

International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Pathological Changes in Vital Organs in COVID -19 Positive Deceased – An Autopsy Based Study

Dr. Sharija S[1], Dr. Salini R[2]*, Dr. A Sarath Kumar[3]

[1]Professor, Department of Forensic Medicine, Government Medical College Kollam
[2]Associate Professor, Department of Forensic Medicine, Government Medical College, Thiruvannathapuram
[3]Professor, Department of Pathology, Dr.SMCSI Medical College, Karakonam

OPEN ACCESS

Corresponding Author:

Dr. Salini R
Associate Professor
Government Medical College,
Thiruvananthapuram

Received: 25-05-2026
Accepted: 12-06-2026
Available online: 30-06-2026

Copyright © *International Journal of Medical and Pharmaceutical Research*

ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). It is primarily a respiratory illness, but may involve multiple organ systems. Autopsy studies are essential for understanding organ-specific pathological changes associated with SARS-CoV-2 infection.

Objectives: To study the pathological changes occurring in the brain, heart and lungs in Covid 19 positive deceased subjected to medico-legal autopsy.

Materials and Methods: A descriptive cross-sectional autopsy-based study was conducted on 50 COVID-19–positive cases brought for medico-legal autopsy at a tertiary care centre, irrespective of the cause of death. Tissue samples from the brain, heart, and lungs were processed and stained with haematoxylin and eosin for histopathological evaluation. Data analysed using SPSS software.

Results: The age of the deceased ranged from 8 to 84 years, with male predominance (70%). Lung histopathology revealed features suggestive of acute respiratory distress syndrome in 38% of cases and pneumonia in 12%. Common pulmonary findings included vascular congestion, pulmonary oedema, hyaline membrane formation (30%), intra-alveolar haemorrhage (42%), inflammatory cell infiltration (82%), and microthrombi (14%). Cardiac examination showed coronary atherosclerosis in 18% on gross examination. Histopathology demonstrated myocardial infarction-like changes (24%), myocardial haemorrhage (8%), fibrosis (10%), myocarditis (6%), and inflammatory cell infiltrates without classical myocarditis in 16%. Brain examination showed no consistent COVID-19–specific neuropathological lesions.

Conclusion: COVID-19–positive deceased demonstrate a wide range of pathological changes involving multiple vital organs, even when death is attributable to non-COVID causes and the lungs were the most consistently affected organs.

.

Keywords: coronavirus disease 2019 (COVID-19); haemorrhage; alveolar collapse; inflammatory infiltrate.

INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) pandemic was one of the most challenging public health crises. The first case was reported in Wuhan, China, in late December 2019 and is believed to be caused by infection with the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, and it has spread to nearly 200 countries worldwide. Identification of a 2019-nCoV antigen in the lung tissue of patients by immunohistochemical analysis, detection of IgM and IgG antiviral antibodies in the serum samples from a patient at two time points to demonstrate seroconversion, and animal (monkey) experiments to provide evidence of pathogenicity, confirms the virus. SARS-CoV-2 spread primarily via respiratory droplets during close face-to-face contact. SARS-CoV-2 attacks the lungs via the ACE2 receptors, and this infection is associated with the development of pneumonia, ARDS, and multiple organ failure[2]. Infection can be spread by asymptomatic, presymptomatic, and symptomatic carriers. The average time from exposure to onset of symptoms is 5 days,

and in 97.5% of symptomatic people, the symptoms occur within 11.5 days[2]. Coronavirus disease 2019 (COVID-19) has caused significant global mortality, with reported causes of death commonly including severe respiratory failure due to diffuse alveolar damage, sepsis with multiorgan dysfunction, thromboembolic complications, and acute cardiac events[1].

Although initially regarded as a primary respiratory illness, autopsy studies have demonstrated extensive pathological involvement of multiple vital organs, including the lungs, heart, kidneys, and vascular system, highlighting the systemic nature of fatal COVID-19[3,4]. Many studies are available regarding the epidemiology and clinical features of COVID-19. There is a scarcity of literature related to pathological changes in the human body. Therefore, an autopsy-based pathological study is essential to find out organ-specific pathological changes in COVID-19-positive deceased individuals accurately. The present study was conducted to find out the pathophysiological changes occurring in the vital organs - brain, heart, and lung of COVID-19 positive cases brought for medico-legal autopsy.

MATERIAL & METHODS

A descriptive, cross-sectional study was conducted on COVID-19-positive cases brought for medicolegal autopsy at a tertiary-level centre in southern Kerala. The study period was 6 months. Nasal swabs of all dead bodies brought for medicolegal autopsy were subjected to True NAT or CBNAT and Rt- PCR test for COVID-19, and those cases having positive results of any of these tests, irrespective of cause of death, were included in the study. The study was conducted after getting Institutional Research Committee and Institutional Ethics Committee approval. Cases selected after obtaining the informed written consent from the accompanying near relative.

Sample size was calculated by using the formula $n= z\infty^{2}pq/d^{2}$
∞ = type I error 1 - ∞ = 95 % 1 – β = power (fixed at 80% level) n=3. From the study of Nunes MC. et al.[5] 'p' is the presence of alveolar collapse in lungs is 67%, and d is taken as 20% of p, the sample size was calculated as 47. We have included 50 cases during the study period through purposive sampling.

Relevant details of the deceased obtained from the police officials and the available close relatives were entered in the proforma.

Meticulous internal and external examinations were done. The height of the body was taken. Autopsy was conducted by modified Lettulle's technique. Organs examined, tissue bits were collected from various regions of the brain, heart and lungs, preserved in 10% formalin. The sections made from them were stained with Hematoxylin and Eosin and were studied in detail for various pathological changes. A total of 50 cases were taken, examination findings were recorded in the proforma, entered in Microsoft excel and analysed using Statistical Package for the Social Sciences software.

RESULTS

Distribution of age

Age of the study subjects ranged between 8 to 84 years, and the mean age of was 47.04 years (Standard deviation of mean – 16.460).

Types of cases

Among the 50 COVID 19 positive cases studied, 20 were died due to natural diseases, which included consolidation of lungs (18%), coronary artery disease (14%), generalized infection (4%), intra cranial bleeding (2%), death due to rupture of esophageal varices (2%) and opinion as to cause of death pending the reports of laboratory investigation (12%). Other causes of death included hanging (22%), death due to trauma (18%), poisoning (6%) and drowning (2%).

Brain - Gross findings

Among the 50 cases, the most frequent gross finding in the brain was vascular congestion and oedema in 19 cases.

Heart – Gross findings

In the present study, 50% of hearts were normal on gross examination. Other findings noted were Coronary atherosclerosis (18%), coronary artery thrombosis (8%), myocardial haemorrhage (8%), myocardial injury (8%), myocardial fibrosis (6%) and pale myocardium (2%).

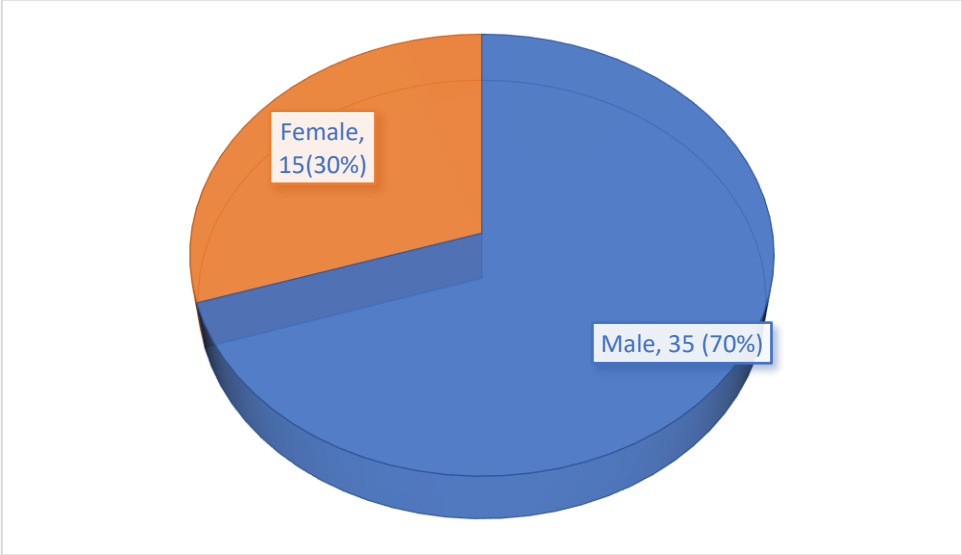
Lung – Gross findings

Vascular congestion and pulmonary oedema were observed in 23% of cases studied. In 26% of cases, there was lung consolidation, and two cases displayed gross features indicative of acute respiratory distress syndrome. Vascular congestion alone was found in 10% of cases, while the remaining cases appeared normal.

This autopsy-based study involving 50 cases found that 9 cases (18%) had no inflammatory cells. Among the cases with inflammation, eosinophils were the most common, present in 14 cases (28%), followed by lymphocytes in 10 cases (20%). Multiple types of inflammatory cells were seen in 12 cases (24%). Macrophages were predominant in 3 cases (6%), while neutrophilic infiltrates were rare, seen in only 2 cases (4%).

Tables and Figures with legends.

Chart: 1 Sex distribution among study population (N=50)



Age group in years	Number	Percentage
1 -10	1	2.0
11-20	2	4.0
21-30	7	14.0
31-40	8	16.0
41-50	10	20.0
51-60	11	22.0
61-70	9	18.0
71-80	1	2.0
81-90	1	2.0
Total	50	100.0

Table: 1 Distribution of study population according to age group (n=50)

Gross Findings in brain	Frequency	Percentage
Normal	3	6.0
Congestion	16	32.0
Pale	2	4.0
Oedema	2	4.0
Intra cranial haemorrhage	2	4.0
Injury	6	12.0
Congestion & oedema	19	38.0
Total	50	100.0

Table 2 Gross findings in brain

Histopathology findings of brain	Frequency	Percentage (%)
Nil	15	30.0
Microthrombi	1	2.0
Hemorrhage	1	2.0
Hypoxia	1	2.0
Congestion & oedema	30	60.0
Oligodendroglioma	2	4.0
Total	50	100

Table:3 Histopathological finding in brain

Histopathological diagnosis of the heart	Frequency	Percentage (%)
Nil	17	34.0
Congestion	10	20.0
Thrombus	1	2.0
Fibrosis	3	6.0
Hemorrhage	4	8.0
Features of myocardial infarction	12	24.0
Myocarditis	3	6.0
Total	50	100.0

Table: 4 Histopathological diagnoses in Heart

Histopathological Finding	Category	Frequency (n)	Percentage (%)
Myocardial fibrosis	Present	5	10.0
Inflammatory cell infiltrates	Lymphocytes	1	2.0
	Eosinophils	6	12.0
	Mixed inflammatory cells	5	10.0
Myocardial hemorrhage	Present	9	18.0
Waviness of myocardial fiber	Present	11	22.0
Myocardial oedema	Present	11	22.0
Myocardial necrosis	Present	3	6.0

Table: 5 Histopathological Findings in the Heart (n = 50)

Histopathology diagnosis in lung	Frequency	Percentage
NIL	4	8
Inflammatory cells	19	38
ARDS	19	38
Carcinoma	1	2
TB	1	2
Pneumonia	6	12
Total	50	100

Table:6 Histopathological diagnosis in lung

Histopathological finding in lungs	Present, n (%)	Absent, n (%)
Intra alveolar Hemorrhage	21 (42.0)	29 (58.0)
Septal widening	8 (16.0)	42 (84.0)
Pulmonary oedema	19 (38.0)	31 (62.0)
Hyaline membrane formation	15 (30.0)	35 (70.0)
Microthrombi	7 (14.0)	43 (86.0)
Pulmonary fibrosis	11 (22.0)	39 (78.0)
Alveolar collapse	7 (14.0)	43 (86.0)

Table: 7 Histopathological Findings in Lungs (n = 50)

DISCUSSION

The present study was conducted to describe the histopathological findings in the brain, heart, and lungs of fifty COVID-19 positive cases, irrespective of causes of death, who came for medicolegal autopsy in a tertiary care hospital in the southern part of India.

In brain, a combination of cerebral oedema and vascular congestion was present in 38% cases in the present study. Diffuse cerebral oedema was observed in approximately 17% of autopsied COVID-19 cases in pooled analyses in a study conducted by Pajo et al[6]. In a systematic histopathologic analysis of 79 COVID-19 autopsies with complete brain evaluation, cerebral congestion was observed in 11 cases (13.9%) [7] and 18% cases in a systematic review[6], compared to 32% in the present study. There was no significant pathology of the brain in 6% of cases in microscopic examination in our study.

Neuropathological examination in fatal COVID19 cases does not consistently demonstrate specific brain pathology in similar autopsy series.[8]

Heart

The major gross findings in the heart of COVID- 19 positive autopsy cases studied were coronary atherosclerosis, subendocardial haemorrhage, coronary artery thrombosis, myocardial fibrosis, and myocardial haemorrhage. Microscopic examination of the myocardium showed the presence of waviness of myocardial fibres, haemorrhage in the myocardium, oedema of myocardial fibres, inflammatory cell infiltration, and myocardial necrosis.

Gross examination of the heart revealed 18% coronary atherosclerosis. Autopsy - based histopathological studies of COVID-19 have frequently demonstrated pre-existing coronary atherosclerosis. Reported prevalence ranges from approximately 20% to over 50%, which shows the high burden of cardiovascular comorbidity among fatal cases[4,9,10]. The possibility of preexisting coronary atherosclerosis also cannot be excluded. Compared to the 6% of cases of the present study, myocardial fibrosis was observed in 80% of hearts examined in a detailed cardiac pathology report on 50 COVID-19 autopsy cases[11]. It likely represents chronic ischemic injury or pre-existing cardiac disease rather than a direct consequence of acute SARS-CoV-2 infection.

Cardiac microvascular fibrin thrombi were identified in 66% of fatal COVID-19 autopsies by a study done by Bois MC et, al[12], but in the present study, microvascular thrombus was not found in any of the cases. In 2% of cases, thrombus was noted in major coronary arteries. This disparity may be due to the inclusion of COVID - 19 positive cases with other causes of death in our study, because the severity of the infection may be less due to early period of infection.

In the present study, myocarditis was observed in 6% cases, which is like the findings of another similar study, where they found myocarditis in 4.9% cases[13]. In the present study, histopathological examination of the myocardium demonstrated lymphocytic inflammatory cell infiltrates in 16% cases, not fulfilling criteria for classical viral myocarditis. This finding is consistent with previous research indicating that true myocarditis is uncommon in COVID-19, and myocardial injury is more often secondary to systemic inflammation [9,14].

Lungs

Vascular congestion and pulmonary oedema were macroscopically as well as microscopically present in the lungs. Other gross findings were acute respiratory syndrome and consolidation. Hyaline membrane formation, alveolar haemorrhage, septal widening, pulmonary fibrosis, septal widening, alveolar collapse, microthrombi and inflammatory cell infiltrate are the other findings on histopathology of lungs. Microscopic diagnosis suggestive of ARDS was obtained in 38% of cases. Carsana **et al.**[3] reported ARDS in approximately 70–80% of cases, and Bradley **et al.**[15] observed it in nearly 75% of cases. This disparity may be due to a smaller number of fatal COVID cases in the present study. Microscopic diagnosis of pneumonia was found in 12% of cases. A study conducted by Carsana **et al.**[3] also obtained pneumonia in about 10–20% cases, closely mirroring our findings.

Severe capillary and venous congestion with alveolar oedema are consistent findings in COVID-19 lungs in most of the similar studies[3,4,16,17]. In the present COVID autopsy study, pulmonary capillary congestion was observed in 54% cases and in both Menter et al[3] and Carsana et al.'s series, it was observed in 100% cases. While Carsana et al. additionally reported interstitial/intra-alveolar oedema in 97% of lungs examined, compared to our study which had 38% of cases.

Hyaline membranes, representing the exudative phase of diffuse alveolar damage, have been reported in approximately 70–90% of fatal COVID-19 cases across multiple autopsy studies[15-18,20,21]. But in the present study, it was observed in 30% of cases. The low prevalence may be due to the inclusion of the samples of COVID-19 positive cases along with various other causes of death.

Intra-alveolar haemorrhage has been frequently reported as one of the histopathological features in fatal COVID-19, although its prevalence varies widely across studies.[3,4,15,17-19]. In a series of 71 medico-legal autopsies from India[20] and another similar study from South Africa[21] intrapulmonary haemorrhage was present in 21.1 % of subjects in comparison to our finding of 42%. This ranges from 21% to 42%, may reflect differences in study design, case selection, and timing of death relative to disease course

In the present study, widening of the alveolar septa was identified in 16 % of lungs from COVID-19–positive deceased persons. Similar interstitial involvement in the histological study comprising of 169 fatal COVID-19 cases, unclassified interstitial lesions, encompassing alterations of the alveolar septa and pulmonary parenchyma, were reported in 21 % of cases[21].

Interstitial inflammatory cell infiltrates were observed in the lungs in 82% of cases, which agrees with the findings of the study by Nunes M C et al[5] where they got in 80% of cases.

Alveolar collapse is reported in 67% cases in a study conducted by Nunes MC. Et al.[3], compared to 14% in our study. Alveolar collapse is one of the features of diffuse alveolar damage (DAD), which is seen in severe COVID - 19 lungs. The variation may be due to a smaller number of fatal COVID- 19 cases in our study

Fibrin microthrombi within alveolar capillaries and small vessels, which are present in 14% cases in the present study, compared to 6% and 35% in similar related studies[5,20]

CONCLUSION / RECOMMENDATIONS

This autopsy-based study demonstrates that COVID-19–positive deceased show a wide range of pathological changes in multiple vital organs, even when death occurred due to causes other than COVID-19. The lungs were the most consistently affected organs, with frequent findings of diffuse alveolar damage, inflammatory cell infiltration, vascular congestion, hyaline membrane, and thrombosis, indicating significant pulmonary involvement in SARS-CoV-2 infection irrespective of the immediate cause of death. Cardiac examination revealed common pre-existing conditions such as coronary artery disease; however, classical viral myocarditis was uncommon, suggesting that most cardiac changes were related to systemic inflammation, hypoxia, or underlying cardiac disease rather than direct viral injury. Brain findings were largely nonspecific. Overall, the study highlights the systemic effects of SARS-CoV-2 infection in vital organs and emphasises the value of autopsy studies in identifying organ involvement in COVID-19–positive cases, even if COVID-19 is not the primary cause of death. Inclusion of non - COVID deaths might have diluted the prevalence and severity of COVID-19–specific pathological changes. Low sample size limits the generalization of findings. Due to the absence of clinical details like, duration of illness, severity of illness, ventilatory support etc, clinicopathological correlation is not possible. There is chance of influencing the findings by the existing comorbidities, which was also not included in the study. So further broader spectrum studies are required in this field.

Ethical approval

Institutional Research committee and Institutional Ethics Committee and approval have been obtained before the commencement of the study.

Conflict of interest statement

There was no conflict of interest

Source of Funding

NIL

REFERENCES

1. Poloni TE, Moretti M, Medici V, Turturici E, Belli G, Cavriani E, et al. COVID-19 pathology in the lung, kidney, heart and brain: the different roles of T-cells, macrophages, and microthrombosis. *Cells*. 2022;11:3124.
2. Maiese A, Manetti AC, La Russa R, et al. SARS-CoV-2 and the brain: a systematic overview of neuropathological findings in COVID-19. Brain Pathol. 2021;31(6):e12907.
3. **Carsana L, Sonzogni A, Nasr A, et al.** Pulmonary post-mortem findings in a series of COVID-19 cases from northern Italy: a two-centre descriptive study. *Mod Pathol.* 2020;33(11):2136-2145.
4. **Menter T, Haslbauer JD, Nienhold R, et al.** Post-mortem examination of COVID-19 patients reveals diffuse alveolar damage with severe capillary congestion and variegated findings. *Histopathology.* 2020;77(2):198-209.
5. **Nunes MC, Hale MJ, Mahtab S, Mabena FC, Buys A, Yende-Zuma N, et al.** Clinical characteristics and histopathology of COVID-19 related deaths in South African adults. **PLoS One.** 2022;17(1).
6. Pajo AT, Espiritu AI, Apor AP, et al. Neuropathologic findings in patients with COVID-19: a systematic review. Neurol Sci. 2021;42(4):1255-1266.
7. Gheban-Roșca IA, et al. A histopathological analysis of extrapulmonary lesions in fatal coronavirus disease (COVID-19). *Pathology- Research and Practice*. 2024 ;263:1-8. numbers].
8. Bryce C, Grimes Z, Pujadas E, Ahuja S, Beasley MB, Albrecht R, et al. Pathophysiology of SARS-CoV-2: the Mount Sinai COVID-19 autopsy experience. *Mod Pathol*. 2021;34(8):1456-67.
9. Basso C, Leone O, Rizzo S, De Gaspari M, van der Wal AC, Aubry MC, et al. Pathological features of COVID-19–associated myocardial injury: a multicentre cardiovascular pathology study. **Eur Heart J**. 2020;41(39):3827-35.
10. Ferrer-Gómez A, Pian-Soler J, Esteban-Giner MJ, et al. Cardiac pathology in patients with COVID-19: a histopathological study of 30 autopsy cases. Rev Esp Cardiol (Engl Ed). 2021;74(10):842-850.
11. Almamlouk R, et al. COVID-19-Associated cardiac pathology at the postmortem evaluation: a collaborative systematic review. Clin Microbiol Infect. 2022;28(8):1066–1075.
12. Bois MC, Boire NA, Layman AJ, Aubry MC, Alexander MP, Roden AC, et al. COVID-19–associated nonocclusive fibrin microthrombi in the heart. **Circulation**. 2021;143(3):230-43.
13. Lindner D, Fitzek A, Bräuninger H, Aleshcheva G, Edler C, Meissner K, et al. Association of cardiac infection with SARS-CoV-2 in confirmed COVID-19 autopsy cases. JAMA Cardiol. 2020;5(11):1281-1285. doi:10.1001/jamacardio.2020.3551.

14. Halushka MK, Vander Heide RS. Myocarditis is rare in COVID-19 autopsies: cardiovascular findings across 277 postmortem examinations. **Cardiovasc Pathol**. 2021;50:107300.
15. Bradley BT, Maioli H, Johnston R, et al. Histopathology and ultrastructural findings of fatal COVID-19 infections in Washington State: a case series. Lancet. 2020;396(10247):320-332.
16. Fox SE, Lameira FS, Rinker EB, Vander Heide RS. Cardiac endotheliitis and multisystem inflammatory syndrome after COVID-19. **Ann Intern Med**. 2020;173(12):1025-7.
17. **Schaller T, Hirschbühl K, Burkhardt K, et al.** Postmortem examination of patients with COVID-19. *JAMA.* 2020;323(24):2518-2520.
18. **Tian S, Hu W, Niu L, Liu H, Xu H, Xiao SY.** Pulmonary pathology of early-phase 2019 novel coronavirus (COVID-19) pneumonia in two patients with lung cancer. *J Thorac Oncol.* 2020;15(5):700-704.
19. Xu Z, Shi L, Wang Y, et al. Pathological findings of COVID-19 associated with acute respiratory distress syndrome. Lancet Respir Med. 2020;8(4):420-422.
20. **Vijayan MS, Mohan B, Prasad VK, Sheeju PA.** Histopathological study of lung changes in COVID-19 cases: Autopsy study. *J Forensic Med Toxicol.* 2025;42(1):55-59.
21. **Morin J, Sagan C, Pere M, Chelha R, et al.** Post-mortem lung biopsies in fatal COVID-19 acute respiratory distress syndrome: a prospective cohort study of 169 patients (HISTOCOVID). *Ann Intensive Care.* 2025;15:80.