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Original Review Article

A Review on the Post mortem Findings of COVID-19 patient

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Abstract

COVID-19 has swamped the entire world and created a storm in the modern medicine. It was first detected in Wuhan, China in December 2019 and was declared a pandemic by WHO in March, 2020. Over the years' multiple health concerns associated with various coronavirus strains have been identified, namely, The Middle Eastern Respiratory Syndrome (MERS), Severe Acute Respiratory Syndrome (SARS) and the COVID -19. With the ongoing pandemic of the COVID-19, the medical fraternity revolves around the conjectures of the challenges coming up. It has been a task to understand the mechanism of action of the virus or the disease pathology, due to it being a novel virus. Another major reason for less data availability is cited to be comparatively lesser autopsies. Autopsy findings may provide new insights into the pathogenesis and might potentially assist in formulating therapeutic strategies for reducing disease mortality. Complete and detailed autopsy may help to understand the tropism and extent of the disease on different organs and tissues. This article highlights the important postmortem findings and the importance of an autopsy with appropriate guidelines.

1. Introduction

Autopsies are an essential tool for better understanding of a novel disease or an unidentified cause of death.¹ However, a great reluctance to perform autopsies is observed worldwide. With the onset of the pandemic, the experts of medicine were urged to focus on the development of vaccine and other effective treatment modalities.

It was also found that the SARS- COV2 is similar to the genomic sequence, clinical manifestation and biological behavior of SARS- COV. Although it is believed that SARS-COV-2 is comparatively more

virulent. The spike surface glycoprotein, small envelope protein, matrix protein and nucleocapsid protein are the four major structural proteins present. Angiotensin converting enzyme 2 (ACE2) binds the spike proteins to the host receptors.^{2 3 4}

Despite the understanding being difficult and new findings coming up, there was a reluctance in performing autopsy at the start. Various countries started performing autopsy eventually and adapted their own methodology. As per the paper written by S. Tian et al on Pulmonary Pathology of early phase

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2019 coronavirus in two patients of lung cancer. Biopsies of living and deceased patients' lung were performed. China published their first full autopsy in a medico legal journal in February 2020.⁵ It is also seen that in countries like Germany, Italy, USA, Britain autopsies are performed in a good number. In India, non invasive autopsies are conducted for the COVID 19 patients. The in-hospital deaths undergoing COVID-19 treatment are considered as non medico legal, the suspected or latent status brought dead to hospital are considered as medico legal. Considering the high transmission rates of the virus, autopsy is considered to be a high-risk procedure. In order to save the health care workers from acquiring the infection, switching over to non invasive autopsy techniques or performing partial or no autopsy is being considered. This will also prevent the needless autopsies happening in our country.⁶

Having said that, the main reason for the reluctance worldwide to perform autopsies is the concern about getting infected from the deceased person. It is advised to follow proper protocols and sanitation measures to prevent contamination and infection. It is said that "what we do not find alive, we find in dead" and autopsy reports give us an insight of the reality.

2. Systemic autopsy findings

Following are the systemic autopsy findings as per various references:

i. Pulmonary Findings

- a) The Broncho-alveolar fluid has shown a large quantity of chemokine from the macrophages in patients with severe COVID-19.⁷
- b) The hyper inflammation in severe COVID-19 patients shared similarities with cytokine release syndrome, also leads to the hypothesis of the dysregulated activation of the mononuclear phagocyte compartment.⁸
- c) Damage to alveolar structure with minor serous and fibrin exudation and hyaline membrane formation. The findings show that the coronavirus particles in the bronchial epithelia and type 2 alveolar epithelia and immunohistochemical staining were positive for the 2019- nCov antigen and the PCR analysis was positive for 2019 - nCov nucleic acid.⁹

- d) 58% incidence of DVT of which 33% of patients had pulmonary embolism as a direct cause of death.¹⁰

ii. Cardiovascular Findings

a) Macroscopic

- Cardiomegaly with right and left ventricular dilatation.¹¹
- Pericardial Effusion- gray, red fish like.¹²

b) Microscopy

- Scattered individual cell myocyte necrosis suggestive of viral myocarditis.¹¹
- Inflammatory cells- lymphocytes and macrophages.¹²

- c) The myocardial damage from COVID-19 that led to the death of patients is about 7% and one of the contributory factors in death in 33% cases.¹³
- d) Myocarditis, Myocardial Infarction, Arrhythmias, embolism, and DIC are the main complications in patients with cardiovascular comorbidities.¹⁴
- e) SARS-CoV-2 causes acute respiratory failure and multiple organ failure until death.¹⁴

iii. Renal Findings

- a) Kidney can be damaged with marked microthrombi of the glomerulus which can be a sign of Disseminated Intravascular Coagulation.¹⁵
- b) Renal Proximal Tubular Injury was the main finding correlating with AKI. It was typically mild as compared to AKI.¹⁶
- c) In Light Microscopy RBC aggregates were found in peritubular capillaries. It is seen that direct parenchymal infection of tubular epithelial cells and podocytes with marked acute tubular injury and erythrocyte aggregation occurs in severe lethal COVID-19.¹⁷

iv. Hematological Findings

- a. Hematological dysfunction can be explained by the virus induced procoagulant and coagulopathy, virus invasion and damage of lymphocytes. This leads to predisposition of DVT and pulmonary thromboembolism.¹⁸

v. Neuropathological Findings

- a) Patients show hemorrhagic white matter lesions throughout the cerebral hemisphere with macrophages and a surrounding axonal injury.¹⁹
- b) Hemorrhagic and PRES- related brain lesions are often observed in postmortem brain MRI.²⁰
- c) SARS-CoV-2 related olfactory impairment seems to be limited to olfactory bulbs.²⁰

vi. Spleen

- a) T and B lymphocyte in the spleen decrease in varying degrees, lymphoid follicles are atrophied, the number of NK cells do not change significantly.²¹

vii. Liver

- a) Hepatic Steatosis, Portal Fibrosis, Acute Liver Necrosis.²²
b) Ductal Proliferation

viii. Pancreas

- a) Focal Pancreatitis²²
b) Degeneration of the islet cells²³

ix. Reproductive System

- a) TUNEL assay- Increased apoptotic spermatogenic cells.²³
b) Extensive Germ Cell Destruction²³
c) Thickened Basement membrane with peritubular and vascular congestion²³

x. Other Causes

- a) Adrenal cortical Hyperplasia²²
b) Epidermis- Parakeratosis, acanthosis, necrotic keratinocytes, lymphocyte satellitosis and pseudoherpetic²³
c) Extra pulmonary findings from certain comorbidities like Diabetes and Hypertension are related to septic shock, superficial perivascular dermatitis, orchitis, myositis, myocarditis, alteration in the renal glomeruli etc.¹⁹

3. Conclusion

An ocean of information is yet to be deciphered about the COVID-19 virus, which has led to complete lockdown globally. From asymptomatic forms to multi-organ dysfunction syndrome resulting in sepsis or shock, COVID-19 has a wide range of clinical symptoms. To highlight, the organs most commonly affected by COVID-19 include lung, heart, kidneys, vasculature and the central nervous system. Of these, pulmonary findings are the most significant postmortem findings.

It is of utmost importance to identify the extra pulmonary findings as well, through further research. By understanding the pathology of the virus, a better treatment plan can be decided. Although a lot of significant work is being done in various parts of the world for COVID-19 vaccine, finding the treatment is all the more important. Autopsy findings obtained from patients can provide new insights into the pathogenesis and might potentially assist in formulating therapeutic

strategies to reduce disease mortality. It is important to perform full and detailed autopsy to understand the tropism and extent of the disease on different organs and tissues.

The extent of postmortem examination varies in different studies ranging from the microbiological sampling to limited examination of organs of interest. Infrastructure, availability of biosafety conditions, protocols and attempts to minimize exposure and various other factors play an important role for the variability found in different studies. However, proper safety protocols must be followed while performing the autopsy. Our article highlights the important postmortem findings and the importance of an autopsy with appropriate guidelines.

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