




Clinical Experience with COVID-19 at a Specialty Orthopedic Hospital Converted to a Pandemic Overflow Field Hospital

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Abstract *Background:* COVID-19, the illness caused by the novel coronavirus, SARS-CoV-2, has sickened millions and killed hundreds of thousands as of June 2020. New York City was affected gravely. Our hospital, a specialty orthopedic hospital unaccustomed to large volumes of patients with life-threatening respiratory infections, underwent rapid adaptation to care for COVID-19 patients in response to emergency surge conditions at neighboring hospitals. *Purposes:* We sought to determine the attributes, pharmacologic and other treatments, and clinical course in the cohort of patients with COVID-19 who were admitted to our hospital at the height of the pandemic in April 2020 in New York City. *Methods:* We conducted a retrospective observational cohort study of all patients admitted between April 1 and April 21, 2020, who had a diagnosis of COVID-19. Data were gathered from the electronic health record and by manual chart abstraction. *Results:* Of the 148 patients admitted with COVID-19 (mean age, 62 years), ten patients died. There were no deaths among non-critically ill

patients transferred from other hospitals, while 26% of those with critical illness died. A subset of COVID-19 patients was admitted for orthopedic and medical conditions other than COVID-19, and some of these patients required intensive care and ventilatory support. *Conclusion:* Professional and organizational flexibility during pandemic conditions allowed a specialty orthopedic hospital to provide excellent care in a global public health emergency.

Keywords COVID-19 · SARS-CoV-2 · pandemic · orthopedics

Introduction

COVID-19, the illness caused by the novel coronavirus, SARS-CoV-2, has disrupted the lives of most humans around the globe, with over 6.6 million cases and almost 400,000 deaths worldwide as of June 5, 2020 [8]. While the

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first known cases of COVID-19 were reported from Wuhan, China, in December 2019, the virus quickly spread, becoming a pandemic [4]. The first known cases in the USA were reported in January 2020 in Washington State; the first confirmed case in New York City was announced on March 1, 2020 [3, 5]. Within weeks, the New York City area became one of the epicenters of the pandemic [11, 12].

New York City responded to this unprecedented situation with rapid adjustments in health policy and resource allocation. Anticipating a critical need for hospital beds, including critical care capacity, state and federal agencies considered the suspension of elective procedures. Hospital for Special Surgery (HSS), an orthopedic specialty hospital affiliated with the large neighboring teaching hospital, New York-Presbyterian Hospital (NYPH), quickly anticipated the looming crisis, discontinuing elective surgeries on March 16, 2020. HSS, normally with an inpatient capacity of slightly over 200 patients, reduced its capacity to a census of 20 patients. As NYPH began to see a drastic upswing in the number of COVID-19 patients, HSS transformed into an overflow hospital, initially for patients without COVID-19 and then for COVID-19 patients. On March 21, the first patient infected with SARS-CoV-2 was transported across the short pedestrian bridge from NYPH to HSS, where over the course of the next 5 weeks, 148 COVID-19 patients received care.

Patients with COVID-19 arrived at the hospital through one of three routes: transferred as relatively stable patients from outside hospitals, transferred as critically ill patients from outside intensive care units (ICUs) at nearby hospitals, or admitted or transferred to HSS for other (non-COVID-19) indications and developed evidence of COVID-19 either on or after arrival. ICU patients were eligible for transfer to HSS if they were not rapidly decompensating or requiring renal replacement therapy. A robust protocol of PCR testing upon admission for all patients was developed, and rigid protocols for isolation consistent with Centers for Disease Control and Prevention (CDC) guidelines were enacted. Clinicians and hospital administrators worked to monitor, treat, and discharge patients with COVID-19 while maximizing staff safety. Clinicians rapidly enrolled patients in expanded access programs for remdesivir and convalescent plasma and used other biologic agents to treat critically ill and worsening patients.

Rapid structural changes to hospital operations were implemented. The ambulatory surgical suites and adjacent post-operative care unit were converted into a COVID-19 ICU. In the specialized units where COVID-19 patients were placed, rooms were converted to negative pressure settings to mitigate possible viral transmission. One of the orthopedic inpatient floors was converted into a telemetry-capable COVID-19 medical unit. Three inpatient operating rooms (ORs) became dedicated COVID-19 OR suites: while these rooms maintain positive pressure airflow for sterility purposes, we incorporated the use of dual portable high efficiency particulate air (HEPA) filters to reduce risk of viral spread. There was a rapid increase in capacity for prompt molecular laboratory testing of COVID-19 patients. Every unit of the hospital was impacted. More broadly, dramatic

changes were seen in the delivery of outpatient care: outpatient clinics were closed for non-emergent visits, and providers quickly and consistently began using telehealth strategies to deliver care. The hospital was designated as the primary orthopedic trauma center for the city, and the ambulatory hand and foot center was converted into an orthopedic triage center capable of receiving patients transported by ambulance. Satellite orthopedic clinics in surrounding counties were established for emergency orthopedic care.

In the context of this drastic shift in the care provided by our institution, we aimed to assess the clinical outcomes of our COVID-19 patients and to review our experience with the disease within the context of an orthopedic hospital generally unaccustomed to the treatment of severe respiratory disease outside of our pre-existing four-bed orthopedic ICU. We further wished to broadly compare our outcomes with those in the extant literature for length of stay and mortality.

Methods

We received institutional review board approval to conduct an observational cohort study of all patients admitted to HSS between April 1 and April 23, 2020 who had SARS-CoV-2 infection confirmed by at least one positive result from a polymerase chain reaction (PCR) test via nasopharyngeal swab. Demographics, comorbidities, laboratory findings, respiratory status, pharmacologic treatment, and clinical outcomes were collected. The primary end point was defined as hospital discharge including death. Clinical outcomes were defined as significant hospital events, such as invasive mechanical ventilation, cardiovascular complications, or renal failure.

Data were either manually abstracted from the HSS electronic health record and entered in REDCap or extracted from the HSS data warehouse. Elixhauser comorbidity index (ECI) [10] was calculated for each patient. Data and statistics were processed in R (version 3.5.2).

Results

During the study period, 148 inpatients diagnosed with COVID-19 received care at HSS. The majority were transfers from outside institutions. The number of daily admissions ranged from 1 to 12 patients between April 1 and 23, 2020. Eight patients were admitted to HSS for orthopedic emergencies and found on PCR screening to be COVID-19 positive. Overall, the mean age of patients was 62 years (SD 15); sex distribution was 65.5% male, and the average body mass index (BMI) was 28 (SD 6; Table 1). The patients were 41.9% Hispanic/Latino. The most common presenting symptoms were shortness of breath (65%), fever (62%), dry cough (53%), fatigue (23%), and diarrhea (22%; Table 2). Most frequent comorbidities included hypertension (51%), diabetes (32%), and hyperlipidemia (24%; Table 3). The overall length of stay from outside hospital admission to discharge from HSS was 18 days (SD 13; Table 4). Across the entire cohort of 148 patients, ten patients died: five

Table 1 Patient demographics and clinical characteristics

	Overall	COVID floor admit	COVID ICU admit	Other admit
<i>N</i>	148	111	19	18
Male (%)	97 (65.5)	73 (65.8)	13 (68.4)	11 (61.1)
Age (mean (SD))	61.56 (14.96)	59.86 (12.38)	66.26 (15.22)	67.11 (24.92)
BMI (mean (SD))	28.22 (6.22)	28.65 (6.02)	28.42 (5.35)	25.39 (7.75)
Hispanic or Latino ethnicity (%)	62 (41.9)	52 (46.8)	7 (36.8)	3 (16.7)
Black or African-American (%)	11 (7.4)	6 (5.4)	2 (10.5)	3 (16.7)
American Indian or Alaska Native (%)	4 (2.7)	3 (2.7)	0 (0.0)	1 (5.6)
Asian (%)	24 (16.2)	21 (18.9)	2 (10.5)	1 (5.6)
Native Hawaiian or other Pacific Islander (%)	5 (3.4)	4 (3.6)	1 (5.3)	0 (0.0)
White (%)	48 (32.4)	33 (29.7)	8 (42.1)	7 (38.9)
ECI simple sum method (mean (SD))*	2.28 (1.86)	2.06 (1.73)	2.89 (2.28)	3.00 (1.94)
	Oxygen support on HSS admission (%)			
Mechanical ventilation	19 (12.8)	0 (0.0)	18 (94.7)	1 (5.6)
Nasal cannula	95 (64.2)	87 (78.4)	0 (0.0)	8 (44.4)
Room air	34 (23.0)	24 (21.6)	1 (5.3)	9 (50.0)

*ECI = Elixhauser Comorbidity Index [10]

originated from outside intensive care units, four were initially admitted with primary orthopedic complaints, and one had been transferred from an outside hospital as a stable non-COVID-19 patient.

Three patient categories were explored further.

COVID-19 Hospital Floor Admissions

Of 111 COVID-19 patients transferred from outside hospitals to inpatient floors, the mean age was 60 years (SD 12); 73 were men (66%), and the average BMI was 29 (SD 6.2). The most common symptoms in this cohort were shortness of breath (70%), fever (68%), dry cough (60%), fatigue (28%), and diarrhea (28%). Prior to admission to HSS, 97 (87%) patients had initiated or completed a 5-day course oral hydroxychloroquine, with 56 (51%) patients having received concurrent azithromycin (Table 5). At HSS, six (5.4%) patients received advanced immunotherapies

including convalescent plasma (3; 2.7%), tocilizumab (1; 0.9%), remdesivir (1; 0.9%), and intravenous immunoglobulin (IVIG; 1; 0.9%; Table 6). Among this cohort subset, four (3.6%) were transferred to the ICU, with two (1.8%) ultimately requiring subsequent intubation for progressive respiratory failure. The overall hospital length of stay for these patients was 15 days (SD 8.0). Among non-critically ill patients transferred with COVID-19, 103 (93%) were discharged home, five (4.5%) were discharged to a skilled nursing facility (SNF), and three (2.7%) were transferred back to an outside hospital as the pandemic waned and hospital bed capacity improved. None, including those who required subsequent intensive care, died (Table 4).

COVID-19 Intensive Care Admissions

Of 19 intubated patients admitted directly to the COVID-19 ICU, the mean age was 66 years (SD 15); 13 were men

Table 2 Presenting symptoms on initial hospital admission

	Overall	COVID floor admit	COVID ICU admit	Other admit
<i>N</i>	148	111	19	18
Shortness of breath (%)	96 (64.9)	78 (70.3)	17 (89.5)	1 (5.6)
Fever (%)	91 (61.5)	75 (67.6)	14 (73.7)	2 (11.1)
Dry cough (%)	79 (53.4)	66 (59.5)	13 (68.4)	0 (0.0)
Fatigue (%)	34 (23.0)	31 (27.9)	2 (10.5)	1 (5.6)
Diarrhea (%)	33 (22.3)	31 (27.9)	2 (10.5)	0 (0.0)
Myalgias (%)	21 (14.2)	21 (18.9)	0 (0.0)	0 (0.0)
Chest pain (%)	18 (12.2)	16 (14.4)	2 (10.5)	0 (0.0)
Nausea/vomiting (%)	17 (11.5)	16 (14.4)	0 (0.0)	1 (5.6)
Chills/rigors (%)	10 (6.8)	10 (9.0)	0 (0.0)	0 (0.0)
Abdominal pain (%)	8 (5.4)	7 (6.3)	1 (5.3)	0 (0.0)
Anosmia (%)	8 (5.4)	7 (6.3)	0 (0.0)	1 (5.6)
Sore throat (%)	7 (4.7)	7 (6.3)	0 (0.0)	0 (0.0)
Ageusia (%)	6 (4.1)	5 (4.5)	0 (0.0)	1 (5.6)
Productive cough (%)	6 (4.1)	5 (4.5)	1 (5.3)	0 (0.0)
Nasal congestion (%)	4 (2.7)	3 (2.7)	1 (5.3)	0 (0.0)
Asymptomatic (%)	9 (6.1)	1 (0.9)	0 (0.0)	8 (44.4)
No COVID-19 related symptoms (%)	12 (8.1)	5 (4.5)	1 (5.3)	6 (33.3)

Three patients were excluded due to missing symptom data

Table 3 Risk factors and underlying comorbidities

	Overall	COVID floor admit	COVID ICU admit	Other admit
<i>N</i>	148	111	19	18
Renal failure (%)	12 (8.1)	9 (8.1)	3 (15.8)	0 (0.0)
Coagulopathy (%)	5 (3.4)	3 (2.7)	0 (0.0)	2 (11.1)
Peptic ulcer disease (%)	4 (2.7)	2 (1.8)	1 (5.3)	1 (5.6)
Liver disease (%)	1 (0.7)	1 (0.9)	0 (0.0)	0 (0.0)
Hypothyroidism (%)	12 (8.1)	9 (8.1)	1 (5.3)	2 (11.1)
Fluid and electrolyte disorders (%)	2 (1.4)	2 (1.8)	0 (0.0)	0 (0.0)
Former smoker (%)	14 (9.5)	12 (10.8)	0 (0.0)	2 (11.1)
Current smoker (%)	5 (3.4)	2 (1.8)	1 (5.3)	2 (11.1)
Vascular disease (%)	19 (12.8)	8 (7.2)	5 (26.3)	6 (33.3)
Pulmonary vascular disorders (%)	3 (2.0)	1 (0.9)	2 (10.5)	0 (0.0)
HIV/AIDS (%)	2 (1.4)	2 (1.8)	0 (0.0)	0 (0.0)
Rheumatic disease (%)	1 (0.7)	0 (0.0)	1 (5.3)	0 (0.0)
Diabetes (%)	53 (35.8)	37 (33.3)	11 (57.9)	5 (27.8)
COPD (%)	19 (12.8)	14 (12.6)	3 (15.8)	2 (11.1)
HTN (%)	78 (52.7)	58 (52.3)	8 (42.1)	12 (66.7)
Anemia (%)	21 (14.2)	15 (13.5)	2 (10.5)	4 (22.2)
Cancer (%)	16 (10.8)	9 (8.1)	2 (10.5)	5 (27.8)
MI (%)	1 (0.7)	1 (0.9)	0 (0.0)	0 (0.0)
CHF (%)	7 (4.7)	4 (3.6)	1 (5.3)	2 (11.1)
Hyperlipidemia (%)	36 (24.3)	24 (21.6)	7 (36.8)	5 (27.8)
Cardiac arrhythmias (%)	18 (12.2)	8 (7.2)	4 (21.1)	6 (33.3)
Dementia (%)	13 (8.8)	4 (3.6)	2 (10.5)	7 (38.9)
Depression (%)	8 (5.4)	5 (4.5)	1 (5.3)	2 (11.1)
Alcohol abuse (%)	5 (3.4)	3 (2.7)	0 (0.0)	2 (11.1)
Drug abuse (%)	1 (0.7)	0 (0.0)	0 (0.0)	1 (5.6)

COPD chronic obstructive pulmonary disease, *HIV/AIDS* human immunodeficiency virus/acquired immune deficiency syndrome, *HTN* hypertension, *MI* myocardial infarction, *CHF* congestive heart failure

(68%), and the average BMI was 28 (SD 5.4). Similar patterns of ethnicity were seen in this subgroup to the total population. Present symptoms in this cohort included shortness of breath (90%), fever (74%), dry cough (68%), fatigue (11%), diarrhea (11%), and chest pain (11%). Diabetes and vascular disease were common (47% and 26%, respectively; Table 3). Prior to admission to HSS, 18 (95%) patients had initiated or completed a 5-day course of oral hydroxychloroquine, with five (26%) patients receiving concurrent azithromycin (Table 4). Upon arrival to HSS, 10 (52.6%) patients received advanced immunotherapies including convalescent plasma (3; 15.8%), remdesivir (3; 16%), tocilizumab (2; 11%), and IVIG (2; 11%) (Table 5).

The overall hospital length of stay for these patients was 35 days (SD 13), the longest out of the three cohorts. Five (26%) were discharged home, five (26%) were discharged to a SNF, four (21%) were transferred back to an outside hospital, and five died (26%) (Table 5).

Admissions for Primary Non-COVID-19 Indications

During the study period, 18 patients were admitted for reasons other than COVID-19 (primarily orthopedic hip or knee trauma) and were diagnosed with COVID-19 on admission or during the hospital stay. The mean age of this group was 67 years (SD 25). Of the 18 patients in this

Table 4 Clinical outcomes

	Overall	COVID floor admit	COVID ICU admit	Other admit
<i>N</i>	148	111	19	18
Transferred to ICU (%)	31 (20.9)	4 (3.6)	19 (100.0)	8 (44.4)
Intubated (%)	25 (16.9)	2 (1.8)	18 (94.7)	8 (44.4)
Length of stay at HSS (mean (SD))	10.78 (9.37)	8.14 (6.07)	21.95 (13.26)	15.28 (11.32)
Total length of stay (mean (SD))	18.24 (12.64)	14.97 (8.05)	34.95 (13.15)	20.72 (19.77)
		Discharge status (%)		
Acute general hospital	8 (5.4)	3 (2.7)	4 (21.1)	1 (5.6)
Home	115 (77.7)	103 (92.8)	5 (26.3)	7 (38.9)
Skilled nursing facility	15 (10.1)	5 (4.5)	5 (26.3)	5 (27.8)
Expired	10 (6.8)	0 (0.0)	5 (26.3)	5 (27.8)

ICU intensive care unit, *SD* standard deviation

Table 5 Pharmacologic treatment prior to HSS admission

	Overall	COVID floor admit	COVID ICU admit	Other admit
<i>N</i>	148	111	19	18
Hydroxychloroquine (%)	118 (79.7)	97 (87.4)	18 (94.7)	3 (16.7)
Azithromycin (%)	62 (41.9)	56 (50.5)	5 (26.3)	1 (5.6)
HTN meds (ACE inhibitors) (%)	70 (47.3)	52 (46.8)	11 (57.9)	7 (38.9)
Corticosteroids (%)	13 (8.8)	8 (7.2)	2 (10.5)	3 (16.7)
Analgesics (NSAIDs) (%)	52 (35.1)	31 (27.9)	11 (57.9)	10 (55.6)
Other (%)	4 (2.7)	3 (2.7)	0 (0.0)	1 (5.6)
None (%)	28 (18.9)	13 (11.7)	2 (10.5)	13 (72.2)

ACE angiotensin-converting enzyme, HTN hypertension, NSAID non-steroidal anti-inflammatory drug

cohort, 11 were men (61%) and the average BMI was 25 (SD 7.8). Most of these patients presented with no COVID-19-related symptoms (78%). A significant proportion had underlying dementia (33%), diabetes (28%), or cerebrovascular disease (22%; Table 3). In keeping with the fact that these patients were rarely recognized to have COVID-19 prior to their transfer, only 17% patients had initiated hydroxychloroquine (Table 4). At HSS, two (11%) patients ultimately received advanced immunotherapies including tocilizumab (1; 5.6%) and IVIG (1; 5.6%; Table 5) in the setting of critical illness. Within this group, eight (44%) developed COVID-19-related respiratory failure requiring intubation and intensive care. The overall hospital length of stay for these patients was 21 days (SD 20). Seven (38.9%) were discharged home, five (27.8%) were discharged to a SNF, one (5.6%) was transferred back to an outside hospital, and five (27.8%) died.

Discussion

COVID-19's surge into New York City in March 2020 led this specialty orthopedic hospital to undergo immediate transformation into a field hospital with broad redeployment of clinical staff into unfamiliar roles far removed from their usual surgical and peri-operative routines. Although each floor's team was staffed by attending physicians trained in internal medicine or family medicine, and each ICU team led by critical care-trained anesthesiologists, many team members were providing care in unfamiliar areas. For instance, available house staff consisted

of orthopedic and anesthesia residents and fellows in rheumatology, physiatry, anesthesiology, and orthopedics, and many orthopedists assumed roles more traditionally taken by medical interns. These factors made caring for complex medical patients more daunting. Despite these and other challenges, over the course of 2 months, 148 COVID-19 patients were well managed and our clinical experience reveals the ability of small institutions to provide high-quality care in emergencies with versatility and at a rapid scale.

Our study has several limitations. Our study was retrospective, observational, and of limited size. We therefore can draw limited conclusions about any specific treatment modality; no comparative assessments of treatment efficacy can be made for hydroxychloroquine or other therapeutic agents, including blockade of interleukin-1 and interleukin-6, immunomodulation with IVIG, or passive immunotherapy with convalescent plasma. Furthermore, because most of our unique cohort consisted of patients neither too sick nor too well to be transferred from another hospital, it may not be fully representative of the disease as it manifests at conventional hospitals with emergency rooms.

We described patients in three subgroups, each with characteristics distinct from most published reports of COVID-19 patients. The largest subgroup comprised COVID-19 patients selected as stable enough to be transferred to HSS but beneficial to offload from overloaded hospitals. Such selection factors likely decreased the proportion of patients in our cohort with quickly improving or quickly worsening clinical courses at the time of hospital

Table 6 Pharmacologic treatment during HSS admission

	Overall	COVID floor admit	COVID ICU admit	Other admit
<i>N</i>	148	111	19	18
Hydroxychloroquine (%)	7 (4.7)	5 (4.5)	0 (0.0)	2 (11.1)
Tocilizumab (%)	4 (2.7)	1 (0.9)	2 (10.5)	1 (5.6)
Remdesivir (%)	4 (2.7)	1 (0.9)	3 (15.8)	0 (0.0)
Convalescent plasma (%)	6 (4.1)	3 (2.7)	3 (15.8)	0 (0.0)
IVIG (%)	4 (2.7)	2 (1.8)	2 (10.5)	1 (5.6)
Vasopressors (%)	23 (15.5)	2 (1.8)	15 (78.9)	6 (33.3)

IVIG intravenous immunoglobulin

transfer. Among inpatients admitted for COVID-19 who were not critically ill when transferred, mortality was zero. Among those who were critically ill when transferred, 26% died. Despite more recent data suggesting a lack of treatment efficacy [2, 7], the vast majority of patients received hydroxychloroquine (with or without azithromycin), based on in vitro and anecdotal evidence and consistent with common practice in this area at the time of the pandemic [13]; most of this treatment was initiated prior to hospital transfer. Limited numbers of our patients were treated with other agents. Remdesivir, which has subsequently been shown to provide modest clinical benefit in randomized trials [1, 14], was prescribed to four critically ill patients (subject to the terms of the emergency use authorization under which it was made available), of whom three survived. Dexamethasone, noted to improve outcomes in preliminary results of a randomized trial [6], was used intermittently in our cohort; a separate analysis of its effects on outcomes in our cohort is underway.

A unique subgroup of 16 patients in our cohort who presented with emergent orthopedic complaints was found to have COVID-19 infection incidentally. Peri-operative outcomes of orthopedic patients with incident COVID-19 remain a question of considerable interest. Early reports suggest significant associated risk of adverse outcomes in trauma patients with COVID-19 [9]. In an effort to limit infected patients from undergoing non-emergent orthopedic surgery, our institution has established extensive peri-operative COVID-19 screening procedures, including questionnaires, nasopharyngeal PCR testing, and antibody testing. This data, along with blood markers of inflammation and immunity that are now being broadly collected, will help us to assess the proportion and health characteristics of recently-infected patients. Further study of this data may inform care of orthopedic patients with COVID-19.

The novel coronavirus has altered the fabric of healthcare for the foreseeable future, and while in June 2020 the incidence of COVID-19 cases declined in New York City, global cases continued to rise. Healthcare systems must continue to examine their flexibility to cope with future systemic stresses. In the setting of acute stressors overflowing healthcare systems, adaptation of specialty surgical hospitals may represent a model of provision of excellent care in settings where adjoining community hospitals require overflow care.

This orthopedic specialty hospital transformed in the course of 3 weeks into a medical-surgical hospital able to provide high-level care to COVID-19 patients. Using guidance from our partners from NYP as well as the expertise of our own medical staff, we successfully treated non-critical COVID-19 patients. Patients at varying levels of acuity were treated by providers in unfamiliar roles. Research across multiple disciplines will provide further insight into optimizing organizational flexibility during a pandemic.

Compliance with Ethical Standards

Conflict of Interest: Andy O. Miller, MD, Milan Kapadia, BS, Meghan A. Kirksey, MD, PhD, Milan Sandhu, MS, Deanna Jannat-

Khah, DrPH, Trang Bui, MD, MPH, K. Keely Boyle, MD, Alexandra Krez, BA, Linda Russell, MD, Jennifer O'Neill, DNP, APN, NEA-BC, Emily M. Stein, MD, MS, Michael W. Henry, MD, and Vinicius C. Antao, MD, PhD, declare that they have no conflicts of interest. Emily M. Stein, MD, MS, reports grants from Novartis and Radius, outside the submitted work. Douglas E. Padgett, MD, reports personal fees from DJO Global, PSI LLC, and Tangen, outside the submitted work.

Human/Animal Rights: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013.

Informed Consent: Informed consent was waived from all patients for being included in this study.

Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

References

1. Beigel JH, Tomashek KM, Dodd LE, et al. Remdesivir for the treatment of Covid-19—preliminary report. *N Engl J Med.* 2020;NEJMoa2007764. <https://doi.org/10.1056/NEJMoa2007764>
2. Geleris J, Sun Y, Platt J, et al. Observational study of hydroxychloroquine in hospitalized patients with Covid-19. *N Engl J Med.* 2020;382(25):2411–2418. <https://doi.org/10.1056/NEJMoa2012410>
3. Goldstein J, McKinley J. Manhattan woman is first confirmed coronavirus case in state. *New York Times.* 2020 Mar 1. Available from: <https://www.nytimes.com/2020/03/01/nyregion/new-york-coronavirus-confirmed.html>. Accessed 2020 Jun 6.
4. Guan W, Ni Z, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med.* 2020;382(18):1708–1720. <https://doi.org/10.1056/NEJMoa2002032>
5. Holshue ML, DeBolt C, Lindquist S, et al. First case of 2019 novel coronavirus in the United States. *N Engl J Med.* 2020;382(10):929–936. <https://doi.org/10.1056/NEJMoa2001191>
6. Horby P, Lim WS, Emberson J, et al. Effect of dexamethasone in hospitalized patients with COVID-19: preliminary report [preprint]. *medRxiv.* 2020 Jun 22;2020.06.22.20137273. Available from <https://www.medrxiv.org/content/10.1101/2020.06.22.20137273v1>
7. Infectious Diseases Society of America. Infectious Diseases Society of America guidelines on the treatment and management of patients with COVID-19. 11 April 2020. Available from <https://www.idsociety.org/practice-guideline/covid-19-guideline-treatment-and-management>
8. Johns Hopkins University and Medicine. COVID-19 Map. Johns Hopkins Coronavirus Resource Center. 2020. <https://coronavirus.jhu.edu/map.html>. Accessed 5 June 2020
9. Mi B, Chen L, Xiong Y, Xue H, Zhou W, Liu G. Characteristics and early prognosis of COVID-19 infection in fracture patients. *J Bone Jt Surg Am.* 2020;102(9):750–758.
10. Moore BJ, White S, Washington R, Coenen N, Elixhauser A. Identifying increased risk of readmission and in-hospital mortality using hospital administrative data. *Med Care.* 2017;55(7):698–705. <https://doi.org/10.1097/MLR.0000000000000735>
11. New York City Department of Health and Mental Hygiene. COVID-19: data summary. Available from: <https://www1.nyc.gov/site/doh/covid/covid-19-data.page>. Accessed 2020 Jun 6.

12. New York State Department of Health. Information on novel coronavirus (COVID-19). Available from <https://coronavirus.health.ny.gov/home>. Accessed 2020 Jun 6.
13. Rhodes NJ, Dairem A, Moore W, et al. Multicenter point-prevalence evaluation of the utilization and safety of drug therapies for COVID-19 [preprint]. *medRxiv*. Published 2020 Jun 5. 2020.06.03.20121558. Available from <https://pubmed.ncbi.nlm.nih.gov/32577687/>, <https://doi.org/10.1101/2020.06.03.20121558>
14. Wang Y, Zhang D, Du G, et al. Remdesivir in adults with severe COVID-19: a randomised, double-blind, placebo-controlled, multicentre trial [published correction appears in *Lancet*. 2020 May 30;395(10238):1694]. *Lancet*. 2020;395(10236):1569–1578. [https://doi.org/10.1016/S0140-6736\(20\)31022-9](https://doi.org/10.1016/S0140-6736(20)31022-9)