correspondence

Positive Postmortem Test for SARS-CoV-2 Following Embalming in Confirmed COVID-19 Autopsy

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To the Editor

We report a case of an 82-year-old man who, at 1 to 2 days antemortem, developed the clinical symptoms of cough, fever, and low oxygenation while in a nursing home facility. Before onset, the patient was hospitalized approximately 2 months antemortem for attempted left lower leg arteriograms. Medical history of the patient included diabetes mellitus type 2 (since the 1990s), multifocal stenosis of coronary arteries (onset unknown), adrenal gland insufficiency (since the 1990s), kidney failure (since 2015), and sacral decubitus ulcer (since late 2019). Prior surgical procedures included lower extremity arteriograms and blood transfusion, both performed in February 2020. Of note, a physician-ordered chest x-ray showed abnormal left lower lobe infiltrate antemortem. Medical laboratory studies were notable for low RBC counts (2.3×10^6/μL) and low hemoglobin (6.0-7.1 g/dL). A lung-only private medical autopsy with coronavirus disease 2019 (COVID-19) precautions was performed following embalming on day 1 postmortem[1]; the interval from embalming to autopsy was 1 day.

Macroscopic examination showed that the upper airway was clear of debris and foreign material; the mucosal surfaces were smooth, yellow-tan, and unremarkable. The pleural surfaces were smooth, glistening, and unremarkable bilaterally. The pulmonary parenchyma was red-purple in color. Serial sectioning was negative for grossly identifiable and palpable lesions and scarring. The pulmonary arteries were normally developed, patent, and without thrombus or embolus. The right lung weighed 820 g, and the left lung weighed 789 g. A nasopharyngeal swab and a lung swab of the left lower lobe were sent to a reference laboratory for the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) nucleic acid amplification test, performed using multitarget real-time reverse transcription–polymerase chain reaction (limit of detection, 15.625 copies/reaction).

Microscopic examination showed that right-sided lung sections exhibited emphysema within pulmonary parenchyma; however, they were free of significant edema, acute inflammation, chronic inflammation, fibrosis, hemorrhage, and macrophages. Left-sided sections showed predominance of lymphocytes with accompanying diathesis of monocytes, neutrophils, and hemosiderin-laden macrophages (refractile but not polarizable) within alveoli **Image 1**. Findings were more pronounced in the left lower lobe but also readily identifiable in left upper lobe. Sections were negative for significant eosinophilic component, interstitial or septal changes, vasculitis or vasculopathy, and diffuse alveolar damage. Of note, the background left-sided parenchyma also showed emphysema. Polarization failed to reveal refractile material. Pathologic diagnoses of atypical or viral pneumonia of the left lung and emphysema were rendered. COVID-19 pneumonia was deemed a contributing cause of death in this case.

The overall histologic pattern of atypical or viral pneumonia is sufficiently distinct from influenza pneumonia (marked more by diffuse alveolar damage with accompanying exudate and fibrinopurulent debris) and could possibly suggest COVID-19 lung injury. Histopathologic findings in this case were similar to a handful of other lung histopathologic findings in COVID-19–confirmed cases[2,3]; however, some observers noted diffuse alveolar damage as a predominant diagnostic finding in cases with asthmatic diathesis.[4]

COVID-19 nucleic acids were identified from both specimens and reported to the clinician, family, and funeral home director. Of note, the COVID-19 test yielded positive results following the embalming procedure (vascular phase entailed injection of 22 L solution of 2.4% formaldehyde, and visceral phase entailed injection of 11 L solution of 3% formaldehyde; both solutions also contained accessory fluids: methanol, monopropylene glycol, and mineral salts).

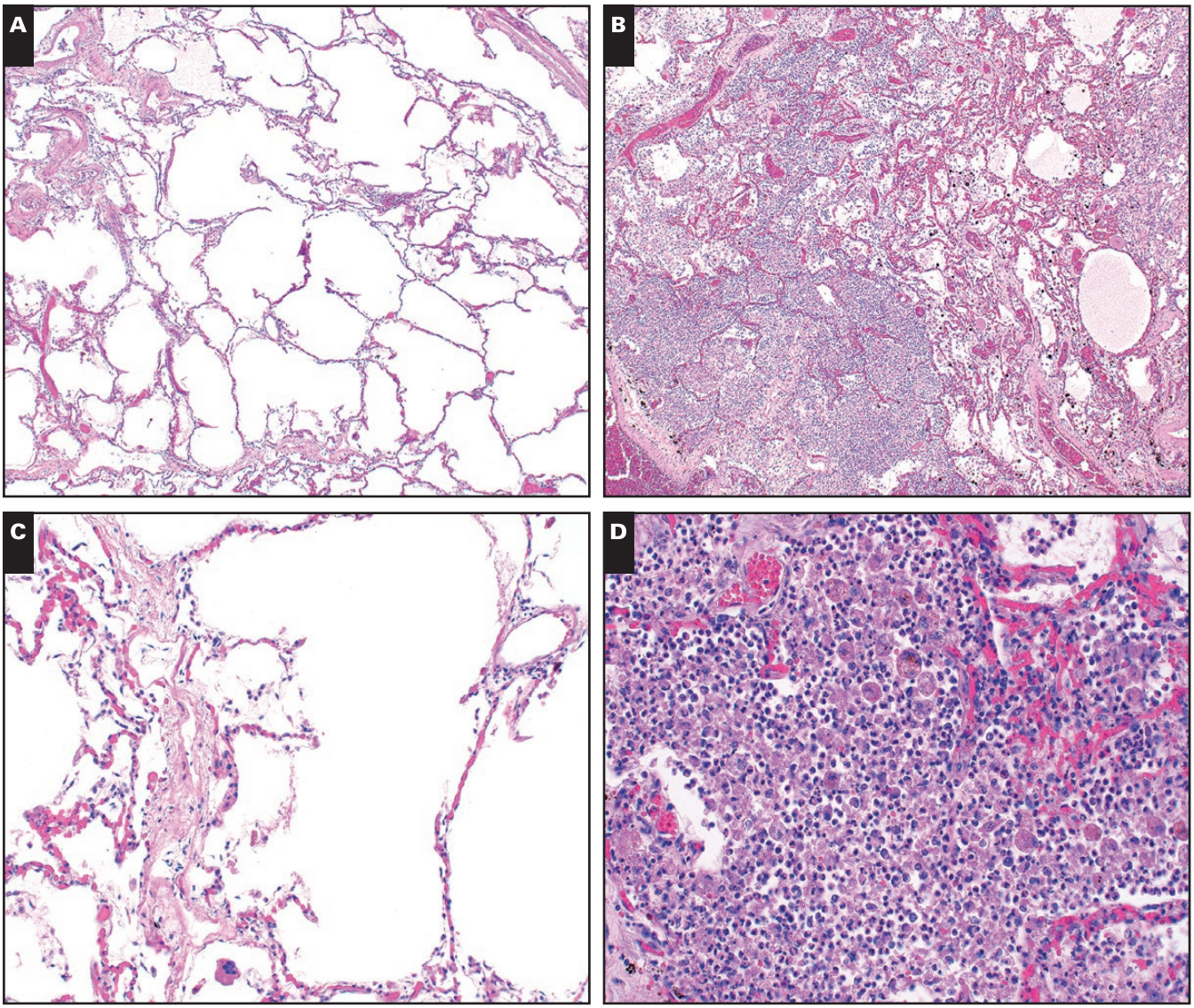

Image 1 Representative pulmonary photomicrographs. **A**, Low-power magnification of right lower lobe showing focal emphysema. **B**, Low-power magnification of left lower lobe showing emphysema occupied by mononuclear cells. **C**, High-power magnification of right lower lobe highlighting focal emphysema and near absence of mononuclear cells within alveoli. **D**, High-power magnification of left lower lobe showing alveolar spaces occupied by lymphohistiocytic and neutrophilic infiltrates that involved but did not expand alveoli.

The embalming process entails removal of the blood from the body through the veins and replacement with formaldehyde-based chemicals through the arteries; the process enables processes such as private or public viewing as part of the funeral ceremony. Based on this empirical observation, our case serves as proof-of-principle that embalming is not an absolute contraindication for COVID-19 testing. Moreover, thought can be given to adding formaldehyde to collection kits, which may preclude or minimize chance of exposure to laboratory technicians during preanalytical specimen handling and procurement. This suggestion is based on a traditional empirical principle of virology whereby viruses are inactivated by formaldehyde. Moreover, formalin inactivation was used for the production of many commercial human viral vaccines.

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