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Development of a surgical workforce access team in the battle against COVID-19

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The spread of the novel SARS-CoV-2 coronavirus and the resulting coronavirus disease 2019 (COVID-19) has transformed the landscape of healthcare worldwide. First identified in China in December 2019, it has rapidly spread across the world, with major outbreaks occurring initially in China, Iran, Italy, and Spain. The first case in the United States was identified on January 20, 2020, and it has proliferated across the United States since then.[1] COVID-19 infection is characterized by rapid respiratory compromise, and affected patients frequently require long intensive care unit (ICU) stays. Because of its severity and rapid transmissibility, the World Health Organization declared the disease a pandemic on March 11, 2020. At the time of this writing, >1.2 million cases have been confirmed worldwide, with 320,000 cases and 9000 deaths in the United States.[2]

Several features of COVID-19 have allowed it to proliferate rapidly. It appears to spread much more readily than other respiratory viruses such as seasonal influenza,[3] and it has a long incubation period during which asymptomatic individuals can transmit the infection to others.[4] Once patients become symptomatic, the rate of severe respiratory compromise has been high and patients can require treatment in an ICU. Preliminary data from Italy have suggested that 16% of patients with COVID-19 required ICU management.[5] The long length of stay and high resource usage required for these patients pose particular challenges within the context of the American healthcare system. For example, the United States has fewer physicians per capita (2.6 vs 3.4 per 1000) and hospital beds per capita (2.8 vs 4.7 per 1000) than other advanced nations.[6]

To address the challenges posed by COVID-19, governments have responded by imposing limitations on travel, social interaction, and commercial activity. Similarly, healthcare systems across the United States have made major changes in anticipation of a surge of patients with COVID-19. These changes have included canceling elective procedures, transitioning outpatient encounters to telehealth, cross-training providers from various specialties to treat medical patients, and repurposing various wards into respiratory isolation units.

CONTRIBUTION OF VASCULAR SURGEONS

Vascular surgeons, similar to physicians in many other procedural specialties, have not been on the front lines for this disease, as our medicine, critical care, and emergency medicine colleagues have. Nonetheless, vascular surgeons can contribute in important ways to serve patients and support our colleagues. The promotion of social distancing and judicious use of personal protective equipment have been key components of the response. To that end, at our institution, elective cases were canceled in mid-March and outpatient clinic visits have been replaced by telehealth encounters whenever possible. The result has been a significant decrease in the overall clinical volume across our division and the entire surgery department.

This reduction in surgical volume has allowed us to make changes to the traditional, established models of provider staffing. Our institution has addressed the increased demand for critical care providers by redeploying anesthesiologists to ICUs. It has also redeployed most medical subspecialty fellows to general medicine teams, where they are allowed to practice independently by virtue of their primary board certification. Providers in surgical fields, especially residents, have likewise been redeployed to ICUs and medicine teams. Advanced practice providers have been shifted to the emergency department, testing centers, and call center teams triaging patients with COVID-19.

In addition to supporting these institutional changes, our division has assessed vascular-specific additional opportunities to contribute. We sought out to answer the following three questions:

1. How can we best leverage the skillset of the members of the vascular surgery division, including vascular surgery attending physicians, integrated vascular surgery residents, and advanced practice providers?
2. How can we provide the best service to the hospital system and to our medical colleagues in the context of the current needs?

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Table I. Scope document for surgical workforce access team

Scope
Surgical SWATs will be responsible, 24/7, for responding to all university requests for arterial or venous access, with the exception of the ED; page-to-puncture will be initiated within 60 minutes of pager activation of the SWAT
Resources
Catheter cart with all necessary materials to place arterial catheters, triple lumen central catheters, sheath introducer (Cordis) central catheters, temporary dialysis catheters
Duplex ultrasound machine
Personal PPE
Pager
Personnel
Each SWAT will consist of a SWAT leader (senior vascular surgery resident or attending) and a SWAT junior (junior vascular surgery resident or advanced practice provider), with on-call vascular attending providing back up
Program will be initiated with one team with a commitment to increase the number of teams as necessary; each additional team will require duplication of all resources
Algorithm
Preferred location for central intravenous access in order of priority
Left internal jugular vein
Right internal jugular vein
Left subclavian vein
Right subclavian vein
Femoral artery
Preferred location for temporary hemodialysis access in order of priority
Right internal jugular vein (16-cm long, curved)
Left internal jugular vein (20-cm long, curved)
Left subclavian vein (16- or 20-cm long, straight)
Right subclavian vein (16- or 20-cm long, straight)
Femoral artery (20- or 24-cm long, straight)
Preferred location for arterial line access in order of priority
Radial artery
Brachial artery
Femoral artery
Removal of uncomplicated catheter by the primary team

ED, Emergency department; *PPE,* personal protective equipment; *SWAT,* surgical workforce access team.

3. How can we accomplish these goals while maintaining control of our own workforce?

We ultimately decided that creating a vascular access team would allow us to best address each of these questions and use our unique skillset to assist the hospital's efforts to combat COVID-19.

VASCULAR ACCESS TEAM

As stated previously, a large proportion of hospitalized patients with COVID-19 are critically ill and require ICU care. These patients will typically require central venous and arterial catheterization, and many will require temporary hemodialysis catheters. From conversations with ICU providers in heavily affected areas such as Italy, New York, and Washington, we became aware that these catheter placement procedures consumed a large portion of time for critical care providers. As vascular surgeons, we are uniquely positioned to quickly and efficiently perform these bedside procedures, thereby allowing other providers to focus on areas in which their skillsets can be used best. We worked with our institutional leadership to establish a vascular access team with clear, strong guidelines to signal our commitment to the critical care teams. Specifically, we established the following key parameters (Table I):

1. The team will be responsible 24/7 for placing all central venous catheters, arterial catheters, and temporary dialysis catheters for inpatients on the main campus of our hospital system
2. The team will commit to provide a page-to-puncture time of ≤60 minutes

We also worked with our critical care colleagues to develop a multidisciplinary, standardized, algorithm to guide optimal locations for catheter placement. Prone ventilation has been recommended for adults with severe acute respiratory distress syndrome due to COVID-19 for 12 to 16 hours daily to improve lung recruitment.[7] From our conversations with colleagues in Italy (G. Graselli, personal communication, March 25, 2020), temporary dialysis catheters will function most consistently when placed in the right internal jugular vein position for patients in the prone position. Our multidisciplinary team also concluded that avoiding catheter-related infections was the greatest priority, because these can be devastating in patients who are already critically ill. Therefore, we place dialysis catheters in the following preferred order: right internal jugular vein, left internal jugular vein, subclavian vein, and femoral vein. To preserve the right internal jugular vein for dialysis catheters, we place central venous catheters in the following preferred order: left internal jugular vein, right internal jugular vein, subclavian vein, and femoral vein. For arterial access, we prioritize the radial artery, followed by the brachial artery and then the femoral artery.

STAFFING AND RESOURCE MODEL FOR A SURGICAL WORKFORCE ACCESS TEAM

Our goal was to create a staffing model that was scalable according to volume to respond to a projected surge of patients with COVID-19. In addition, we want to be able to replicate this model at other hospitals in our health care system if the clinical need arises. Therefore, we decided to build surgical workforce access teams (SWATs) around two-person units. Each unit consists of a SWAT leader (fourth- or fifth-year vascular resident or attending) and SWAT junior (junior vascular resident or advanced practice provider). Having two members on each SWAT allows us to facilitate preprocedure tasks such as reviewing history, obtaining informed patient consent, and gathering the equipment necessary to meet our 60-minute target. At our institution, all vascular surgery attendings and residents are credentialed for central and arterial catheter placement.

We structured our coverage such that each SWAT works a 12-hour shift, 7 days in a row. Because of the 60-minute page-to-puncture commitment, these SWATs stay in house while on duty. Staying in house also allows the SWAT to provide 24/7 coverage for all vascular surgery floor and consultation patients, relieving the general surgery night float residents from having to cover these patients and freeing them to take on other COVID-19–related responsibilities. To maintain compliance with the Accreditation Council for Graduate Medical Education requirement of an 80-hour workweek averaged over a 4-week period, providers work for 2 weeks followed by 1 week off. In the case of a vascular surgical emergency or if multiple catheter requests arrive in rapid succession, a backup team is available that will be called to maintain continuous coverage.

Fig. Photograph of mobile catheter placement cart.

Each SWAT requires a separate set of equipment, consisting of a completely self-sufficient mobile catheter cart with all the necessary vascular access supplies (Fig; Table II) and a duplex ultrasound machine. Because we have anticipated that this service will be required for several weeks, we worked with our hospital's supply chain team to ensure a sustainable daily resupply mechanism with fixed par levels for each item. We believe this method will provide significant benefits over ad hoc stocking from existing supply pools, especially as the volume of patients increases. Additionally, a two-person team maintains efficiency and minimizes the number of providers involved per catheter placement, thereby reducing the use of personal protective equipment (Table III).

A further benefit of basing our staffing model around two-person teams is that it maximizes healthcare worker availability. Data from China, Italy, and Spain have suggested that the incidence of COVID-19 infection is high among healthcare workers. At our institution, we had one team member develop symptoms; however, the individual fortunately ruled out and subsequently improved. We designed our structure with a

Table II. List of equipment for mobile catheter placement cart

Drawer	Item	Quantity in cart
1	Gloves, size 6	6
	Gloves, size 6.5	6
	Gloves, size 7	6
	Gloves, size 7.5	6
	Gloves, size 8	6
	Gloves, size 8.5	6
	Tape	5
	Coban bandage	5
	3-Way stopcock	5
	20-Guage × 1-1/2-in. needle	10
	25-Guage × 5/8-in. needle	10
	10-mL syringe	10
	Lidocaine vials (1%, 5 mL)	10
2	Micropuncture set	10
	Arrow set	3
	Arm boards	10
	12-in. extension tubing	10
	Radial drapes	5
3	CHG dressing	20
	Ultrasound probe cover	10
	Sterile gauze	5
	Saline flushes	10
	3-0 Silk suture (Keith needle)	1 box
4	Brachial drape	2
	Body drape	4
	Gown	8
	Blue towels	2
5	Triple lumen kit	2
6	HD catheter, 16-cm, curved	1
	HD catheter, 20-cm, curved	1
	HD catheter, 20-cm, straight	1
	HD catheter, 24-cm, straight	1
Top	ChloraPrep sticks	1 box
	Masks with face shield	1 box
	Bouffant caps	1 box

CHG, Tegaderm, chlorhexidine, gluconate; *HD*, hemodialysis.

backup pool to maintain continuity of coverage and allowing affected providers to rest and recover, and we were able to do so in that case.

CONCLUSIONS

In response to the COVID-19 pandemic, our vascular surgery division has implemented a 24/7 vascular access team to provide catheter placement services throughout our medical center. We believe this model has allowed us to maximize our skillset while providing an important service for the hospital during this crisis. Additionally, this model has allowed us to control our own workforce and preserve workforce availability in the likely event that some of our providers contract the disease.

Although the specific needs at each institution across the United States and the world will vary, the need for timely and expert catheter placement in these critically ill patients will exist everywhere. We believe that vascular surgeons are uniquely positioned to deliver this service expeditiously and safely. We hope that by taking these time-intensive procedures out of the hands of our critical care and medicine colleagues, they will be better positioned to leverage their expertise in caring for the patients with COVID-19.

Table III. Personal protective equipment used by each team member for catheter placement (two members typically involved for each patient)

Item	Quantity per provider	Reusable?
N95 mask	1	Yes
Goggles	1	Yes
Surgical mask	1	No
Bouffant cap	1	No
Gown (nonsterile)	1	No
Gloves (nonsterile)	2	No
Boot covers	2	No
Gown (sterile)	1	No
Gloves (sterile)	1 pair	No

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