

An autopsy study of two COVID-19 deaths

Dinesh Rao¹, R. Yadav², Siddiqui³, Kiran⁴

¹ Professor and HOD, Department of Forensic Medicine, The Oxford Medical College, Bangalore, India

² Professor and HOD, Department of Pathology, NDMC Medical College, New Delhi, India

³ Professor, Department of Pathology, ABVMC, Bangalore, India

⁴ Associate Professor, Department of Forensic Medicine, TOMCH, Bangalore, India

*Corresponding Author: Dr. Dinesh Rao, Professor and HOD, Department of Forensic Medicine, The Oxford Medical College, Banagalore, India Email: dineshrao22@yahoo.com

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Abstract

Objective: To Understand the Disease Process and its Outcome and report the findings and the Methods followed in two complete autopsies on individual infected with severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). **Methods:** 1. A Complete Autopsy Exploring all the Body Cavities was Performed. 2. All Adequate Measures Taken to Prevent the Spread of Infection. 3. Autopsy was conducted on the Deceased who was undergoing Treatment for (COVID-19). 4. The diagnosis of Coronavirus disease 2019 (COVID-19), was confirmed by (RT-PCR), real-time reverse transcriptase polymerase chain reaction. **Results:** In Two Cases Postmortem Swabs were Taken one case Confirmed Positive Eighteen hours after Death] for (SARAS), (Cov2), and the Other was Negative Twenty-Six hours after Death for the Virus (Case-1), The Lungs were Heavy and Hard with Isolated Hemorrhages and Marginal Hemorrhages The combined Weight of both the Lungs was (2180gms), There were Multiple Thromboembolic involving Pulmonary vessels with significant Coagulative Necrosis and Diffused Alveolar Damage and Interstitial Enlarged with Interstitial Inflammatory cells Hyaline Changes Seen at Places. Giant Cells also seen, Isolated Areas of Alveolar Spaces Filled with Proteinaceous Fluid the Lungs Showed no Significant Change in Size. Inflammatory Signs involving Liver Heart Spleen, Kidney Present. Isolated Hemorrhages in the Brain present. Thrombus also seen in Kidneys with Hyaline glomerulus Tubules with Necrosis (Case-2), showed Fibrosed Lung with (DIC), Features but significant coronary artery disease. But the Lung showed Features of Infection Microthrombi. Brain showed Lymphocytic Infiltration. **Conclusion:** a. SARS-CoV-2 Virus Present Few Hours after Death in nose, Throat & Respiratory Passages. b. Signs of Primary and Secondary Stages of Infection present in both Cases. DIC features present in both the cases but more Extensive in First Case. c. Causes of Death in was Exclusively an outcome of SARAS Cov2 Infection, whereas, in Second Case Patient Died as an outcome of Preexisting Disease process. d. The Findings have alerted the Clinicians to understand the Possibility of Pulmonary Thromboemboli and DIC in all Organs and DAD Patients with SARS-CoV-2 infections. e. This Results Highlights the Importance of Clinical Autopsies and Further Research, so as to derive a Standard Method of Clinical Management and Understand the Disease Process.

Keywords: COVID-19 Autopsy, Corona VirusCoV-2, ARDS, DAD, Thromboemboli, DIC, Hyaline.

INTRODUCTION

In India a total of (8.31million), cases reported of which (124000), deaths confirmed [1]. whereas by 31 December (2020), global death figure stood at (1 813 188), though preliminary estimates suggest the total number of global deaths attributable to the (covid-19), pandemic in (2020), is at least 3 million representing (1.2 million), more deaths than officially reported [2].

The clinical literature is widely available but this changes over the period of the pandemic because very little was known on the

pathological process of the disease hence autopsy was essential to understand the disease process.

Coronaviruses (covid), are a large family of viruses that cause illness ranging from the common cold to more severe diseases a novel coronavirus (covid), is a new strain that has not been previously identified in humans the new virus was subsequently named the (covid-19 virus), this are enveloped single-stranded (RAN), (viruses 2).

The other known members of this family of viruses are, severe acute respiratory syndrome coronavirus (SARS-covid) [3,4]. and

middle east respiratory syndrome this coronavirus (meres-covid) [5]. is known to cause acute (dad), diffuse alveolar damage hyperplasia of the pneumocytes and interstitial infection.

Individuals infected with (covid-19), have had a wide range of symptoms ranging from mild symptoms to severe illness this symptom may appear 2-14 days after exposure to the virus they usually known to report with complaints like fever or chills cough shortness of breath or difficulty breathing fatigue muscle or body aches new loss of taste or smell sore throat congestion or runny nose & diarrhea (CDC) [6]. few deteriorate rapidly to develop (ARDS), acute respiratory distress syndrome [7,8]. like symptoms.

Diffuse alveolar damage (DAD) [9,10]. is commonly associated with (ARDS), along with hyaline membrane formation in the alveoli in the acute stage and interstitial widening by edema and fibroplasia in the organizing stage.

It is also widely known that dad results by a wide variety of causative factors like oxygen toxicity drug toxicity toxic inhalants or ingest ants shock severe trauma sepsis irradiation pulmonary injury due to infection and acute exacerbations interstitial pneumonia [11–14].

Mild cases are usually asymptomatic which present with mild fever & cough, only severe cases present with (ARDS), with pneumonia [7,8].

Due to the new nature of disease and only few studies are attempted and these studies do confirm the existence of microthrombi thromboembolic phenomenon exudative diffuse alveolar damage with massive capillary congestion [15-18].

In the present study efforts are made to understand the gross and histopathological findings of organs and also understand the presence or absence of virus in the dead, from a patient who was unsuccessfully treated for (SARS-cov-2), India.

We present two (covid-19), complete autopsies of which one died due to known (covid1-9), complications and the other died as a result of an outcome of preexisting disease process despite saras (cov2), infection.

METHODS

The deceased was undergoing treatment for (covid-19), for 13 days his body was shifted to the morgue wrapped and completely covered body bag a full body autopsy exposing all the body cavities were performed besides thorough external examination of the body.

The autopsy was performed in accordance with guide-lines set forth by the incur and high-risk autopsy protocol.

The doctors' photographers & technicians where all examiners were donned in (Pep), including (n-95), masks eye protection disposable scrubs caps gowns gloves and rubber shoes or boots.

Scrubs were worn under the (Pep), after completion of the autopsy process all clothing's and disposable suits (Pep), were removed and disposed as per the regional biowaste management guidelines for infective cases the autopsy was performed in a negative pressure suctioned equipped morgue.

The autopsy examination consisted of two parts

The first part—collection of swabs and the second swab dissection of the body with gross and microscopic examination of organs.

First part-

Testing for (covid-19), was performed by swabbing at five regions of the body one swab was taken from the nose second swab from the mouth and pharynx third swab from the surface of the lungs fourth swab from the trachea and bronchi and fifth swab from the surface of the skin on the neck and face.

The swabs that were collected from the kits available and the same were inserted into the transport medium to the department of microbiology for rt-per real-time reverse transcriptase polymerase chain testing.

Second part-

Representative sections of tissue were taken and fixed in formalin as seen in Figure (03), for more than 72 hours the tissues thus obtained were processed and embedded in paraffin blocks and then sections taken and mounted on glass slides dried and then stained with he the tissues and slides will be retained in the department for future reference or scrutiny tissue was processed embedded in paraffin cut onto glass slides and stained with he in the usual fashion representative sections of tissue will be retained in formalin in our storeroom for a 1-year period after completion of the cases the slides will be retained indefinitely.

CASE 1

The deceased was a 62-year-old man with a past history of hypertension and diabetes since (08), years he was admitted to the hospital with history of fever with dry cough and throat pain in the last five days no running nose or body ache the deceased a driver by profession rarely adhered to the governments precautionary measurement to prevent the disease and had travelled to numerous places within the city on daily basis he had come into primary contact with one of his colleagues who was diagnosed with (SARS-cov-2), positive immediately after he was diagnosed positive of (SARS-cov-2), the local municipal authority dispatched the ambulance and was shifted to the oxford medical college (covid-19), center Bangalore he was treated for 13 days he had no respiratory episodes or fever until a day before his death.

During autopsy evidence of clinical intervention was found no signs of intubation found the decedent was (165cms), in length (58kgs), in weight postmortem radiography not performed rigor mortis not present limbs were flaccid postmortem staining faintly present over the dependent parts of the back.

Internal examination revealed hard and firm lungs (pic 4), the both lungs were heavy right lung weight (1,200g), left lung weight (980gms), maroon and grey colored with black anthracitic patches as seen in Figure (01), isolated areas of hemorrhages present margins sharp and hemorrhages present along the length of the margins as seen in Figure (02), we can see in Figure (01), the lungs are not edematous but firm and hard in consistency retaining its size the consistency was similar to that of liver the upper and lower respiratory tract were patent and were lined by a smooth brownish yellow slough like material with areas of hemorrhages. no mucus plugs were noted.

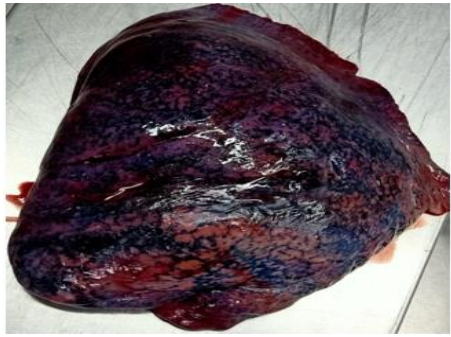


Figure 1: Left Lung Lobes

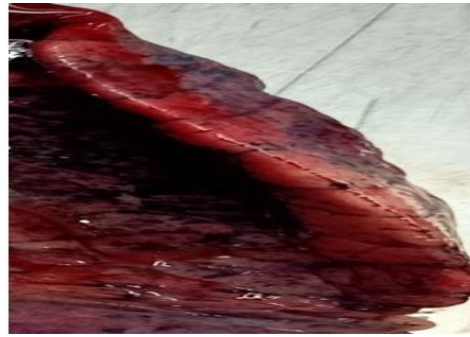


Figure 2: Marginal Hemorrhages



Figure 3: Lungs Fixed in Formal saline-Greyish Patches and Loss of Parenchymal Structure.

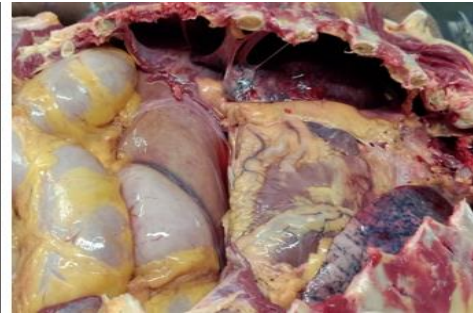


Figure 4: Exposed Thoracic Cavity exposing Lung Surface, Heart and GIT.

Nasal and throat swabs were positive for (SARS-Cov-2), whereas swabs from lung surface trachea and bronchi and skin surface of neck and face showed negative for (SARS-Cov-2), by real time –per technique department of microbiology.

Microscopic examination of the lungs revealed obliteration of alveolar spaces enlarged interstitial which can be seen in (Figure 5 & 6), with extensive inflammatory cells consisting predominantly lymphocytes and macrophages and neutrophils multiple thromboembolic can be seen in (Figure 5 & 6), in the vessels with coagulative necrosis and destruction of alveolar

Walls the lungs showed isolated areas of hyaline changes as seen in (Figure 5), areas of hemorrhages are present at places.

The bronchi and bronchioles showed signs of mild to chronic inflammation patent airways devoid of mucus eosinophils were absent immune histochemistry was not done nor electron microscopical examination was done inflammatory cells present in the liver and heart no pleural effusion present features of hypertensive disease were present along with atherosclerotic changes in the vessels.

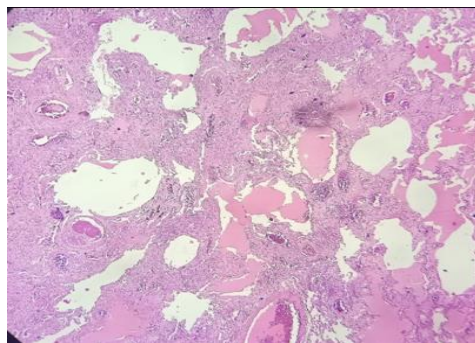


Figure 5: Microscopic Figure of Lungs showing Thrombus, Coagulation Necrosis, Alveolar Rupture, Interstitial Inflammatory Cells, Hyalin.

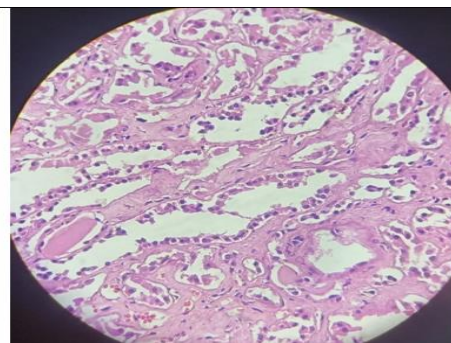


Figure 6: Microscopic Figure of Lungs showing Coagulation Necrosis, Alveolar Rupture, Interstitial Inflammatory Cells & Hyalin.

Other findings

Noted at autopsy were right pleural adhesions hypertensive heart disease with coronary artery atherosclerosis with thickening of the arteries sections from the heart showed early features of myocarditis. the liver spleen and kidney showed multiple thrombus in the vessels as seen in (Figure 7,8,9),

Necrotic renal tubules with hyalinization of tubules present the vascular changes due to diabetes and hypertension present, which can be seen in (Figure10&11), in the organs the spleen and brain changes were not specific endocrines were not examined microscopically the underlying cause of death was due to (SARAS-Cov-2), (covid-19), with ads and dad as immediate and antecedent causes respectively however

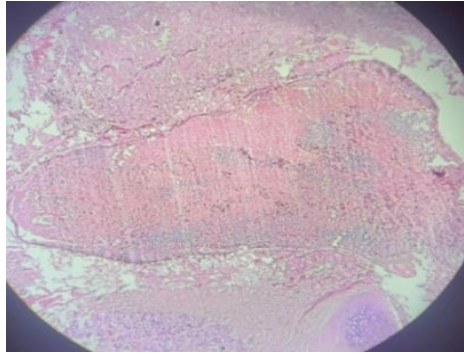


Figure 7: Microscopic Figure of Lungs, showing Large Thrombus in Pulmonary Vessel

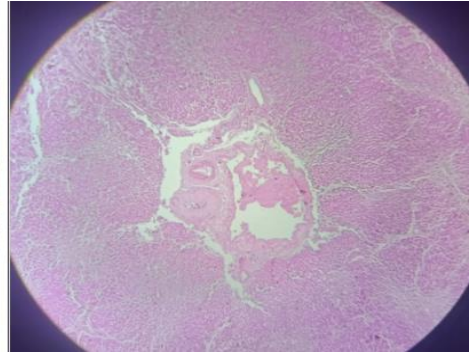


Figure 8: Thrombus in Liver

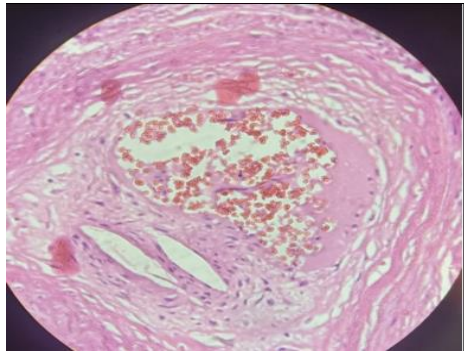


Figure 9: Thrombus in Spleen

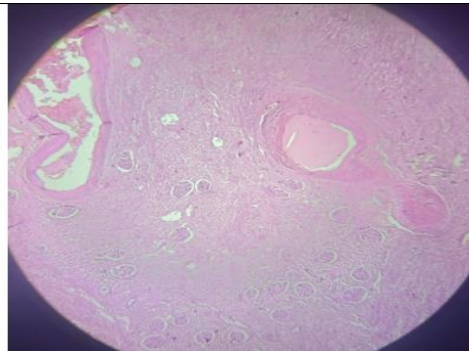


Figure 10: Thrombus in Kidney

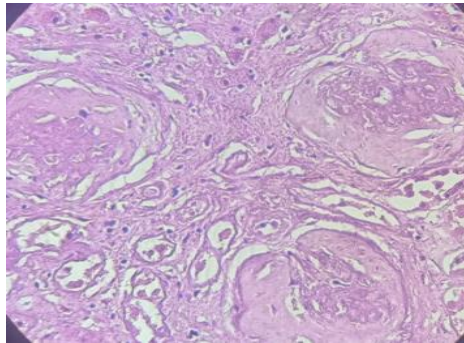


Figure 11: Complete Glomerular Sclerosis

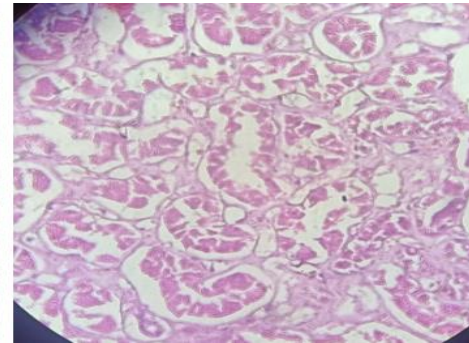


Figure 12: Necrotic Renal Tubules with Focal Segmental Sclerosis

Preexisting hypertension diabetes and coronary artery disease were the contributing factors swabs taken from the external orifices and lung surface and respiratory passages confirmed saras (Cov-2), infection eighteen hours after death by routine ripper technique.

CASE 2

The deceased was a 65-year-old female with past history of hypertension and diabetes. during his current illness she was treated for (08), days for fever and body ache and was discharged for home quarantine after she was tested positive for (SARS-Cov-2), the deceased home maker had travelled back from use few weeks back she had no other history of primary contact however there were more than (45000), cases reported in the city per day during her admission 15 days after her home quarantine she developed breathing problems and fever and she was brought back to the hospital wherein she was diagnosed (SARS-Cov-2), negative

she died six days after her admission to the hospital.

During autopsy evidence of clinical intervention was found and the same documented the deceased's length measured (161cms), weighed (69kgs), postmortem radiography not performed rigor mortis not present limbs were flaccid postmortem staining faintly present over the dependent parts of the back.

Internal examination revealed the both lungs showed moderate edema and are relatively firm in consistency right lung (510gms), and left)lungs-430gms), and are not adherent to the wall upper lobes firm than the lower lobes the surface of the left lobes lower lobes showed hemorrhages and right lobes upper and lower lobes showed hemorrhages red hepatization isolated petechial hemorrhages present over the lung surface cut section showed congestion lungs devoid of fluids on compression cut section of

left lungs showed triangle shaped hemorrhages over the lower lobes and upper lobes right lobes cut section showed hemorrhages over the lower lobes and upper lobes in the parenchyma the diaphragm showed extensive congestion.

Nasal and throat swabs and swabs from lung surface trachea and bronchi and skin surface of neck and face showed negative for (SARS-Cov-2), by real time-per technique department of microscopic.

Microscopic examination of the lungs revealed obliteration of alveolar spaces, enlarged interstitial with fibroplasias (Figure-13 & 14), and inflammatory cells and thromboembolic (Figure-15), in the vessels devoid of coagulative necrosis and there was extensive destruction of alveolar walls the lungs devoid of hyaline changes.

The bronchioles and bronchi showed signs of mild to chronic inflammation patent airways devoid of mucus eosinophils were absent immune histochemistry examination was not attempted nor electron microscopical examination was done inflammatory cells present in the liver kidney brain (Figure-13), and heart no pleural effusion present features of hypertensive disease was

present along with atherosclerotic changes in the vessels.

Other findings noted at autopsy were hypertensive heart disease with coronary artery atherosclerosis with thickening of the arteries and thrombus (Figure-14), sections from the heart showed early features of fibrosis (Figure-15), the kidney showed thrombus in the vessel's necrotic renal tubules with hyalinization of tubules present. the vascular changes due to diabetes and hypertension present the brain changes showed features of encephalitis (Figure-16), endocrines were unremarkable.

The underlying cause of death was due to saras (Cov-2), (covid-19), with (ARDS), and dad as immediate and antecedent causes with chronic ischemic heart disease respectively however preexisting hypertension diabetes and chronic nephritis were the contributing factors the manner of death was listed as natural.

Swabs taken from the external orifices and lung surface and respiratory passages were negative for saras (Cov-2), infection 26 hours after death by routine ripper technique.

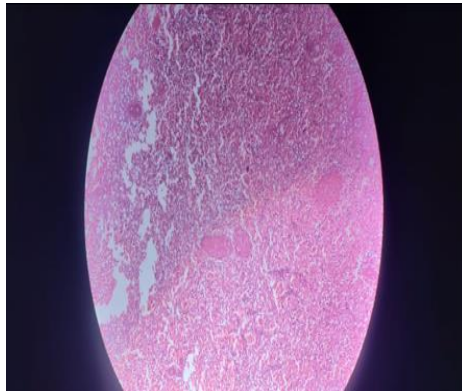


Figure 13: Penumonitis with Microthrombi

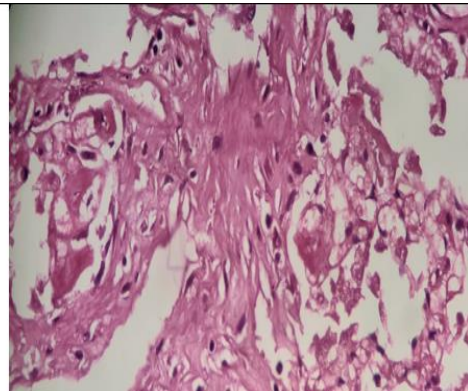


Figure 14: Fibroplasia of the Lungs

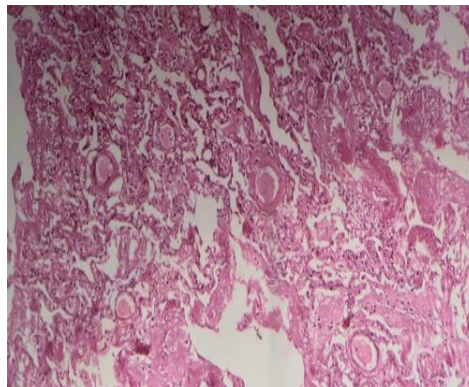


Figure 15: Micro thrombi in Lungs

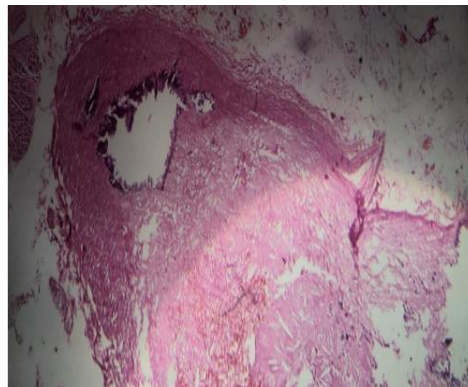


Figure 16: Coronary Artery Calcification with Thrombus

DISCUSSION

In majority of (covid-19), deaths wherein autopsy is declined or discouraged the possibility of understanding the disease process cannot be possible without the clinical autopsies in new diseases of this nature [20,21]. any misgivings will cost the precious lives of the patients hence the clinical autopsies are

very essential to evaluate the clinical management in new infections or diseases of this nature it is also highlighted the importance of understanding the disease process and the outcome of the disease process it is needless to mention the importance of exact cause of death [22] which have influence in framing the health policies and deriving preventive programmers though the author understands performing autopsy in all cases is humanely impossible due to given nature of the contagion and the limited understanding of the (sars-cov2).

A complete autopsy always provides opportunity [23,24], to understand the disease process and helps in adequate sampling besides scientific sampling of tissues to understand the existence of virus these two cases revealed different causes of death in the first case patient died due to complications of (sars-cov-2), infection whereas in the second case the immediate cause of death was an outcome of coronary artery disease though the effects of (saras-cov-2), were present.

In the first case the increased presence of thromboembolic in pulmonary vessels and other organs, ruptured alveoli (dad) [25-27], and isolated areas of hyaline membrane changes were consistent with similar such autopsy findings done elsewhere as seen in (Figure 17), but only contrast findings were the hyaline changes in our (case-1), were at places in the lung whereas in similar such studies they were extensive [21].

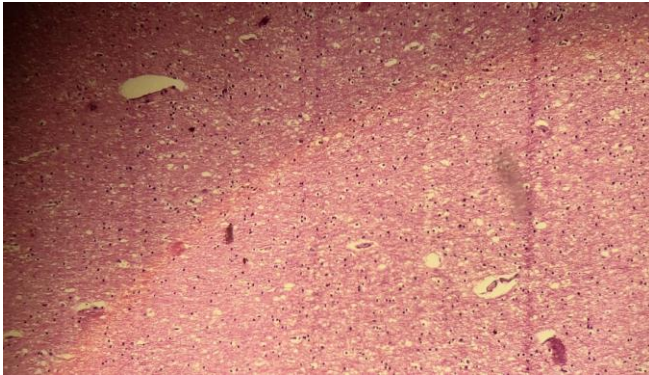


Figure 17: Encephalitis

In Second case the Lung findings did show the presence of Diffused Alveolar Damage besides the Nephrosclerosis changes and Cardiovascular findings as described but the Hyaline Changes were non-Existent However the Thromboembolic were found in the Lungs [26,27]. But the Individual Died due to Myocardial infarction due to Underlying Coronary Artery Disease.

Hence the Two (COVID-19), Autopsies Highlight the Importance of Autopsies in Understanding the Effects of (SARAS-Cov-2), Infection and the Different Causes of Death Expose the Disastrous Policy of Issuing (SARAS-Cov-2), as Cause of Death in all (COVID-19), Deaths.

Hence the Present Study on Two (COVID-19), Autopsies Highlights the Importance of Autopsy in Understanding the Actual Cause of Death and Helps the Clinical Management of Patients infected with (SARAS-Cov-2).

However, the Study also impresses upon the Fact that More such Autopsies are Required to Understand the Effects of (SARAS-Cov-2), on Healthy Individuals and Individuals with Co morbid Conditions the Author regrets the fact that due to Inadequate Facilities Immunohistochemistry and Electron Microscopical Study [28], was not done and its Importance is needless to mention in the present Study.

The Author also understands the Fact that Drawing Conclusions on Two Autopsies are Not Scientific and More such Studies to be Encouraged to Understand the Disease and its New Strains. But at the same time proud to announce that It was First Such Attempt Made in India to understand the Effects of (SARAS-Cov-2), on organs despite Administrative and Social Challenges Involved.

CONCLUSION

- (SARS-Cov-2), Virus Present Few Hours after Death in nose, Throat & Respiratory Passages.
- Signs of Primary and Secondary Stages of Infection present in both Cases DIC features present in both the cases but more Extensive in First Case.
- Causes of Death in was Exclusively an outcome of (SARAS-Cov-2), Infection whereas in Second Case Patient Died as an outcome of Preexisting Disease process.
- The Findings have alerted the Clinicians to understand the Possibility of Pulmonary Thromboembolic and (DIC), in all Organs and (DAD), Patients with (SARS-Cov-2), infections.
- This Results Highlights the Importance of Clinical Autopsies and Further Research so as to derive a Standard Method of Clinical Management and Understand the Disease Process.

Abbreviations

COVID-19: Coronavirus Disease

DAD: Diffuse Vascular Damage

DIC: Disseminated Intravascular Coagulation

SARAS-Cov-2: Severe Acute Respiratory Syndrome Corona virus 2

ARDS: Acute Respiratory Distress Syndrome

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