

# Autopsy in the time of COVID

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## Abstract

Whilst much literature has been published since the start of the COVID-19 pandemic, there remains limited knowledge of the autopsy findings following death from SARS-CoV-2 infection. The practicalities of triaging and examining bodies with suspected COVID-19 are complex and the need for full post-mortem must be balanced with the potential risks to mortuary staff. This brief case report describes the features of a COVID-19 autopsy performed at the start of the first phase of the pandemic and highlights some important learning points for trainees engaged in autopsy practice.

**Keywords** autopsy; COVID-19; diffuse alveolar damage

## Case report

A female patient in her early 60s was referred for a post mortem via the coronial system. She had no significant past medical history and had been unwell for a week prior to death with complaints of dizziness and palpitations, diarrhoea and poor oral intake as well as a persistent cough. On assessment by paramedics, the patient was found to be tachycardic and hypotensive. Supportive measures were initiated but the patient collapsed with pulseless ventricular tachycardia (VT) recorded at the scene. Despite prolonged resuscitation attempts, sustained return of circulation was never achieved and death was confirmed in the emergency department. Due to the ongoing coronavirus pandemic, a nose and throat swab was taken on arrival in A&E - this was negative for COVID-19 on RT-PCR testing.

Relevant post mortem findings are outlined below; unless otherwise stated, all other findings were unremarkable.

External examination:

- Features of resuscitation: endotracheal tube and peripheral venous cannulae

Cardiovascular system:

- Heart weight 328g, cut sections showed mottled myocardium but no definite ischaemia or fibrosis
- Moderate atheroma (70% stenosis) of the left anterior descending artery, rest within normal limits
- Mild atheroma of the aorta

Respiratory system:

- Bilateral small (<50 mls) serous effusions with no adhesions
- Both lungs were heavy, red and congested (left 780g and right 660g) and were filled with turbid fluid. There was also fluid present in the trachea and main bronchi

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- No evidence of emphysema, pulmonary embolus or neoplasia
- Genitourinary system:
- Normal appearance of kidneys and pelvic organs
- Musculoskeletal system:
- Multiple anterior rib fractures (left-sided ribs 3, 4, 5 and right-sided ribs 4 and 5) consistent with attempts at resuscitation

Histological samples from the heart and lungs were retained to determine the cause of death and microbiology swabs were taken from the lower respiratory tract. Samples of lung tissue were also retained for testing for respiratory viruses.

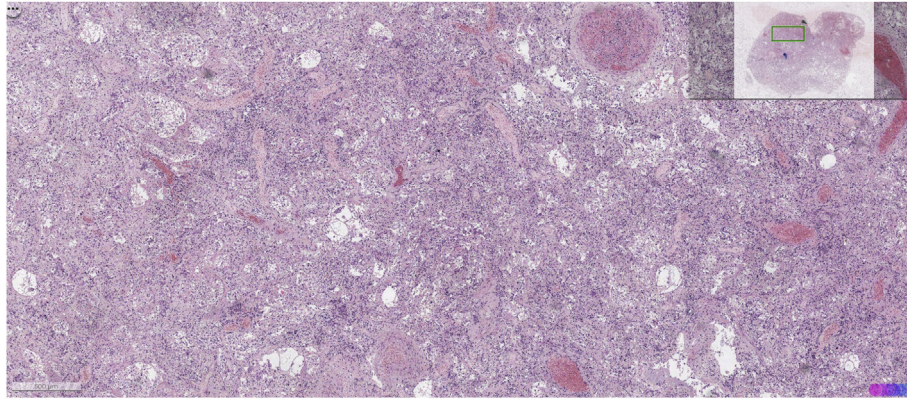
Representative sections from the heart were normal with no evidence of acute myocarditis or myocyte necrosis. There was no myocyte disarray or significant fibrosis. Lung histology (shown in Figures 1–3) showed widespread diffuse alveolar damage (DAD) consistent with a clinical acute respiratory distress syndrome (ARDS). Pulmonary oedema, hyaline membrane formation and lymphocyte infiltration were seen along with foci of desquamated pneumocytes. These cells showed marked reactive atypia with hyperchromasia and prominent nucleoli. Martius scarlet blue (MSB) stain highlighted the presence of fibrin thrombi in small and medium sized arteries.

Microbiology culture revealed growth of *Proteus vulgaris* and *Escherichia coli*, of uncertain significance. Viral RT-PCR testing of the bronchoalveolar fluid swab detected the presence of the SARS-CoV-2 RdRP gene consistent with COVID-19 infection and this was subsequently given as the underlying cause of death (part 1(a)) with coronary artery disease listed as a contributing condition (part 2). Rapid communication of this result was facilitated by the Coroner's Office, ensuring that the deceased's family and close contacts were able to isolate as appropriate.

## Discussion

Since the beginning of the global COVID-19 pandemic, much has been written about the clinical features, the pathological findings and the limits of testing for this novel disease. This literature will not be repeated here, other than to point the reader to the work of Dr Youd and colleagues, who have published excellent papers describing the autopsy findings in COVID-19<sup>1</sup> and who provided early guidance around the practicalities of performing autopsy in suspected COVID-19 cases.<sup>2</sup>

Trainees should be aware of the concept of "pre-test" probability (from Bayes' theorem<sup>3</sup>) which pertains to the likelihood of an event or outcome based on demographic, prognostic and

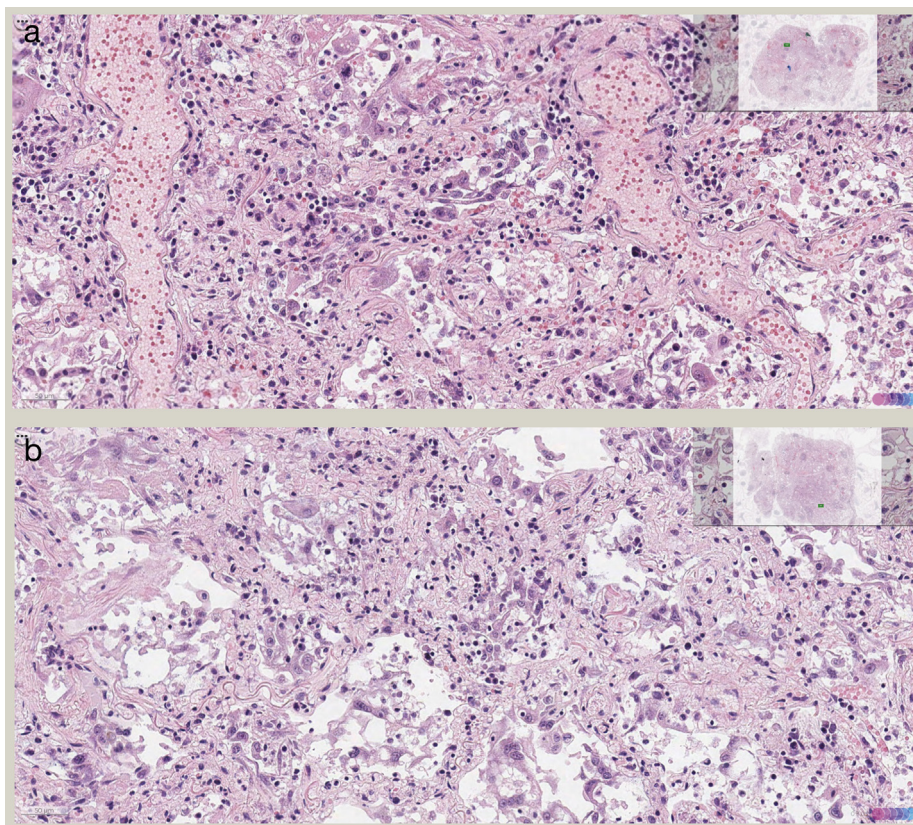


**Figure 1** Histology of congested lung showing hyaline membranes and diffuse inflammation.

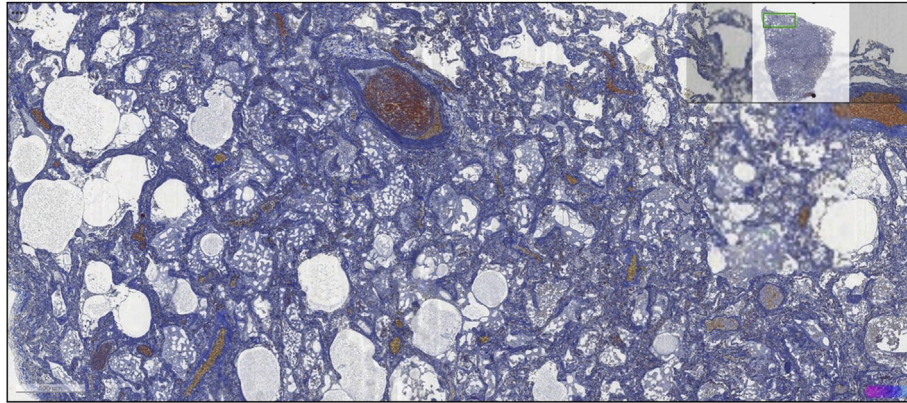
clinical factors prior to diagnostic testing. In this case; the context of a global pandemic, high local case numbers, and appropriate symptoms (persistent cough and signs of sepsis) meant that the threshold for suspecting COVID-19 infection was low and the likelihood that the initial swab represented a "false negative" was high. The post mortem was therefore performed as a high risk examination (with full personal protective equipment (PPE)) by a senior trainee with consultant supervision and all mortuary factors were optimized for safety.<sup>4</sup>

As a result of this case, and a review of the literature and guidance at the time, we changed our practice locally to perform

a "mini-thoracotomy" to gain access to the chest cavity in suspected COVID-19 cases. Lower respiratory tract swabs can then be taken for viral RT-PCR testing, enabling a diagnosis to be made, whilst limiting exposure to the pathologist and mortuary staff. A similar protocol is outlined by Seetulsingh and colleagues,<sup>5</sup> and anecdotal reports suggest that such "two-stage" (i.e. if the mini-thoracotomy isn't diagnostic, then the pathologist proceeds to a full post mortem examination) autopsies have been widely adopted in the UK. Obviously in coronial cases, the post mortem is being undertaken as a legal requirement to identify the cause of death and a full autopsy must be performed where



**Figure 2** Histology of congested lung highlighting the desquamated pneumocytes displaying marked pleomorphism and reactive atypia.



**Figure 3** MSB stain reveals presence of hyaline thrombi within vessels.

### Intra and extra-pulmonary causes of diffuse alveolar damage

Pulmonary	Extra-pulmonary
Infection	Sepsis
- Bacterial	Trauma
- Viral	Burns
- Fungal	Drugs (e.g. chemotherapy agents, methotrexate, amiodarone and others)
Aspiration	Acute pancreatitis
Emboli (Fat/amniotic fluid/foreign body)	Transfusion related acute lung injury (TRALI)
Inhalation of toxic substances	Autoimmune conditions (including SLE, RA, PAN)
Near drowning	

**Table 1**

alternative or equally likely causes of death are present or suspected.

Finally, trainees should be aware of the many and varied causes of DAD, not least because of its recurring presence in the Certificate of Higher Autopsy Training (CHAT) exam! Diffuse alveolar damage can be caused by both pulmonary and extra-pulmonary insults (summarized in [Table 1](#)) giving rise to acute and progressive respiratory failure clinically. Histologically the lung will show inflammation, intra-alveolar oedema and haemorrhage with hyaline membrane formation at the site of alveolar epithelial damage.<sup>6</sup> The finding in our case of pneumocyte desquamation is similar to that reported in early COVID-19 cases from China<sup>7</sup> but in concordance with this and other literature, we did not see the presence of definite viral inclusions.

### Conclusion

In this brief report we present the pulmonary findings of COVID-19 seen in the lungs of a patient who came to post mortem through the coronial system. We highlight the need for autopsy pathologists to have a high index of suspicion for the presence of COVID-19 in the current climate, and emphasise the need to evaluate swab results in the context of the clinical history, accepting that this may be limited in some cases. Finally we

outline some of the causes of diffuse alveolar damage which may need to be evaluated at autopsy and point the reader in the direction of references to supplement their knowledge of this important entity. ◆

### Practice points

- SARS-CoV-2 has been categorized as a hazard group grade 3 (HG3) pathogen; appropriate health and safety considerations should be taken before performing autopsies in suspected cases of COVID-19.
- Diffuse alveolar damage is the pathological correlation of acute respiratory distress syndrome and trainees should be familiar with both the pathogenesis and aetiology of this entity.
- Autopsy pathology provides important information in the understanding of new diseases and can help inform patient care and clinical management.

### REFERENCES

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**Multiple-choice questions**

**1. Which of these are *not* HG3 pathogens?**

- A. Hepatitis A virus
- B. Hepatitis C virus
- C. MERS-CoV
- D. SARS-CoV-2

Answer: A. Hepatitis A virus

**2. Which of these would be the correct PPE for a suspected COVID-19 case?**

- A. Gown, gloves, surgical mask, eye protection
- B. Gown, gloves, apron, FFP-3 mask, visor

- C. Gown, gloves, apron, surgical mask, visor
- D. Gown, gloves, apron, FFP-3 mask, eye protection

Answer: B. Gown, gloves, apron, FFP-3 mask, visor

**3. Increased mortality in COVID-19 infection is associated with which of the following pre-existing conditions?**

- A. Diabetes mellitus
- B. Ischaemic heart disease
- C. Obesity
- D. All of the above

Answer: D. All of the above