INTRODUCTION

In March 2020, the first coronavirus disease 2019 (COVID-19) positive patient was identified in New York City (NYC). Over the next month, the NYC metropolitan area would go on to becoming the worst-affected area in the country. By April, the city would go onto have more confirmed coronavirus cases than China, the United Kingdom, or Iran. By May, NYC would go onto have more cases than any country other than the United States. By June, there were 205,000 cases of COVID-19 and 16,140 deaths in NYC, 374,000 cases and 24,079 deaths in New York State [1].

Living through this pandemic has forever changed the lives of many across the world. New Yorkers witnessed their hospital systems become overwhelmed with a massive influx of critically ill patients. Protocols, workflow, staffing, and individual responsibilities all changed as health care providers scrambled to help where they could. As we see, for the second time this year, a rapid rise in the number of COVID-19 cases in the United States, I wanted to share our experience as vascular surgeons during the first surge from a health care system located in New York City, one of the largest epicenters of the pandemic.

COVID-19 PREPARATION AND ADAPTATION

As COVID-19 cases grew in the NYC area, the Mount Sinai Health System prepared for the surge with re-designation of various areas in our hospital. Make-shift rooms were set up in our lobby and atrium to accommodate more inpatients (Fig. 1). Outdoor tents were established for rapid COVID-19 testing and triaging. Post Anesthesia Care Units were converted into intensive care units (ICUs) for patients who would require ventilator support. Our office staff and hospital leadership secured personal protective equipment (PPE) for all healthcare workers as they would undoubtedly be needed. Outpatient visits were initially reduced, then ultimately cancelled as the number of cases grew. All office personnel was converted to work-from-home where patient phone calls were routed and addressed. Many physicians adopted telemedicine which, while limited by inability to
perform a physical exam or diagnostic study, helped us answer questions and address some of the concerns our patients had.

On March 14, New York Governor Andrew Cuomo issued a statewide “stay-at-home” order (Fig. 2). Despite this, from March through May of 2020, the number of cases grew exponentially, with over 2,000 COVID-19 positive patients in our hospital beds at one time at its peak. Our operating room (OR) availability was significantly reduced, as personnel was limited to emergency coverage teams. The Vascular Activity Condition (VASCCON) has been previously described [3]. As COVID-19 cases rapidly expanded within NYC, the Mount Sinai Health System began to limit, at first, elective cases (VASCCON 3) followed soon by urgent cases (VASCCON 2) allowing only emergent surgeries to be performed. Several urgent procedures were cancelled by my partners (9-cm asymptomatic abdominal aortic aneurysms, chronic limb threatening ischemia, symptomatic high grade carotid artery stenosis) as hospital resources, beds, and ORs were focused on carrying for COVID-19 patients.

**SURGICAL PLATOONS- NON-VASCULAR SURGERY ROLES**

COVID-19 did not affect all of the hospitals in our health care system equally. There are eight hospital campuses comprising the Mount Sinai Health System. Of these, two of our affiliate hospitals in the boroughs of Queens and Brooklyn experienced the most rapid surge of COVID-19 patients. These areas which had a large number of nursing homes and rehabilitation facilities saw an older, more fragile population presenting with severe, acute COVID-19 infections. As the inpatient admissions quickly reached capacity, the emergency rooms became overfilled with patients who were awaiting beds. With all of the hospitals in the areas under a similar situation, the emergency room...
could not go on diversion (Fig. 3).

In response to this, the Department of Surgery drew on the work force throughout the health care system and created platoons, comprised of two surgery attendings (all specialties including vascular surgery), 1 surgery trainee (fellow or senior resident), 1 advanced practice provider (physician assistant or nurse practitioner), and 2 medical assistants. Health care professionals with multiple comorbidities (particularly cardiac and pulmonary), advanced age, and immunosuppression were excluded from the platoons. The idea was that this platoon could be deployed to any area of need within the health care system (inpatient floors, emergency room, ICUs) to help with the work that was needed. Prior to deployment, training sessions were organized to educate the platoons on safe utilization of PPE and up to date care of COVID-19 patients. The inpatient service teams, now with a smaller census due to cessation of elective and urgent cases, were predominantly managed by junior residents with direct attending supervision.

In March 2020, I joined a team comprised of the chief of bariatric surgery, minimally invasive surgery fellow, a general surgery nurse practitioner and two departments of surgery medical assistants. Over the course of the next three months, we were deployed to help in the emergency room and ICUs at Mount Sinai Brooklyn. My experience was quite different than what I had imagined. The hospital, more than needing physician help of diagnosing and managing patients, needed hands for manual tasks—patient transport, sign out, cleaning beds, blood draws, contacting patient families, and arranging transfer to other hospitals within the system to de-burden individual hospitals. It may not have been glorious work, but it was the work that was needed and all members of the surgical platoons dedicated themselves to their roles to help in any shape or form [4].

**PROTECTING LOVED ONES**

As Mount Sinai physicians continued to treat COVID-19 patients in the hospital, one major concern was the health and safety of the family members at home. Health care workers developed various strategies to minimize the exposure of their loved ones. Many physicians moved into hotels near the hospital during the duration of the pandemic. Others developed decontamination stations where they would remove all of their clothing and wipe down all of their belongings in an attempt to disinfect to the best of their ability before entering the home. Some of my colleagues “moved in” into their office where they stayed during the entirety of the pandemic, living in the hospital (Fig. 4).

**LINE SERVICE**

Acutely ill COVID-19 patients required a variety of lines. Frequent need for arterial blood gases necessitated arterial lines. Central venous lines were needed for transfusion of vasoactive agents and volume resuscitation. Non-tunneled large bore dialysis catheters were needed for patients in acute renal failure. Complications encountered during a central line and arterial line placements can be detrimental and could utilize valuable OR and ICU resources that need to be preserved. As physicians from specialties that had not traditionally placed these lines were deployed to care for COVID-19 patients, our vascular surgeons joined a team of interventional radiologists and cardiologists to create a line service to provide safe, effective line placement. This practice was adopted in several institutions throughout the country as well [5]. Depending on the availability of resources (adequate PPE, availability of ultrasound) and the condition of the patient (intubation status, renal failure, need for prone positioning) the optimal location of the central line would vary between internal jugular, subclavian or femoral veins. Our group did find that several of these lines would thrombus shortly after insertion with saline-lock or low-dose heparin lock solutions. We subsequently adapted our practice to instill ports with 5,000 unit/mL heparin solutions [6].

**ACUTE THROMBOSES**

Several authors have highlighted that COVID-19 infections cause hypercoagulability in patients and are thus treated with therapeutic anticoagulation [7]. Additionally,
our institution highlighted that even in patients with mild respiratory symptoms, some patients may present with acute arterial thrombosis as the initial presentation of COVID-19 [8]. Our institution adopted a similar strategy, treating all COVID-19 inpatients with therapeutic anticoagulation. This affected the way we performed our diagnostic studies as well. Patients with a high index of suspicion for a deep vein thrombosis or a pulmonary embolism were empirically treated without obtaining a confirmatory duplex ultrasound or a computed tomography scan, which would have used valuable PPE and exposed the radiology technicians while not changing the patients’ treatment.

While elective and urgent cases were not being performed, we saw several consults for COVID-19 related vascular thromboses. 23.8% of our consults were for venous cases while 76.2% were for acute arterial events. The most frequently involved arterial segment was the femoropopliteal region (38.1%). For patients requiring operative intervention, if the patients were not intubated, every effort was made to perform the procedure under local anesthesia. For patients who underwent operative intervention, postoperative complications were seen in 53.9%, including pneumonia (41.7%), shock (41.7%), acute renal failure (33.3%), cardiac arrest (33.3%), and myocardial infarction (16.7%). The in-hospital mortality rate was 33.3%. The predominant cause of death was hypoxic respiratory failure leading to cardiac arrest. General anesthesia and acute kidney injury on admission were risk factors for mortality.

THE AFTERMATH AND RE-OPENING “NORMAL” PRACTICE

It has been a challenge returning to a normal vascular surgery practice. In June 2020, as the number of COVID-19 inpatients significantly reduced, we began to lift the restrictions placed during the height of the pandemic. We carefully and thoughtfully re-opened our offices, spacing out visit times to prevent multiple patients in the waiting room and to allow thorough sanitization of the exam rooms in between patients. With a long backlog of cases due to a 3-month shutdown of the ORs, vascular surgeons at my institution uniformly worked with high volumes of urgent cases from June to September. Several authors have written that particularly in patients with chronic limb threatening ischemia, patients who had not been monitored and surveilled during the pandemic presented with more severe disease [9,10] leading to higher rates of major amputation. Our anecdotal experience is the same. As we say often in vascular surgery, “Time is tissue.” Patients who may have been salvaged with earlier revascularization and better wound care lost their windows for treatment.

Now in December 2020, while we continue to abide by mandatory masking, social distancing, and regular sanitization of the work place, my vascular surgery practice has essentially returned to “normal,” with similar volumes prior to March. But how long will that last? With winter approaching and cases of COVID-19 climbing again throughout the country, vascular surgeons may once again be called upon to help. We should be ready.

CONFLICTS OF INTEREST

The author has nothing to disclose.

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