REVIEW ARTICLE

Role of Exercise and Positioning in Acute Respiratory Complications in COVID-19 A Review

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ABSTRACT

Viral infections are major cause of respiratory diseases. The number of cases of viral infections are higher in older adults and children. The symptoms associated with viral infections are fever, coughing , sneezing, runny and stuffy nose with body aches. There is no specific unified antiviral treatment suggested for COVID-19, and no vaccine is presently available. The treatment is symptomatic, and oxygen therapy signifies the major treatment intervention for patients with severe respiratory issues due to viral infection. The prevalence of acute respiratory distress syndrome (ARDS) in patients with COVID-19 is 8.2 %. Commonly used supportive interventions are Range of Motion exercises, progressive mobilization, strengthening exercises and Passive exercise to build up balance and coordination for the better body functioning and decrease respiratory complications. The patient management algorithm is divided into three categories according to the severity for suspected cases and confirmed patients in acute care setting. The physiotherapy intervention's goals during respiratory complications is to reduce the risk associated with prolonged recumbent position and to facilitate oxygenation. Prone positioning can reduce the mortality rate in ARDS and also increases the $PaO_{2/}FiO_2$. Mobilization should be done, as cough is an aerosol generating procedure and lead to the mucus secretions and expectoration which can be secreted out using Mobilization methods . These methods improves cardiopulmonary endurance and oxygen saturation among patients having respiratory distress due to viral infections. Further, exercise program increases the resistance to upper respiratory tract infections. Before application of such methods the staff members should be properly equipped with personal protective strategies for all the suspected or confirmed cases and the droplet precautions must be executed.

Key Words: *COVID-19, Exercise ,Patient Positioning ,Protection Strategies, Viral Infections.*

Introduction

Globally, viral infections are the major cause of respiratory diseases.[1] The relatively common viruses include corona , influenza, meta pneumovirus and para influenza as well as. The number of cases of viral infections is higher in older adults and children.[2] As per WHO viral infections are considered as major public health issue. Various viral epidemics have been witnessed in the past two decades including severe acute respiratory syndrome coronavirus (SARS-Cov) and Influenza (H_1N_1).The Middle East respiratory syndrome (MERS-Cov) was first noted in 2012 in the Kingdom of Saudia.[3] Coronavirus 2 (SARS-Cov 2) appeared in 2019.[4] The novel corona virus is highly contagious and led to the current pandemic. The COVID-19 is a major viral attack emerged as outbreaks of respiratory complications.[3] The mode of transmission is from one person to another by touching hands or having contact to a contaminated surface and then touching the mouth, nose or eyes. During coughing and sneezing the infected airborne particles (aerosols) are produced which remain alive for up to three hours in the air.[5] These infected airborne particles can be inhaled by a person or might be present at the mucus membranes of eyes. The viral respiratory infections are communicable and most commonly affect the upper and lower respiratory tract. The symptoms associated with viral infections are fever, coughing or sneezing, runny or stuffy nose and the body aches.[6]

The severity of disease ranges from no symptoms to mild illness of the upper respiratory tract, while severe symptoms may lead to respiratory failure and death.[7] The common sign and symptoms related to coronavirus are fatigue fever and dry cough. A few

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numbers of patients can develop sign and symptoms such as sore throat, nasal congestion, runny nose and diarrhea. Few patients can have low grade fever, light fatigue and no occurrence of pneumonia. In severe cases of infection shortness of breath, difficulty in breathing and pneumonia can be present. Severe cases then progress to septic shock, acute respiratory distress syndrome (ARDS), metabolic acidosis and can lead to death.[8] According to WHO, globally till 19th May 2020, there have been 4,731,458 confirmed cases of COVID-19, including the 316,169 deaths.[9,10]

Viral Attacks and Respiratory Illness

Until now there is no exact unified antiviral treatment for COVID-19, and no vaccine is presently available. The treatment depends on symptoms, and oxygen therapy remains the major treatment for patients who are severely infected. Mechanical ventilation may be required in cases of respiratory failure non-compliant to O_2 therapy, although hemodynamic support is important for dealing with the septic shock.[3]

Due to COVID-19 the prevalence of acute respiratory distress syndrome in Wuhan China is 8.2 %.[11] Studies suggest that in moderate to severe ARDS , prone positioning (PP) can reduce the death rate and also increases the PaO_2/FiO_2. According to an observational cohort study during an acute respiratory distress syndrome the early administration of high flow nasal cannula (HFNC) and prone positioning can help to avoid the need of intubation. The patients with severe acute respiratory distress syndrome were not suitable for the HFNC/NIV (non-Invasive Ventilation) with prone positioning.[12] The patients remained in long term prone position treatment sessions results in decreased mortality rate in those patient.[9] The mechanism of prone positioning for improvement in ARDS patients is by improving the tidal volume, decrease of alveolar shunt, increase in end expiratory lung volume, increase in elasticity of chest wall, and affecting recruitment in dorsal lung regions.[13] However the effectiveness of prone positioning depends on accurate selection of patients and application of appropriate treatment protocol. According to a meta-analysis by Munshi et al, e prone positioning applied for at least 12 hours per day, resulted in decreased mortality in ARDS patients. [14]Another meta-analysis revealed that prone position reduces the mortality rate only in cases where patients with severe hypoxia are getting ventilation with low tidal volume, and the treatment is started in the initial 48 hours. If Prone position is administered in the initial hours, for longer period of time and for the patients with severe impaired oxygenation, it reduces mortality rate [15] Recently in an observational study Guerin et al. revealed that among the ARDS patients only 13.7% have been positioned in prone position. Even in severe ARDS patients the prone positioning was 32.9%. There were two main reasons behind the reluctance of physicians about this treatment: one was that Physicians judgment in mostly cases that hypoxemia is not severe enough to justify the usage of prone position and still suggest prone position as safe/rescue method and second was that most patients with ARDS have hemodynamic instability which prevents the decision for the use of the prone position.[16]

Physiotherapy Management

In patients with critical illness, medications and supportive role of physiotherapy techniques is to reduce the complications in such cases. These can be associated with prolonged static position, due to respiratory complications and after effects of prolonged lying in same position. The physiotherapy management includes exercises with passive Range of Motion and positioning.[17] Mobilization techniques include mobility in bed, sitting out of the bed, and balance during sitting, from sitting to stand, walking, tilt table, ergometry of upper and lower limb and other exercise programs. It is advisable to initiate the early mobilization.[15] To prescribe the exercise and mobilization program there should be proper consideration of the patient condition (stable with stable hemodynamic and respiratory function).[18]

Management Categories

The patient management is divided depending on the severity of the illness of the patient. Patients are managed with recommended classification in three management categories given by a Medical Corporation in Qatar.[28]These includes category A , for sedative or ventilated patients , while Category B includes Ventilated and minimally sedative and category C is further divided in to Category C-1, C-2 and C-3 , bed bound or less conscious patients ,active

but conscious and dependent ones ,conscious and functionally independent patients respectively (Table I and II). In ICU survivors the early exercise program increase recovery and functional status.[19] Prolonged extensive exercise results in immune suppression, whereas the moderate intensity exercises enhance immune function and minimize the severity and possibility of respiratory tract viral infections.[20]

Qin Sun and coworkers used prone position during management of Novel coronavirus for pneumonia and reported an improvement in oxygenation and pulmonary heterogeneity. [17] In a systemic review to assess the effectiveness of exercise in the occurrence, duration and severity of acute respiratory infections, the authors analyzed 14 trials of participants aged from 18 to 85 years. The key results of study showed that there is no difference between the exercise group and no exercise group while comparing the number of episodes per person of acute respiratory infections.[21] A narrative review highlighted the evidence that exercise during the lifespan increases the confrontation to upper respiratory tract infections, while the immune system is suppressed by the regular strenuous exercise. [22] A nested cross-sectional study described that after critical illness the inflammation occurs which is associated with poor physical recovery throughout the first 3 months post-intensive care unit (ICU) discharge. During the sedentary period of hospitalization the muscular adaptation and skeletal function are extra benefits of regular exercise. One systematic review of exercise-based rehabilitation trials following intensive care unit (ICU) discharge quoted lack of methodological strength through studies and observed no noticeable effect on functional capacity or health-related quality of life (HRQOL) after exercise interventions that were commenced during the post-ICU period.[23]

These studies state that there should be further trials related to respiratory complications in patients undergoing rehabilitation in intensive care units .These not only help in early rehabilitation of patients but also help the health departments to design policies. There can be specific trainings and short courses to deal with such pandemic situations.

Precautions During Respiratory Interventions

1)When interventions related to rehabilitation are indicated, plan it with team and properly arranged execution.

2) Ensure the use of minimum number of staff members to perform the activities.[18]

3) Make sure that all equipment is available and working properly in reachable range.

4) All equipment should be decontaminated.

5) If there is need of equipment to be shared between patients, properly disinfect it.[24]

6) Interventions of respiration like breathing exercises, postural drainage, and clearance of secretions techniques are basically aerosol producing techniques. That's why these interventions should be avoided.

7) Before initiating any procedure, the physiotherapist must compare the benefits with the risks. PPE (Personal protective equipment) such as N-95 mask, head covers, protective eye covers, shoe-covers, face shields and disposable gowns should be used

8) If possible the physiotherapist should follow the posterior approach while performing the mobilizations and position themselves to a distance of ≥2 m to be out of the line of cough.(standing on the foot side of table) Dyspnea may be present in the case of acute hypoxemia despite the administration of O_2 >10-12 L per minute with a reservoir mask.[25] In this case during the physiotherapy procedures the use of non-invasive ventilation (NIV) or continuous positive airways pressure (CPAP) or the high flow nasal oxygen (HFNO) can be helpful.[26]

9) Face mask should be preferred than the nasal cannula when the patient has to be mobilized. If the nasal cannula is the single option, fix it properly in the nostrils and then cover it with the surgical mask.[27]

10) When the patient is on non-invasive ventilation make sure there is no air leakage while starting the physiotherapy sessions.

11) For open mouth breath patients to facilitate the O_2 saturation a non-invasive mask can be used which is connected by a T tube to circuit.

12) For the purpose of improving the oxygenation the patient should be in sitting or semi sitting position. Lateral decubitus position's alternations,

prone or half prone positions can be helpful.

13) To minimize the muscle activity and to improve the ventilation these positions preferred to be passive.

14) The patients who are on non-mechanical ventilation must wear a face mask during the session.

15) Do not share the same equipment for different patients without sterilization. [21]

Need of Protection In Acute Phase

1)It is necessary not to perform the procedures which cause extra stress on the breathing because it can put the patient to a higher risk of the respiratory distress.[28]

2)The procedures that are fewer recommended during the acute phase of COVID-19. includes: Pursed lip breathing exercises, Diaphragmatic and deep breathing exercises.

3) Lungs re-expansion techniques such as cough machines, PEP bottle or bronchial hygiene Rib cage stretching/manual mobilizations/ respiratory training of muscles.[29]

Personal Protection Strategies

1) For droplets prevention hair covers fluid resistant shoe covers and should be used.

2) Repeated shoe cover usage is avoided because recurrent removal can increase the risk of contamination in the staff.

3) During the patient care the PPE especially face mask should not be adjusted.

4) Local guidelines should be followed about the information of laundering and wearing uniforms. Staff should be encouraged to change their uniform before leaving the work place and should be carried to home in plastic bag for the washing.

5) Before entry to the clinical areas all personal used items should be removed such as mobile phones, jewelry, watches, pens etc.

6) There should be limited use of stethoscope. If necessary usage of dedicated stethoscopes within the isolation areas can be done.

7) If the PPE items are reusable such as goggles, these items must be properly disinfected and cleaned before re-use.

8) If there is expected large amount fluid exposure an extra plastic apron should be wear.[10]

9)All the staff members should be trained properly for the wearing (donning) and removing (doffing) of the personal protective equipment. Including the N-95 mask by fit checking. A list of staff has to be maintained who has completed their personal protective equipment training and education.[30]

10) To ensure the good fitting of mask the staff

Table No I: Respiratory Status and Physiotherapy Management of COVID-19 Patients

	Status	Management Strategies
Category A	**Sedative or Paralyzed/ Ventilated Patients**	It includes patients who are critically ill and they may be in prone position.
		The patients who are on ECMO (Extra Corporeal Membrane Oxygenation).
		The physiotherapy intervention's goals on this stage are to reduce the risk associated with prolonged recumbent position and to facilitate oxygenation.
		Physiotherapy management might consist of therapeutic positioning and Passive joint ROM exercises.
		The decision of continuing the physiotherapy treatment must depend on the potential capacity of patient and further considering the risk vs. benefits comparison.
		Regarding physical therapy management there should be regular communication with the multidisciplinary team.
Category : B	**Ventilated and Minimally Sedative Patients.**	Depending on the patient's level of consciousness and level of cooperation, develop an individual treatment plan.
		The main aim of physiotherapy management at this stage is to reduce the risk of longtime recumbent position.
		To facilitate the process of oxygenation and to improve the functional independence.
		Physiotherapy management at this stage may include the Range of Motion exercises, therapeutic positioning and progressive mobilizations.
		Aerosol generating processes should be limit or minimized. Before initiating any procedure the physiotherapist should

members with beard should be motivated to shave their facial hairs. For all the suspected or confirmed cases the precautions regarding droplets must be implemented. The staff members must have to wear items including, surgical mask, long sleeve fluid resistant gowns, face shields or goggles and gloves.[31]

Table No: II Respiratory Status and Physiotherapy Management of COVID-19

Category C	**Status**	**Patients on Non-Mechanical Ventilation**	
Outcomes		Depending on the level of consciousness and functional independence the patients in this category are Further divided into three categories.	**The Overall Aims of the Interventions are :** To minimize the work load of breathing To smooth the process of oxygenation. To improve the capacity of lungs. To improve the functional capacity.
		Interventions	
Category C-1	**Less conscious , bed bound patients**	Physical therapy interventions may consist of positioning and passive range of motion exercises. Further progression of treatment and number of session depends on the rehabilitation potential of the patients. Regular basis meeting with MDT to make sure the patient's adherence to the exercise plan.	
Category C-2	**Active, Conscious and Dependent, Patients**	Interventions in this category include range of motion exercises, progressive mobilization, strengthening exercises and exercise plan to build up balance and coordination. Based on the patient's dependency of oxygen, functional independence and muscle power, an individual plan is developed. Before starting the mobilization technique, make sure the availability of all necessary equipment. Mobilization would be done as it is an aerosol generating procedure and lead to the cough and expectoration. These techniques should be performed with maximum precaution and care. Use of mobility aids should be available in the isolation area for the usage of coronavirus patients only. All the mobility aids should be kept in the room of patient, and if there is a need to be reused, the equipment should be disinfected and cleaned properly. Large equipment should be avoided as much as possible .The use of properly disinfected if being used for confirmed cases/ patients. Strictly follow the precautionary measures while performing the mobilizations.	
Category C-3	**Patients are active, conscious and functionally independent.**	Physiotherapy treatment includes breathing exercises, ROM exercises, and progressive ambulation. Develop an individual exercise plan according to the endurance of patient. Limit exposure by counseling the patient and encourage them to continue the plan independently. Regular meeting with the multidisciplinary team about the patient's performance.[32]	

Conclusion

Early ICU rehabilitation including positioning and exercises can reduce the complications associated with acute respiratory distress syndrome.

Limitation

1)This review was written about the role of exercise and positioning only, other physical therapy interventions were not included.

2)This review has discussed conservative management not the medication, which is first line symptomatic administration.

Recommendations

This review suggest that the further trials based on patient conditions and severity of respiratory complications ,should be conducted. Such trails will not only beneficial for the patients ,but also will help the practitioners ,physical therapists and respiratory therapists to work in collaboration with health care providers in such critical situations. This is responsibility of healthcare providers, research scholars, epidemiologists and health care department to play their role to fight against any outbreaks.

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