysis showed X-ray demonstrating significant changes with respect to Lungs. Within group analysis showed the difference in the X-ray changes was statistically significant with p value <0.05 with respect to air space consolidation, ground glass appearance, crazy paving appearance in group A, whereas Group B showed no statistical significance**. Table 2. S**imilar improvement was seen in both the groups hence, between group analysis showed no statistical significance with p value 0.872.

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Table 2: p values of X-ray changes in subjects with COVID between pre and post-therapy within groups

Parameters	Group A		Group B	
	P value of Pre therapy	P value of Post therapy	P value of Pre therapy	P value of Post therapy
Alveolar Consolidation	0.148	<0.05*	0.152	<0.05*
Ground glass Opacification	0.217	<0.05*	0.315	<0.05*
Crazy paving appearance	0.189	<0.05*	0.287	<0.05*

p* value was considered significant if it was less than or equal to <0.05

V. DISCUSSION:

In the present study, Group A showed high significant improvement in all the outcome measures enlisted above against group B demonstrating Respiratory Physiotherapy given with High Flow Nasal Cannula system significantly improves the outcome measures in subjects with COVID rather than earlier than subjects with Mechanical ventilation administered in group B. It is already been demonstrated that subjects with COVID have destitute with respect to oxygen consumption leading to lower SPO2 levels along with tachycardia, tachypnea.[8] Few Physiotherapy studies have stated that exercises like respiratory physiotherapy, diaphragmatic breathing, chest expansion techniques and prone lying improve the condition leading to enrichment of standard respiratory and heart rate along with SPO2.[9]

A review by Feng F et al[9] established Qigong therapy if performed by COVID subjects is efficient in COVID subjects. The therapy consists of 4 set of exercises. On parallel justification, the current study demonstrated that chest expansion exercises and diaphragmatic breathing exercises showed high significant upgrading in all the cardio-respiratory parameters with significant changes in p value post therapy. Also, the present study showed high significant improvement in subjects with COVID who are administered with High Flow Nasal Cannula. The foundation for this may be that; chest expansion exercises induces negative pressure within the lung, thus increasing air entry, within the lung and also maintaining the lung expansion within normal limits. And high flow nasal canal delivers about 60L[10] of oxygen which may add on its benefits to keep the lungs and the subjects body oxygenated. Subjects with COVID are known to infest the infection in lower lobe owing to which diaphragm undergoes weakness leading to excess use of accessory muscles. In the present study diaphragmatic breathing showed significant effect in improving all the respiratory and cardiac parameters thus suggesting diaphragmatic breathing has a significant improvement in subjects with COVID.

A study by ---- et al[11] verified that prone lying for 3 hours is effective in subjects with COVID. The stated reason for this was the therapy, induced ventral alveolar opening and thus decreasing the anatomical space dead

space and improving the air entry in the respiratory system. In the current study prone lying for 3 hours in 4 session along with other respiratory therapy was carried out twice a day showed high significant improvement in the all the parameters in Group A and the earliest recovery when compared to group B. Thus the present article depicts that Group A with subjects with High flow nasal cannula, who were delivered Structured Exercise Physiotherapy Protocol demonstrated better, high significant result and earlier improvement when compared to Group B with Mechanical ventilation and Structured Exercise Physiotherapy Protocol Prone.

In the present study, Both the groups showed definite changes in the Pre therapy. The X-ray of pre therapy in both the groups showed alveolar consolidation, ground glass appearance of the lung, crazy paving appearance and definite air space consolidation. Post therapy with Structured Exercise Physiotherapy Protocol in both the groups demonstrated clear lung fields and opacification. As the chest expansion exercises and deep breathing exercises (a part of Structured Exercise Physiotherapy Protocol) induced the alveolar expansion and improved the ventilation of the lungs within, helping in oxygenation of blood thus improving SPO2; decreased the rate of exertion and breathlessness at rest.[5]

VI. CONCLUSION:

The Structured Exercise Physiotherapy Protocol Performed by COVID fighter who are on High Flow Nasal Cannula System demonstrated, definite, highly significant and early improvement in cardiovascular and respiratory parameters demonstrating efficient enhancement in immunity, health and conditioning of the cardiovascular and respiratory system suggesting effective towards its use in future for COVID fighters. The reduction of rate of Borg's scale of dyspnea showed greater improvement in strength and capacity of lung, thus making the subjects less dependent on ventilatory support.

STRENGTHS: Both the current trend- High Flow nasal Cannula and traditional Mechanical ventilation were dealt in the study by giving Structured Exercise Physiotherapy Protocol to both the groups and checking its efficacy in combination with the oxygen support system. Cardiovascular and Respiratory parameters, along with X-ray were used as outcome measure were definitely improved in both the groups with high significance in group A, suggesting the treatment was delivered to the host tissue of the disease with good oxygen support at the beginning itself. Thus, the study showed that High Flow Nasal Cannula system inculcated in the Structured Exercise Physiotherapy Protocol demonstrated as useful for subjects with COVID which helped in quicker and more healthier improvement.

LIMITATION: CT scan was not used in the present study which would show greater changes in the lung pre and post exercises.

FUTURE SCOPE: The study can be used to inculcate the protocol for subjects diagnosed with COVID. Future study can be performed to check the changes in CT scan during High flow nasal cannula system and mechanical ventilation during Physiotherapy in order to study the therapy in detail.

CONFLICT OF INTEREST: None

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