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Review Article

Lung Transplant after COVID-19 – Would There Be a Need for It in Future?

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Abstract

The coronavirus disease also known as COVID-19 was discovered at the end of 2019 following epidemic of acute respiratory syndrome in humans in Wuhan, China. It leads to lung destruction at acute stage of the disease and, possibly, progressive lung destruction from extensive inflammatory process at the ground zero which is the lung. This will eventually lead to a permanent scaring of the lungs with reduction in the oxygenation of the lungs and eventually end-stage lung disease. The use of ventilations and extracorporeal membrane oxygenation does not seem to hold the ace in guaranteeing a long-term relieve, but lung transplant for the condition may be the solution in a long-term basis.

Keywords: COVID-19, extracorporeal membrane oxygenation, end-stage, lung transplant, ventilation

Introduction

The coronavirus (CoV) disease also known as COVID-19 was discovered at the end of 2019,[1] following epidemic of acute respiratory syndrome in humans in Wuhan, China.[2] The CoVs are positive-stranded RNA viruses with a crown-like appearance as seen under an electron microscope (*coronam* is the Latin term for crown). The crown-like feature is due to the presence of spike glycoproteins on the envelope.[3] The CoVs are now the main pathogens of emerging respiratory disease outbreaks which is transmitted via aerosolized droplets,[4] which are expelled when a person with COVID-19 coughs, sneezes, or speaks. The viral replication is primarily presumed to take place in the mucosal epithelium of the upper respiratory tract (nasal cavity and pharynx) and other organs that express the angiotensin-converting enzyme 2(ACE2) receptors.[5] The initial infection may give rise to a mild viremia with few infections which if controlled at this point and the patient may remain asymptomatic. However, the infection may continue, with the proinflammatory cytokines released by stimulated macrophages in the alveoli playing a role in the pathogenesis. The lung is the ground zero of the infection because of its involvement in taking up the aerosolized droplet and its rich in the ACE2.[6] As the patient breathes, the CoVs are tracked down with further multiplication. If the immune system does not stop the process, at this initial phase, the virus then moves down to attack the lungs, where it can turn deadly. The features of the exudative and proliferative phases of diffuse alveolar disease will be capillary congestion, necrosis of pneumocytes, hyaline membrane, interstitial edema, pneumocyte hyperplasia and reactive atypia, and platelet-fibrin thrombi. Histologically, the main findings are in the lungs, including injury to the alveolar epithelial cells, hyaline membrane formation, and hyperplasia of type II pneumocytes, all components of diffuse alveolar damage.[7] The main relevant finding is the presence of platelet-fibrin thrombi in the small arterial vessels; this important observation fits into the clinical context of coagulopathy which dominates in these patients and which is one of the main targets of therapy.[8] The microvascular thrombosis in the pulmonary circulation could lead to an increased dead space and associated wedge-shaped infarcts in the lungs without the evidence of deep vein thrombosis.[1]

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Scientific Bases That May Lead to the Potential for Lung Transplant

Mechanical ventilators

Mechanical ventilator with positive end-expiratory pressure (PEEP) was applied to improve oxygenation by preventing alveolar collapse, recruit more lung units, and redistribute fluid in the alveoli since it gave the picture of a kind "acute respiratory distress syndrome" like features. However, recently, it has been reported that the use of ventilator for the management of some cases, especially with high PEEP, may not be the sine qua non and all that may be required for the management of COVID-19 patients, as finding showed that it may indeed increase lung alveolar injury and lead to more obstruction of the alveoli.[9]

Extracorporeal membrane oxygenation

Mechanical ventilator may fail in assisting the COVID-19 patient recover; because of the mechanical injury, it causes on the lung epithelial during prolonged used and the use of high PEEP,[9] the lack of the availability of enough ventilators for the teaming number of patients who may need it at a moment like this pandemic of COVID-19, and the need for time for the lungs to rest and heal. However, in a situation when the lung fails to recover, then ECMO may be used as a bridge. interestingly, the U. S. Food and Drug Administration has even issued guidance to provide a policy to assist expand the availability of ECMO treatment for COVID-19 patient in a critical state.[10] In such a critically sick COVID-19 patients with lungs filled with fluid with microvascular thrombosis, and making oxygenation difficult, ECMO will be able to provide oxygenation by passing the injured affected to provide extracorporeal circulation and physiologic gas exchange of the patient's blood. The use of ECMO in this setting can go on until a qualified lung donor is available to facilitate lung transplant.

Possibility of a chronic component of COVID-19

The inflammatory process can leave a recovered CoV patient with damaged lungs and suspected pulmonary fibrosis. The scar tissue, over time, can destroy the normal lung and make it hard for oxygen to get into the blood. Low oxygen levels (and the stiff scar tissue itself) can cause shortness of breath, particularly during physical exertion. Equally, it has been noted that in some patients, the computerized tomography imaging may show fluid or debris filled sacs in the lungs, which may get progressively worse as the illness develops.[11] Lung fibrosis cannot be cured because the scarred changes in the lung tissue do not regress. However, the progression of pulmonary fibrosis can be delayed and sometimes even stopped if detected in time.[12] Consolidation by fibroblastic proliferation with extracellular matrix and fibrin-forming clusters in airspaces is evident.[7]

Age as a factor for surviving the COVID-19

The younger age group is the group that has higher chances of surviving, and with less mortality than the elderly.[13] The implication of this is that patients can be left with damaged lungs leading to reduced lung function. Equally, it has been noted that in some patients, there may be computed tomography showing fluid- or debris-filled sacs in the lungs, which may get progressively worse as the illness develops. The lung scans of COVID-19 patients found a ground-glass opacity in both lungs of each patient.[11] They are the ones who may likely use EMCO for a longer time have on-going inflammation process with the subsequent progression on fibrosis and reduction in lung functions. This may progress to end-stage lung diseases that are suited for lung transplant.

The indications of lung transplant as a treatment

The common known indications for lung transplantation are advanced chronic obstructive pulmonary disease, interstitial lung disease, cystic fibrosis,[14] and variety of diagnoses that span to spectrum of end-stage lung disease[15] of which the COVID-19 patient lung is captured as in end-stage lung disease in acute or likely lung fibrosis subsequently. Early pulmonary fibrosis following the disease has been reported from Italy.[1] Either of these has a potential for being treated for lung transplant. The major drawback is the use of steroid posttransplant that will make patient susceptible to infection including COVID-19.

Conclusion

Since COVID-19 chances among the younger age group would leave them with the possiblity of progressive lung disease and subsequent lung fibrosis; the implication is that lung transplant may surge in no distant time as a veritable treatment option. Therefore, lung transplant may hold the potential for the treatment of patients with end-stage lung sequelae occasioned by COVID-19 disease.

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Conflicts of interest

There are no conflicts of interest.

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