SARS-CoV-2 was first discovered in 2019 and has proven to be a significant public health challenge. While viruses from the coronavirus family have been established as causes of respiratory tract infections, SARS-CoV-2 has also been found in the heart, kidney, testes, and penis. This paper investigates whether SARS-CoV-2 can linger in the prostate by examining the histopathological, ultrastructural, and immunofluorescent elements of prostatic tissue from a patient who was infected by the SARS-CoV-2 virus prior to having a holmium laser enucleation of the prostate (HoLEP) procedure. The findings of this case report suggest that COVID-19 has both the ability to enter prostatic tissue during an acute infection and persist over a timeframe beyond the initial infection period as RNA-containing viral bodies. This case report lays the foundation for future investigations to examine any histopathological changes to the prostatic tissue that may be associated with SARS-CoV-2 viral infection.

Keywords: COVID-19; Microscopy, electron; Prostate; Prostatic hyperplasia; SARS-CoV-2
prostatic malignancy, prostatitis, and prostatic hyperplasia. Therefore, we examined histopathologic elements of prostatic tissue of a patient with COVID-19 [9]. The study protocol was approved by the institutional review board of the University of Miami (IRB No. 20150740). Informed consent was confirmed by the IRB.

**CASE REPORT**

A 60-year-old male with a remote history of urethral stricture who underwent dilatation 25 years ago presented in February 2018 for worsening and bothersome lower urinary tract symptoms, including nocturia, intermittency, and straining. His International Prostate Symptom Score (IPSS) was 24. He was prescribed tamsulosin but stopped after one month due to non-improvement of symptoms and an adverse effect of retrograde ejaculation.

Uroflowmetry exhibited a maximum uroflow rate of 13 mL/s (average rate is 5 mL/s) and a uroflow curve consistent with obstruction. His postvoid residual on ultrasound was 270 mL. He underwent cystoscopy which showed trilobar prostatic enlargement consistent with bladder outlet obstruction; no urethral stricture was identified. He underwent a transabdominal ultrasound of the bladder which revealed an enlarged 44 mL prostate gland with a possible median lobe extending into the bladder. He was restarted on medical management, including daily alfuzosin (10 mg) and tadalafil (5 mg). Prostate-specific antigen (PSA) was measured at 2.0 ng/mL during this period.

The patient continued erectile dysfunction and alpha lithic medical management regimen through February 2021. His urinary symptoms persisted, his uroflow remained objectively consistent with obstruction (maximum uroflow rate 5.5 mL/s; average uroflow rate 2.2 mL/s), and his post-void residual remained elevated (185 mL), constituting a failure of medical management. The patient was counseled on various surgical options and was scheduled to undergo a holmium laser enucleation of the prostate (HoLEP) procedure in May 2021.

In January 2021, several months prior to his HoLEP procedure, the patient was diagnosed with COVID-19. He described several days of fever and diarrhea and was subsequently admitted to the emergency department for evaluation but was found to have normal oxygen saturation and discharged home with diphenoxylate/atropine (Lomotil) for outpatient recovery. He fully recovered from COVID-19 and reported no long-term or ongoing symptoms.

The patient then underwent the HoLEP procedure as scheduled in May 2021. During the procedure, 5.2 g of prostatic tissue were enucleated and sent for analysis, reported as benign prostatic hyperplasia. Next, the tissue was visualized by transmission electron microscopy, which revealed the presence of multiple coronavirus-like spiked viral particles, ranging from 73.3 nm to 109 nm (Fig. 1). Quantitative polymerase chain reaction detected SARS-CoV-2 RNA in the prostate biopsy (Fig. 2). Immunofluorescent and ultrastructural visualization also revealed expression of spike protein and DAPI (4',6-diamidino-2-phenylindole) (Fig. 3, 4). One month follow-up showed 0.9 ng/mL PSA, and patient reported resolution of previous lower urinary tract symptoms.

**DISCUSSION**

This case report provides preliminary evidence that SARS-CoV-2 not only enters prostatic tissue during an acute infection but may persist beyond the initial infection period. TMPRSS2 and ACE2 are found in relatively high concentrations in prostatic tissue, making the prostate a potential target for SARS-CoV-2 invasion. Using EM, we found that our patient had residual viral particles in his prostatic tissue four months after prostate enucleation for benign prostatic hyperplasia.

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**Fig. 1.** Ultrastructure features of prostatic tissue after holmium laser enucleation of the prostate (HoLEP). Coronavirus-like spiked viral particles (white markers) present in the prostatic tissue of a patient infected four months prior to HoLEP.
In tandem with existing research noting viral absence in sperm [10], further investigation into the replicative potential of these prostatic viral bodies is needed. This case report lays the foundation for future investigations to examine any histopathologic changes to the prostatic tissue that may be associated with SARS-CoV-2 infection. It also brings forth the importance of investigating mental health burden and its impact on existing disease state outcomes. Beyond establishing the persistence of SARS-CoV-2 particles in prostatic tissue, this report suggests the importance of discerning the relationships between COVID-19, lower urinary tract symptom severity, and prostatic hyperplasia. Future studies utilizing quantitative real-time PCR and immunofluorescence will investigate the presence of viral RNA and antigens in COVID-19 (+) specimens. Information showing degree of infection will be helpful for understanding causes of new prostatic disease states such as prostatitis or even effects on PSA values.

Conflict of Interest

The authors have nothing to disclose.
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Author Contribution

Conceptualization: EK, NF, RaRa. Data curation: EK, NF, DS. Formal analysis: DS, RaRa, RoRe. Investigation: EK, NF, RoRe. Methodology: RaRa, DS. Project administration: RaRa. Resources: RaRa, PD. Software: DS, RoRe, NF. Supervision: RaRa. Validation: DS, RoRe. Visualization: DS, RoRe. Writing – original draft: NF, RoRe. Writing – review & editing: NF, PD, RaRa.

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