A 63-year-old man with hypoxemia and shock after initial recovery from COVID-19 pneumonia

Sahajal Dhooria1*, Amanjit Bal2*, Mandeep Garg3, Sanjay Jain4, Mini P Singh5, Inderpal Singh Sehgal1, Ritesh Agarwal1, Ashutosh Nath Aggarwal1

1Department of Pulmonary Medicine, Postgraduate Institute of Medical Education and Research, Chandigarh, India, 2Department of Histopathology, Postgraduate Institute of Medical Education and Research, Chandigarh, India, 3Department of Radiodiagnosis and Imaging, Postgraduate Institute of Medical Education and Research, Chandigarh, India, 4Department of Internal Medicine, Postgraduate Institute of Medical Education and Research, Chandigarh, India, 5Department of Virology, Postgraduate Institute of Medical Education and Research, Chandigarh, India

*These authors have contributed equally to this work.

ABSTRACT

A 63-year-old man presented with fever and breathlessness during the coronavirus disease 2019 (COVID-19) pandemic. He was diagnosed to have severe COVID-19 pneumonia. He was treated with oxygen, non-invasive ventilation, and glucocorticoids. He improved over 5 weeks and was shifted out of the intensive care unit. Subsequently, he experienced worsening during hospitalization with refractory hypoxemia and shock and finally succumbed to his illness. An autopsy was performed. Herein, we have presented a clinical discussion on the possible causes of the patient’s fatal outcome followed by the autopsy findings.

KEY WORDS: Acute respiratory distress syndrome, cytomegalovirus, myocarditis, pulmonary embolism, severe acute respiratory syndrome coronavirus 2, spleen

CASE PRESENTATION

Sahajal Dhooria

A 63-year-old man presented with fever and breathlessness during the coronavirus disease 2019 (COVID-19) pandemic. He had an intermittent, low-grade fever for a week. Dry cough and breathlessness appeared 3 days later. A nasopharyngeal swab was positive for the severe acute respiratory syndrome coronavirus 2 (SARS CoV-2) by real-time reverse transcriptase polymerase chain reaction (rRT-PCR). He was admitted to another facility where he was found to have tachypnea and hypoxemia at the time of admission. He was administered high-flow nasal oxygen (HFNO) and intermittent non-invasive ventilation (NIV). He received oral doxycycline and ivermectin, and intravenous ceftriaxone, imipenem, remdesivir, and dexamethasone. His respiratory status did not improve, and he was referred to us 3 weeks into his illness. He tested negative for SARS-CoV-2 by rRT-PCR 3 days before coming to our hospital.

At presentation, he had a heart rate of 100 beats/min, respiratory rate 35 breathes/minute, and blood pressure of 120/84 mm Hg. Pulse oximetry revealed an oxygen saturation of 92% (on high-flow oxygen administration...
via a reservoir mask). He had no pallor, cyanosis, icterus, clubbing, or peripheral lymphadenopathy. There was mild pitting pedal edema, and the jugular venous pressure was not raised. Chest auscultation revealed bilateral crackles. Other systemic examination was unremarkable. He was recently diagnosed to have diabetes mellitus but had no other comorbid illness. He did not smoke tobacco or consume alcohol or psychotropic drugs.

The patient was admitted to the respiratory intensive care unit (RICU). The ratio of arterial partial pressure of oxygen (PaO₂) to the fraction of inspired oxygen (FiO₂) ratio was 95 [Table 1]. He had leukocytosis with a neutrophil-to-lymphocyte ratio of 94:4. The electrocardiogram showed left axis deviation with left anterior hemiblock. His creatine kinase (CK)-MB level was normal. A bedside echocardiogram showed a left ventricular ejection fraction (LVEF) of 40%–45%; the right atrium and ventricle were not dilated, and there was no pericardial effusion. We initiated him on NIV (initial FiO₂, 0.70). We administered him intravenous methylprednisolone (60 mg/day), ranitidine, and prophylaxis for deep venous thrombosis with unfractionated heparin. The patient improved over the ensuing 11 days and was switched from NIV to HFNO, then to oxygen by Venturi mask, and finally to nasal prongs. Methylprednisolone was tapered during the RICU stay and then stopped. The patient was shifted to the ward 15 days after his admission.

After a day in the ward, the patient developed tachycardia (heart rate, 120–160 bpm), tachypnea, progressively worsening hypoxemia, and drowsiness. He did not have any chest pain or hemoptysis. He had significant hyponatremia (serum sodium, 116 mEq/L). The electrocardiogram did not show any new changes. The serum troponin I level at about 12 h of symptom onset was not raised (<0.05 ng/mL). Bedside cardiac ultrasound performed by the intensivist revealed normal-sized right heart chambers, and an estimated LVEF of 30%–35%, with

| Table 1: Laboratory parameters of the patient |
|---------------------------------------------|
| Parameter | Before coming to our hospital | At admission | During hospital stay | On the day of demise |
|----------------------|-----------------------------|-------------|---------------------|---------------------|
| Hemoglobin (g/dL) | 12.6 | 13.4 | 13.4 | 12.4 |
| Total leucocyte count (cells/mm³) | 14,000 | 16,900 | 13,900 | 17,100 |
| Platelet count (cells/mm³) | 189,000 | 226,000 | 244,000 | 228,000 |
| Glucose range (mg/dL) | 200-280 | 180-220 | 155-273 |
| Urea (mg/dL) | 40 | 47 | 43 | 39 |
| Creatinine (mg/dL) | 0.6 | 0.7 | 0.6 | 0.9 |
| Sodium (mEq/L) | 135 | 135 | 132 | 123 |
| Potassium (mEq/L) | 4.7 | 5.1 | 3.9 | 4.6 |
| Chloride (mEq/L) | 97 | 95 | 95 | 80 |
| Calcium (mg/dL) | 8.3 | 8.2 | 7.6 | 7.6 |
| Phosphate (mg/dL) | 4.1 | 2.8 | 4.3 | 4.3 |
| Bilirubin (mg/dL) | 0.7 | 0.7 | 0.6 | 0.4 |
| Aspartate transaminase (U/L) | 22 | 22 | 23 | 36 |
| Alanine transaminase (U/L) | 39 | 42 | 67 | 35 |
| Alkaline phosphate (U/L) | 76 | 82 | 98 | 110 |
| Total protein (g/dL) | 5.6 | 6.4 | 6.0 | 6.0 |
| Albumin (g/dL) | 2.8 | 3.3 | 3.2 | 3.2 |
| Magnesium (mg/dL) | 2.37 | 2.12 | 2.44 | 2.44 |
| Glycated hemoglobin | 9.2% | 9.2% | 9.2% | 9.2% |
| Parathormone pg/mL | | | | |
| 25-hydroxy vitamin D (ng/mL) | | | | |
| Lactate dehydrogenase (U/L) | | | | |
| D-dimer (ng/mL) | 10 | | | |
| Ferritin (ng/mL) | 809 | 1005 | | |
| Creatine kinase-MB (U/mL) | 18.7 | | | |
| Myoglobin (ng/mL) | | | | |
| Troponin I (ng/mL) | | | | |
| High sensitivity Troponin T (pg/mL) | 351.3 | | | |
| BNP (pg/mL) | 38.8 | | | |
| N-terminal pro BNP (pg/mL) | 16,452 | | | |
| Galactomannan index | 0.19 | | | |
| Beta-D-glucan (pg/mL) | 13 | | | |
| Arterial blood parameters | | | | |
| pH | 7.465 | 7.480 | 7.309 | |
| pO₂ | 66.7 | 48.9 | 82.1 | |
| pCO₂ | 35.2 | 30.1 | 43.3 | |
| HCO₃⁻ | 24.8 | 21.9 | 21.3 | |
| Sat | 94.4 | 87.8 | 95.1 | |
| FiO₂ | 0.70 | 0.40 | 0.90 | 0.90 |
| Lactate | 1.13 | 1.03 | 1.27 | 1.27 |

*At about 12 h and 24 h of the worsening. BNP: Brain natriuretic peptide, FiO₂: Fraction of inspired oxygen, HCO₃⁻: Bicarboate, pCO₂: Arterial partial pressure of carbon diaoxide, pO₂: Arterial partial pressure of oxygen, SpO₂: oxygen saturation
no apparent regional wall motion abnormality. The study was suboptimal due to tachycardia (heart rate, 130 beats/min). The lung ultrasound showed sliding lung sign with the presence of A and B lines. Chest radiograph did not show any new-onset lung opacity or pneumothorax [Figure 1e]. The patient was shifted back to the RICU and started on invasive mechanical ventilation (initial static compliance, 14.5 mL/cmH₂O). His oxygenation did not improve on increasing the positive end-expiratory pressure (PEEP) above 5 cm H₂O. He was administered intravenous colistin, subcutaneous enoxaparin (twice daily), pantoprazole, and fludrocortisone. He developed upper gastrointestinal bleeding. Gastric lavage was performed, pantoprazole infusion was started, and enoxaparin was stopped. After 12 h, he developed shock with cold peripheries and reduced urine output. The central venous pressure was 6 cmH₂O. We administered intravenous fluids, and vasopressors (noradrenaline and vasopressin). Urine output was reduced despite adequate fluid resuscitation but improved after administering furosemide. After about a day of the worsening, the myoglobin (414 ng/mL), high-sensitivity troponin T (351.3 pg/mL), CK-MB (60.7 U/mL), and pro-BNP levels (16452 pg/mL) were elevated in the serum. Compression ultrasound of the lower limbs did not reveal any deep venous thrombosis. We decided against a computed tomography (CT) pulmonary angiography for the patient, as we considered it risky to shift him to the radiology department due to his high ventilatory requirements and worsening shock.

The hypoxemia and shock worsened progressively over a day. The patient also had a high fever (axillary temperature, 41°C). There were no significant tracheal secretions, abdominal distension, or pyuria. The blood gas analysis showed a PaO₂ of 82 mm Hg (FiO₂, 0.9; PEEP, 5 cmH₂O), normal partial pressure of carbon dioxide, and a normal arterial lactate level. We initiated him on intravenous hydrocortisone for suspected refractory septic shock. He required progressively higher doses of vasopressors. He had a cardiac arrest on day 40 of the start of his illness. The smears and cultures of tracheal aspirate and blood did not reveal any bacteria or fungi.

The treating team’s final diagnosis was refractory septic shock due to hospital-acquired pneumonia (differential diagnosis of pulmonary embolism [PE]), acute respiratory distress syndrome due to COVID-19, with underlying diabetes mellitus.

Sanjay Jain
I invite Dr. Mandeep Garg, Professor of Radiology, to discuss the radiologic findings in this patient.

Mandeep Garg
The chest radiograph and thin-section CT chest at this admission showed bilateral consolidation and ground-glass opacification that were more prominent in the peripheral lung [Figure 1a and b]. CT chest performed a week after hospitalization revealed partial resolution of consolidation [Figure 1c and d] with persistent ground-glass opacities. The lower lobes of the lungs also showed a small area of traction bronchiolectasis. The chest radiograph on the day of demise [Figure 1e] revealed air-space opacification in the same areas as the radiograph at admission but the opacities appeared less dense than the baseline without the appearance of any new abnormality. The findings were consistent with persistent changes of severe COVID-19 pneumonia that showed some resolution on the follow-up scan with subtle radiologic evidence of lung fibrosis.

Sanjay Jain
Dr. Dhooria, what, in your opinion, was the underlying illness? What could be the cause of the progressive worsening?

DIFFERENTIAL DIAGNOSIS

Sahajal Dhooria
The patient had acute-onset fever, cough, and breathlessness during the COVID-19 pandemic. He had...
a positive rRT-PCR test for SARS-CoV-2 and consistent lung imaging abnormalities. Therefore, the diagnosis of COVID-19 pneumonia is indisputable. The bilateral lung opacities along with significant hypoxemia also suggest that the patient had COVID-19-related severe acute respiratory distress syndrome (ARDS).[1] The ARDS was also persistent (defined as hypoxemia persisting beyond the 1st week in a patient with ARDS).[2] As he was beyond 3 weeks after the illness began, the patient likely had entered into the fibrotic phase of the ARDS.

The terminal worsening occurred acutely over a day, beginning with hypoxemia, and followed by refractory shock with elevated cardiac biomarkers. With this information, I would consider the following possibilities: Massive PE, myocardial infarction (MI) with cardiogenic shock, myocarditis due to SARS-CoV-2, and hospital-acquired pneumonia with refractory septic shock. The patient possibly had ARDS-related lung fibrosis also, which contributed to hypoxemia and poor lung compliance.

Pulmonary embolism

Our patient was hospitalized for an acute illness and had a severe limitation of his activities, and thus was at risk for venous thromboembolism.[3] The terminal worsening occurred acutely and manifested with breathlessness, hypoxemia, sinus tachycardia, and shock. The troponin T and raised proBNP were mildly elevated on the 2nd day. These features support a diagnosis of massive PE. Low central venous pressure and the absence of dilatation of the right heart chambers do not favor this diagnosis. However, echocardiography was performed immediately at the time of worsening before shock appeared. Hence, the right heart chamber dilatation might not have appeared by then. Therefore, I consider PE to be the most likely explanation for the terminal worsening. The possibility of in situ pulmonary artery thrombosis should also be considered in the context of COVID-19. I find it difficult to explain the normal arterial lactate level in the presence of refractory shock, with PE or any of the other considered possibilities.

Myocardial infarction

The clinical features during the worsening also raise the possibility of MI. However, the absence of chest pain, new ECG changes, and regional ventricular wall motion abnormalities on the echocardiogram reduce the likelihood. Moreover, the normal troponin I level at 12 h with only a mild elevation at 24 h, despite a fatal outcome, makes acute MI a less likely differential diagnosis.

Myocarditis

Acute onset of tachycardia and hypoxemia, elevated markers of myocardial injury, and global hypokinesia of the left ventricle also indicate a possibility of myocarditis. COVID-19-related myocarditis might occur early or later in the course of the illness. However, there were no ST-segment or T-wave changes on the electrocardiogram.

The normal troponin level at 12 h of the onset of symptoms and only mild elevation at 24 h, despite a fatal outcome, reduce the likelihood of myocarditis but do not exclude it.

Nosocomial pneumonia with septic shock

Our patient had diabetes mellitus, stayed in an intensive care unit (ICU) for a prolonged duration, and developed new-onset high-grade fever and hypoxemia followed by hypotension. Therefore, a possibility of HAP with septic shock can be considered. However, little tracheal secretions, no new-onset radiologic opacification, sterile blood and tracheal aspirate cultures, and normal arterial lactate levels lower the probability of HAP and septic shock.

Pulmonary mycosis

In a diabetic, administered glucocorticoids and broad-spectrum antibiotics, pulmonary mycosis (aspergillosis or mucormycosis) may occur, especially in the setting of COVID-19 pneumonia.[4] The sudden worsening, absent hemoptysis, no cavity on imaging, and no fungal hyphae in the tracheal aspirate smear do not favor pulmonary mycosis. The normal galactomannan and beta-D-glucan levels in the serum also point against aspergillosis.

Lung fibrosis

The patient’s terminal worsening and refractory hypoxemia are not attributable to lung fibrosis alone. However, lung fibrosis possibly contributed to the patient’s persistent hypoxemia before the terminal worsening. The patient had severe persistent ARDS with poor lung compliance indicating the fibrotic phase of ARDS.

Other organs

I do not suspect any major abnormality in the liver or the kidneys. There is biochemical evidence of hypoparathyroidism (Table 1), but no significant anatomic abnormality is expected in the parathyroid gland.

Final clinical diagnosis

COVID-19 pneumonia with persistent ARDS in the fibroproliferative/fibrotic phase with massive PE; diabetes mellitus; hypoparathyroidism

Sanjay Jain

I now invite Dr. Amanjit Bal, Professor of Histopathology to present the findings on the autopsy.

Amanjit Bal

A partial autopsy was performed. The serous cavities were within normal limits.

Lungs and pleura

The trachea contained thick mucoid secretions without any mucosal ulceration. The carinal lymph nodes measured 1–1.5 cm. The visceral pleura was dull over the lower lobes. The lungs weighed 1400 g. On the gross cut sections, the lungs were consolidated with areas...
that were firm, noncrepitant, and grey [Figure 2a and b]. Honeycombing and traction bronchiectasis were absent on gross examination. The microscopic examination of the lung tissue showed varying stages of diffuse alveolar damage (DAD) ranging from the acute exudative phase to the proliferative and fibrotic phase [Figure 2c-i]. Hyaline membranes were present along the alveolar ducts and septa that were densely eosinophilic on the Periodic acid–Schiff stain (exudative phase). There was massive type II pneumocyte proliferation, desquamation in alveolar spaces, and squamous metaplasia (proliferative phase). There were proliferating myofibroblasts, loose myxoid-appearing fibroblastic tissue centered around alveolar ducts, focal collagenous tissue, and cystic spaces suggestive of microscopic honeycombing (early fibrotic phase). Fibrin thrombi in varying stages of organization were seen in the medium to large pulmonary arteries [Figure 2j and k]. The ultrastructural examination of the lung tissue suggested a few virus-like particles [Figure 2l]. In addition, many Type II pneumocytes showed cytomegaly with characteristic amphophilic-to-basophilic intranuclear cytomegalovirus (CMV) inclusions surrounded by a clear halo. Cytoplasmic inclusions as granular bodies were also noted [Figure 3a and b]. CMV deoxyribonucleic acid (DNA) was detected in the lung tissue by PCR [Figure 3g]. The rRT-PCR for SARS-CoV-2 was negative in the trachea and lung tissue.

Heart
The heart weighed 420 g. All the chambers were dilated. The valves were normal with no mural thrombi. On bread loafing of the heart from apex to base, greyish white areas of fibrosis were noted in the interventricular septum. The microscopic examination from the fibrotic areas showed interstitial fibrosis replacing the myocardial fibers suggesting old healed MI [Figure 4a-c]. The surrounding myocytes showed hypertrophy and anisonucleosis. The left ventricular wall showed brownish discoloration. Sections from the areas of brownish discoloration showed patchy lymphohistiocytic infiltrates in the myocardium along with foci of myocyte necrosis and degeneration [Figure 4d-f]. A lymphohistiocytic infiltrate was also present in the endocardium and the pericardium. The inflammatory cells were dominantly CD68+ histiocytes admixed with CD3+ and CD8+ T-cells [Figure 4g and h]. The rRT-PCR for COVID 19 was negative. The interstitial blood vessels showed endothelial swelling [Figure 4i and j]. The aorta and coronary arteries showed complicated atherosclerosis. The left anterior descending artery had >90% occlusion while the left circumflex and right coronary arteries showed approximately 20% occlusion.

Liver, spleen, and pancreas
The liver weighed 1500 g and had exaggerated mottling. The microscopic examination showed maintained lobular architecture with marked centrizonal hemorrhagic necrosis.

Figure 2: Lungs. (a) Gross view showing a shiny pleural surface except for dullness over the lower lobes; (b) Cut surface showing consolidation; (c and d) Microscopic view showing exudative phase of diffuse alveolar damage with densely eosinophilic and periodic acid Schiff stain positive hyaline membranes (arrow); (e and f) Proliferative phase with squamous metaplasia (arrow), massive proliferation of Type II pneumocytes (arrow), and desquamation (arrow) in the alveolar spaces (g-i) Early fibrotic phase with proliferating myofibroblasts seemingly replacing the hyaline membranes and getting incorporated in the interstitium with focal collagenous tissue (h, Masson’s trichrome stain) and (i) cystic change (arrow), (j and k) Fibrin thrombi (arrows) of varying stages in organization seen in the medium-to-large pulmonary artery branches; (l) Ultrastructural examination showing a few virus-like particles (arrow)
Portal tracts showed mild nonspecific lymphocytic inflammation. The spleen was soft and diffusent, and weighed 250 g. The white pulp showed lymphoid hypoplasia while the red pulp was congested. There was relative depletion of CD3+ T-cells [Figure 5a-c]. The rRT-PCR for COVID-19 was positive. In the pancreas, there was no exocrine atrophy, or interlobular or intralobular fibrosis. A few pancreatic islets showed pink acellular Congophilic amylin deposit consistent with diabetes mellitus [Figure 6a-c].

Kidneys
The kidneys weighed 260 g. The glomeruli showed basement membrane thickening with mild increase in the mesangial matrix [Figure 6d and e]. No significant interstitial fibrosis or tubular atrophy was present. Blood vessels showed hyaline arteriolosclerosis. Electron microscopy revealed basement membrane thickening without any electron-dense deposits [Figure 6f]. No immune complexes were present on immunofluorescence. The features suggest Class I diabetic nephropathy.

Other organs
The adrenals showed dense lymphomononuclear infiltrate and CMV inclusions [Figure 3c]. The gastroesophageal junction showed ulceration on gross examination. There were lymphomononuclear infiltrate and CMV inclusions on microscopic examination [Figure 3d-f]. The bone marrow, thyroid, small intestine, large intestine, appendix, testes, skin, and skeletal muscles did not show significant pathological changes.

Final autopsy diagnosis
DAD (early fibrotic phase), disseminated CMV infection (lungs, adrenal, esophagus, stomach), pulmonary thromboembolism, myocarditis (viral), triple vessel coronary artery disease with old healed MI, class I diabetic nephropathy.
Inderpaul Singh Sehgal
I would like to ask Dr. Bal what, in her opinion, was the predominant cause of the terminal worsening: massive PE, myocarditis, or CMV pneumonitis?

Amanjit Bal
Thrombi were seen in the medium and large pulmonary arteries and appear to be the primary cause of the fatal outcome. The myocarditis was mild and patchy. But it can explain the hypokinetic myocardium on the echocardiography. CMV appears to be more than just a latent infection as an inflammatory infiltrate was also present along with the CMV inclusions, suggesting CMV pneumonitis. It might have contributed to the hypoxemia but does not appear severe enough to be the primary cause of the terminal worsening.

Ashutosh N Aggarwal
The presence of adrenal inflammation with CMV inclusions also suggests an active disseminated CMV infection. It possibly caused adrenal insufficiency, which explains hyponatremia.

Ritesh Agarwal
Dr. Singh, could you elaborate on the absence of SARS-CoV-2 in the lung but its presence in the spleen?

Mini P Singh
In the present case, RT-PCR was done to explore for viral ribonucleic acid (RNA) in trachea, lungs, heart, liver, spleen, and kidneys. Only the spleen demonstrated viral RNA. There is evidence that SARS-CoV2 virus causes depletion of lymph node follicles and atrophy of the splenic white pulp. Previous reports suggest that the presence of SARS-CoV-2 RNA in the lungs becomes increasingly rare beyond 2 weeks of symptom onset.

DISCUSSION
This clinicopathological conference highlights the spectrum of pathologic findings in COVID-19 infection. The pulmonary pathology denotes the progression of DAD through the exudative (1–7 days), proliferative/organizing (8–21 days), and fibrotic (>21 days) phases. These morphological changes representing different phases co-existed reflecting the spatial and temporal heterogeneity of COVID-19 pneumonia.

Massive PE is the likely primary cause of the fatal outcome in our patient. The incidence of PE is reported to be around 2.6%–8.9% in hospitalized COVID-19 patients and up to a third of those requiring ICU admission, despite standard prophylactic anticoagulation. Because patients with COVID-19 may exhibit a hypercoagulable state, the index of suspicion for concurrent PE should be high. The standard clinical rules and algorithms

Figure 5: (a) Microscopic examination of the splenic white pulp showing lymphoid hypoplasia with congested red pulp; (b and c) Immunostaining for CD3 and CD20 indicating T-cell depletion

Figure 6: (a) Microscopic examination of the pancreatic islets showing pink acellular congophilic amylin deposit (arrows), (b) highlighted on the Congo red stain, with (c) apple green birefringence on polarizing light; (d) Microscopic examination of the kidney showing glomerular basement membrane thickening (arrows) confirmed on the (e) periodic acid Schiff stain and (f) electron microscopy
should be followed to suspect and diagnose PE.\[10]\ It should be noted that elevated D-dimer alone should not be used to diagnose PE.\[11] It has been suggested that COVID-19 patients with acute deterioration, prolonged illness, and persistent hypoxemia should be investigated for in situ pulmonary artery thrombosis.\[12] The development of in situ immune-mediated thrombosis might contribute to the pathogenesis of type 1 respiratory failure in COVID-19. In situ thrombosis generally occurs in the smaller pulmonary vessels in the setting of ARDS. In the index patient, the thrombus was lodged in a larger pulmonary artery and appears to be an embolus. Unfortunately, the deep venous system was not dissected, so the presence of deep vein thrombosis cannot be confirmed or refuted.

Our patient had raised cardiac biomarkers and mild, patchy myocardial inflammation on pathology. Around 10%–35% of hospitalized COVID-19 patients have acute cardiac injury defined as an elevated high-sensitivity troponin I or troponin T above the 99th percentile upper reference range.\[13] Myocarditis and the associated systemic inflammation can be delayed up to a month after initial SARS-CoV-2 infection.\[14] However, pathologic myocarditis is rare. In an autopsy series of 22 patients with COVID-19, the majority of whom had mild troponin elevations, there was no pathological evidence of typical lymphocytic myocarditis.\[15] The authors attributed the elevated troponins to acute cor pulmonale due to severe ARDS. The other proposed mechanisms of myocardial damage include direct viral injury via binding to the angiotensin converting enzyme 2 receptors highly expressed in the heart, hyperactivation of the immune system (cytokine storm), or microvascular thrombotic angiopathy.\[16-19] Elevated cardiac troponins in our patient were likely due to myocardial inflammation and the right ventricular strain caused by massive PE.

Patients with ARDS (whether due to COVID-19 or not) are prone to secondary bacterial and fungal infections due to prolonged hospitalization, use of drugs such as glucocorticoids, and invasive mechanical ventilation.\[20] Due to the frequent use of immunosuppressive drugs in severe COVID-19, viral reactivation can also occur. CMV and herpes virus reactivation has been reported in COVID-19 patients.\[21] Our patient also developed disseminated CMV infection involving the lungs, the gastrointestinal tract, and the adrenals.

Several factors such as old age, male gender, diabetes mellitus, hypertension, cardiovascular disease, chronic lung disease, kidney disease, and others confer a higher risk of severe or fatal COVID-19.\[22-23] Our patient was an elderly man with diabetes mellitus. In addition, the patient also had atherosclerosis and previously undiagnosed coronary artery disease with old healed MI on pathology. These comorbidities increased the risk of a poor outcome in our patient.

CONCLUSION

Our patient with diabetes mellitus and coronary artery disease had severe COVID-19 pneumonia with ARDS in its fibrotic phase. He died due to massive PE. Disseminated CMV infection and myocarditis possibly contributed to the fatal outcome.

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Conflicts of interest

There are no conflicts of interest.

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