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The Effect of Chest Physiotherapy Interventions in Preventing Intubation of Covid 19 Patient with Cystic Fibrosis

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Abstract

ntroduction: Coronavirus 19 (Covid 19) was first discovered clinically in china in November 2019. Covid 19 causes lungs secondary complications such as pneumonia and in most severe cases, acute respiratory distress syndrome. During the 2009 influenza pandemic, H1N1 virus caused substantial morbidity in patients with cystic fibrosis, and in a subgroup with severe lung disease. H1N1 infection was associated with respiratory deterioration, mechanical ventilation, and even death. People with cystic fibrosis have a phenotypic spectrum ranging from excellent respiratory health to chronic airways disease with productive cough and respiratory compromise. The common known clinical features of Covid 19 such as dry cough, myalgia and fever are quite distinct from the symptoms of cystic fibrosis. Endotracheal intubation might be required when respiratory distress or airway integrity cannot be achieved or maintained for any reason.

Objectives: To highlight the effectiveness of intensive chest physiotherapy intervention in preventing intubation in Covid 19 patient with cystic fibrosis.

Methods: Chest physiotherapy was performed in postural drainage position which included active cycle of breathing three times a day. The outcome was measured by the quantity of the sputum, mode of oxygen support and arterial blood gas analysis pre and post physiotherapy procedures.

Conclusion: The chest physiotherapy aided to prevent intubation through mechanism of clearing retention of secretions in cystic fibrosis patient with Covid 19. These findings highlight the importance of intensive chest physiotherapy in preventing deterioration in respiratory systems in patients with pre-exciting chest condition and Covid 19.

Keywords: Covid 19 • Cystic Fibrosis • Postural Drainage • Endotracheal Intubation • Chest Physiotherapy • Sputum • Abgs • Oxygen

Introduction

Coronavirus 19 (Covid 19) disease was first emerged and been reported through publication from china [1]. The pandemic spreads from china to Italy and then globally, [2] causes severe burden to health systems in management of cases and avoiding death. It has been reported that Covid 19 cases with previous medical and respiratory issues have high risk of developing secondary complication or and death. Cystic fibrosis is one of the respiratory diseases in Oman and globally, hence, evaluating the impact of the virus on people with cystic fibrosis has become imperative [3]. Reports showed that by the end of March 2020 there were about ten cystic fibrosis patients infected with Covid 19 in Italy, five patients in France, seven in the U.K, five cases in Germany and three in Spain [4]. The infected cystic fibrosis cases with Covid -19 were mainly adults without apparent effect on cystic fibrosis disease severity [4]. Cystic fibrosis is a condition in which involves the exocrine mucous glands and typically affects the lungs, liver, pancreas, gastro intestinal tract, sweat glands and gastro urinary tract [3].

H1N1 virus caused substantial morbidity in patients with cystic fibrosis, and in a subgroup with severe lung disease. H1N1 infection was associated with respiratory deterioration, mechanical ventilation, and even death [5,6]. People with cystic fibrosis have a phenotypic spectrum ranging from excellent respiratory health to chronic airways disease with productive cough and respiratory compromise [5]. It has been reported that common clinical features of Covid19 are quite distinct from the symptoms of cystic fibrosis [3]. Covid-19 symptoms include dry cough, general myalgia and fever but cystic fibrosis presentations are retention of secretion, fever. Therefore, most Covid 19 in people with cystic fibrosis should be recognizable, but it is possible that mild disease might be labelled as within the normal spectrum of symptoms for that individual. A low threshold for testing is therefore needed in this population [6].

Endotracheal intubation is one of the lifesaving procedures performed when respiratory distress or airway integrity affected. Intubation may be also required if non-invasive ventilation failed in long term care via airway aids and devices [7].

The aim of this study is to demonstrate the effectiveness of chest physiotherapy intervention in preventing intubation in Covid 19 patient with cystic fibrosis condition.

Method

This is the case study report of single case treated with designed intensive physiotherapy program in Royal Hospital in Oman. The case was Covid-19 with previous history of cystic fibrosis aging 13 years. He was treated with active cycle of breathing exercises with postural drainage position. Outcome measures were taken pre-program and post program. These outcome measures were quantity of the sputum, mode of oxygen support and arterial blood gas analysis.

Case Presentation

Thirteen years old male boy with cystic fibrosis presented with past history of pancreatic insufficiency, resolving allergic bronchopulmonary aspergillosis, severe asthma and recurrent chest infection. He was on regular follow up for his condition in the hospital with medication of Ivacaftor and regular nebulizer.

He presented on 14th June 2020 with the complaints of two days' history of fever, cough, and increase breathing distress, sputum retentions and reduced oral intake. He was tested positive for Covid 19 and admitted on the same day.

On initial assessment he was afebrile, tachypnic ranging from 35 to 45/min, Tachycardia ranging from 120 to 130/min, had normal blood pressure ranging

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from 110/75 to 130/90 mmhg, oxygen saturation 90% in room air, airway patent, nasal flaring, not pale or cyanosed, GCS15/15, blood glucose 4.6, B/l crepts and reduced air entry in right side. Chest x-ray during admission (Figure 1) shows extensive bronchiectatic changes, with increased peribronchial wall thickening and secretions filling the bronchi (lower lobes). Increased patchy opacification at right upper lobe could be due to secretions in dilated bronchi or pneumonic patch. Clear costophrenic angles. Pt was medically managed with antibiotic, Tami flu, convalescent plasma therapy, and anti-coagulant.

Method

Intensive physiotherapy program included 3 sessions a day. Each physiotherapy session was done after one hour of his food intake or before food. First session after breakfast (8.30am), second session before lunch (12.30pm) and last session of the day before dinner (6.00 pm). Patient was positioned in the postural drainage position and chest percussion applied over the respective lobe. Coughing was encouraged to mobilize the secretion out of the airway end of session. Then active cycles of breathing exercises were encouraged to facilitate the clearance of remaining sputum from the airway. Separate container was used to collect sputum and discarded in the closed bin after each session. The quantities of secretion were measured subjectively by experienced physiotherapist. The vitals aware monitored before and after the physiotherapy sessions. All precautions for Covid 19 were taken during the procedure.

Result

This Covid-19 case with cystic fibrosis was treated with active cycle of breathing with postural drainage position. The outcome measure was the, arterial blood gas analysis, mode of oxygen, sputum analysis after the physiotherapy management.

Table 1 reveals that on initial day of admission pH was high until 17th June and also the mode of oxygen support started with nasal cannula was also upgraded to face mask and then to non-invasive ventilation as stated in Table 2. On 17thJune physiotherapy referral was made to prevent intubation due to accumulation of secretion. The physiotherapy intervention was started on the same day of referral as explained in the method. Large amount of secretion was obtained on the initial day of physiotherapy which cleared the airway as shown in Figure 2. Therefore, physician decided not to intubate the patients as pH becomes normal with substantial increase in the pO_2 (Table 1). As the intervention continued, it helped to reduce the mode of oxygen from non-invasive ventilation to face mask and finally on room air followed by nasal cannula. Subsequently the amount of secretions reduced further (Table 3). On the day of discharge 26thJune 2020 his vitals became normal with normal pattern of breathing on room air, spo2 95%. His airway was patent with equal air entry and has bilateral crepitation due to lung fibrosis as features of cystic fibrosis.

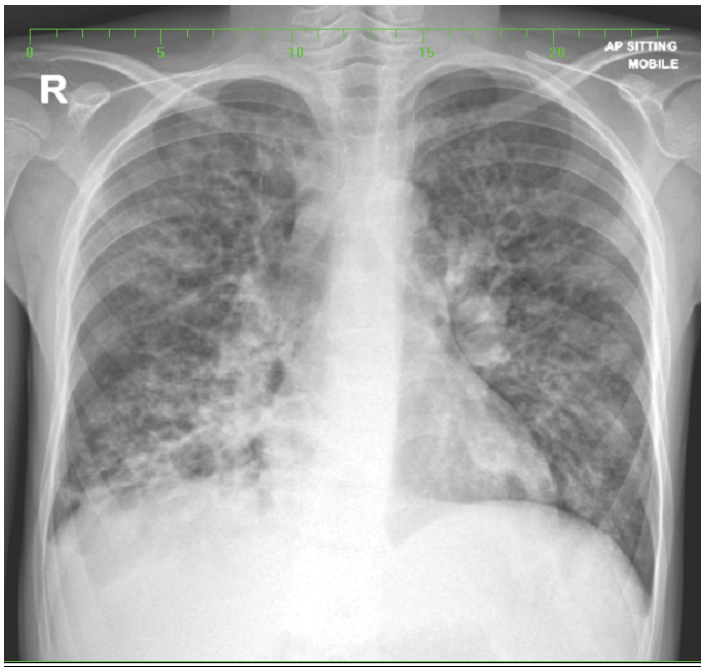

Figure 1. X ray taken on 14th June 2020 during admission shows extensive bronchiectasis which are features of cystic fibrosis, with increased per bronchial wall thickening and secretions filling the bronchi. Increased patchy opacification at right upper lobe. Clear costophrenic angles.

Table 1. It shows Arterial Blood Gas Analysis (ABGs). PH=Power of Hydrogen, pO_2=Partial pressure of oxygen, pCO_2=Partial pressure of carbon dioxide, HCO_3=Bicarbonate. The results show that when pH becomes normal the oxygen saturation in the blood elevates.

Date	pH	pO_2	pCO_2	HCO^{3-}	O_2 saturation
14/06/2020	7.50	51.1	40	30	81%
15/06/2020	7.49	49.2	44	33	80%
16/06/2020	7.50	56.2	45	31	81%
17/06/2020	7.47	69.0	44	30	88%
18/06/2020	7.44	67.1	46	45	81%
19/06/2020	7.42	52.5	45	30	85%
20/06/2020	7.45	49.7	47	31	85%
21/06/2020	7.45	59.4	44	30	84%
22/06/2020	7.42	65.8	41	33	81%
23/06/2020	7.43	62.2	42	36	83%
24/06/2020	7.44	69.8	43	38	85%
25/06/2020	7.41	70.2	42	42	86%

Table 2. It shows the level of oxygen support provided during the treatment. NC= Nasal cannula, FM = Face Mask, O_2= Oxygen, ADVM= Aerosol driven venture mask, FiO_2= Fraction of inspired oxygen. The results show that mode of oxygen support improved throughout the treatment course.

Date	Mode	Amount of O_2	Remarks	RESPIRATORY RATE / MIN
14/06/2020	NC	4 liter	Respiratory distress	35 to 40
15/06/2020	FM	5 liter	Respiratory distress increased	40 to 45
16/06/2020	NIV	FiO_2 50% PEEP 7 PC 11	Patient becomes Tachypnic and awaiting for intubation	40 to 45
17/06/2020	NIV	FiO_2 45% PEEP 5 PC 10	Physiotherapy started	40 to 45
18/06/2020	NIV	FiO_2 30% PEEP 5 PC 10	Patient improved in respiratory parameters	20 to 23
19/06/2020	ADVM	60% @ 8 liter	Reduced respiratory support	18 to 20
20/06/2020	ADVM	35% @ 8 liter		18 to 20
21/06/2020	FM	7 liter		17 to 19
22/06/2020	FM	5 liter	Patient improved in breathing pattern	17 to 18
23/06/2020	NC	4 liter		16 to 17
24/06/2020	NC	3 liter	Normal pattern of breathing	14 to 16
25/06/2020	ROOM AIR			14 to 15

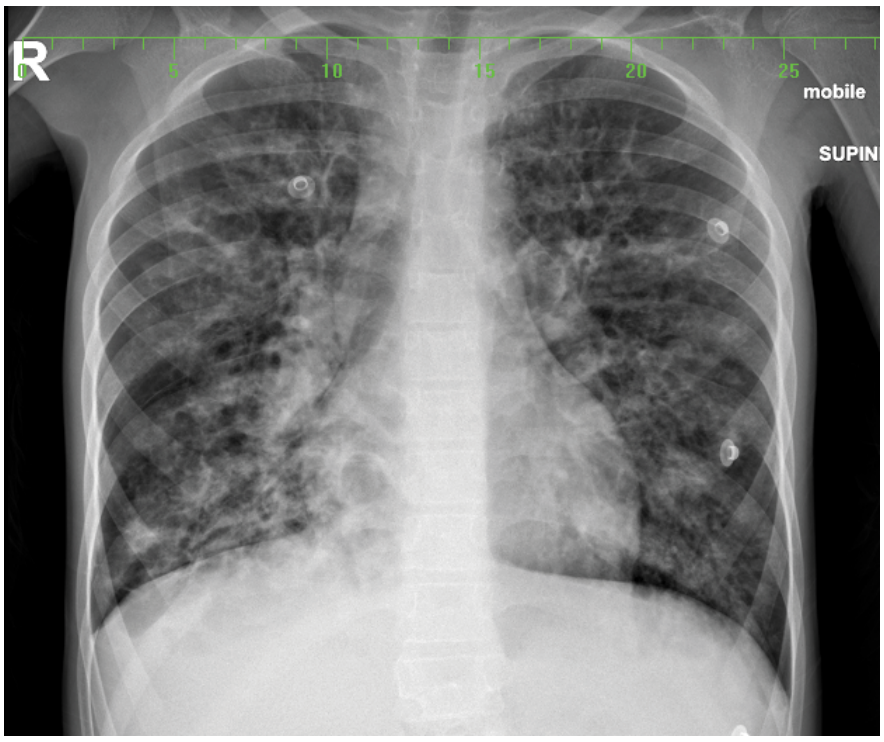

Figure 2. X ray on 17th June shows extensive bronchiectasis changes with small patchy densities bilaterally mainly at lung bases, which are features of cystic fibrosis. Clear costophrenic angles. Normal heart and mediastinum

Table 3. Indicates the amount of secretion obtained after the physiotherapy intervention. The therapy sessions reduced from three to two from 24-06-2020 as the quantity of secretion reduced from large too small.

Date	1st session	2nd session	3rd session
17/06/2020	Large	Large	Large
18/06/2020	Large	Medium	Medium
19/06/2020	Medium	Medium	Small
20/06/2020	Medium	Medium	Small
21/06/2020	Medium	Small	Small
22/06/2020	Medium	Small	Nil
23/06/2020	Medium	Small	Nil
24/06/2020	Medium	Small	No session
25/06/2020	Medium	Small	No session

Discussion

Mucociliary clearance of secretion is the primary innate protective mechanism of the respiratory tract to remove inhaled particles and microorganism from the tracheobronchial system. It depends on the interaction between ciliated columnar cells and the viscoelastic properties of bronchial secretions [8]. There are many techniques that are used for mucus clearance and bronchial hygiene but the gold standard according to World Health Organization (WHO) for the treatment of excess mucus has been postural drainage. Comparison between three airway clearance methods was done and they reported the effectiveness of postural drainage and chest percussion technique to clear the airway [9]. Chest physiotherapy implementing combined postural drainage with chest wall percussion believed to reduce the respiratory complications through promoting clearance of secretions and consequently improving the ventilation of lungs [9]. Postural drainage has been shown to improve mobilization of secretions in patients with cystic fibrosis as well as patients who produce and have difficulty clearing, large quantities of sputum [10,11]. The benefits of postural drainage appear technique-dependent, requiring sufficient drainage time (3-5 min) for each position drained. Traditionally, postural drainage has been shown to improve secretion mobilization in high mucus producing conditions such as cystic fibrosis, particularly combined with percussion, vibration and breathing techniques [10,11]. The results from this case study highlighted the importance of chest physiotherapy in such cases to improve the airway and prevent deterioration. So far, there is no study done on the role of chest physiotherapy in prevention of intubation in cystic fibrosis patients with Covid 19. In fact, some studies reveal the role of chest physiotherapy in prevention of post extubation atelectasis [12].

Conclusion

The reported case study highlighted the effectiveness of chest physiotherapy in preventing deterioration in respiratory function when the retention of secretion is cleared in cystic fibrosis patient with Covid 19. Active cycle of breathing with postural drainage reduce the risk of intubation and shorten the hospitalization. It also improves oxygenation and arterial blood gases. The findings of this case study support the need for further studies with large sample size and control group to clarify the effectiveness of chest physiotherapy.

Limitation of Study

This method is quite subjective and open to criticisms. Although our study has to be considered as exploratory hypothesis. In addition, this a physiologic study and clinical implications of our findings require in-depth analysis. Knowledge of pathophysiologic mechanisms and physiologic consequences of any intervention are fundamental for designing a study. Moreover, the multidisciplinary team interventions also have impact on the prognosis of the patient.

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