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Et al.

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Development of a Surgical Workforce Access Team (SWAT) in the Battle Against COVID-19

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Background

The spread of the novel SARS-CoV-2 coronavirus and its resulting COVID-19 disease 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 country since then.[1] COVID-19 disease 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, there have been over 1.2 million confirmed cases worldwide, with 320,000 cases and 9,000 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 to others.[4] Once patients become symptomatic, there is a high rate of severe respiratory compromise that may require treatment in an ICU; preliminary data from Italy suggests that 16% of COVID-19 patients required ICU management.[5] The long length of stay and high resource utilization 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, health systems across the United States have made major changes in anticipation of a surge of COVID-19 patients. These changes include cancelling elective procedures, transitioning outpatient encounters to telehealth, cross-training providers from various specialties to manage medical patients, and repurposing various wards into respiratory isolation units.

The contribution of vascular surgeons

Vascular surgeons, like 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, there are important ways in which vascular surgeons can contribute to serve patients and support our colleagues. Promotion of social distancing and judicious use of personal protective equipment (PPE) 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 overall clinical volume across our division and the entire department of surgery.

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 may 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 COVID-19 patients.

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

1. How can we best leverage the skillset of the members of the vascular surgery division: 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?
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, while utilizing our unique skillset to assist the hospital's efforts to combat COVID-19.

Vascular access team

As mentioned previously, a large proportion of hospitalized COVID-19 patients are critically ill and require ICU care. These patients typically require central venous and arterial catheterization, and many require temporary hemodialysis catheters. Based on conversations with ICU providers in heavily affected areas such as Italy, New York, and Washington, we became aware that these line 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 offloading other providers to focus on areas where their skillsets are best utilized. 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; in particular, we established the following key parameters (Table I):

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

We also worked with our critical care colleagues to develop a multidisciplinary, standardized, algorithm to guide optimal locations for line placement. Prone ventilation has been recommended for adults with severe acute respiratory distress syndrome due to COVID-19 for 12-16 hours per day to improve lung recruitment.[7] Based on conversations with colleagues in Italy[8], temporary dialysis lines function most consistently when placed in the right internal jugular vein position for patients who are proned. Our multidisciplinary team also concluded that

avoiding catheter-related infections was a top priority, as 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, 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, femoral vein. For arterial access, we prioritize radial artery, followed by brachial artery, followed by femoral artery.

Staffing and resource model for a Surgical Workforce Access Team (SWAT)

Our goal was to create a staffing model that was scalable based on volume in order to respond to a projected surge of patients. 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 SWAT teams around two-person units. Each unit consists of a SWAT Lead (4^{th} or 5^{th} year vascular resident or attending) and SWAT Junior (junior vascular resident or advanced practice provider). Having two members on each SWAT team allows us to facilitate pre-procedure tasks such as reviewing history, obtaining consent, and gathering equipment in order to meet our 60-minute target. At our institution, all vascular surgery attendings and residents are credentialed for central and arterial line placement.

We structured our coverage so that each SWAT team works a 12-hour shift, 7 days in a row. Because of the 60-minute page-to-puncture commitment, these SWAT teams stay in house

while on duty. Staying in house also allows the SWAT team to provide 24/7 coverage for all vascular surgery floor and consult patients, thereby relieving the general surgery night float residents from having to cover these patients and freeing them up to take on other COVID-19 related responsibilities. To maintain compliance with the ACGME 80-hour workweek averaged over a 4-week period, providers work for 2 weeks followed by a week off. In case of a vascular surgical emergency, or if multiple line requests arrive in rapid succession, there is a backup team available that is called in to maintain continuous coverage.

Each SWAT team requires a separate set of equipment, consisting of a completely self-sufficient mobile line cart with all necessary vascular access supplies (Figure 1, Table II) and a duplex ultrasound machine. Because we anticipate 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 volume increases. Additionally, a two-person team maintains efficiency while minimizing the number of providers involved per line placement, thereby reducing the use of PPE (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 suggests that there is a high incidence of COVID-19 infection among healthcare workers. At our institution, we did have one team member develop symptoms, but the individual fortunately ruled out and subsequently improved. We designed our structure with a backup pool to maintain continuity of

coverage while allowing affected providers to rest and recover, and we were able to do so in that case.

Conclusion

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

While the specific needs at each institution across the United States and the world will vary, the need for timely and expert line 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 COVID-19 patients.

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Figure 1: Mobile line placement cart

Table 1: Scope document for SWAT Team

Table 2: List of equipment for mobile line placement cart

Table 3: Personal protective equipment (PPE) used by each SWAT team member for line placement. Two SWAT team members are typically involved for each patient.

TABLE 1

SWAT Team: Surgical Workforce Access Team

- Scope
  - Surgical SWAT teams 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 team

- Resources
  - Line cart with all necessary materials to place A-line, triple lumen central line, cordis central line, temporary dialysis line
  - Duplex ultrasound machine
  - Personal PPE
  - Pager

- Personnel
  - Each SWAT team will consist of a SWAT Lead (senior vascular surgery resident or attending) and a SWAT Member (junior vascular surgery resident or APP), with on-call vascular attending providing back up.
  - Program will be initiated with one team with a commitment to scale up the number of teams as necessary; each additional team will need duplication of all resources

- Algorithm
  - Preferred location for central IV access in order of priority:
    - Left IJ
    - Right IJ
    - Left Subclavian
    - Right Subclavian
    - Femoral

  - Preferred location for temporary hemodialysis access in order of priority:
    - Right IJ (16 cm length, curved)
    - Left IJ (20 cm length, curved)
    - Left Subclavian (16 or 20cm length, straight)
    - Right Subclavian (16 or 20cm length, straight)
    - Femoral (20 or 24cm length, straight)

  - Preferred location for arterial line access in order of priority:
    - Radial
    - Brachial
    - Femoral

- Removal of uncomplicated line by the primary team

TABLE 2

Drawer	Item	Quantity in cart
1	Gloves 6	6
	Gloves 6.5	6
	Gloves 7	6
	Gloves 7.5	6
	Gloves 8	6
	Gloves 8.5	6
	Tape	5
	Coban	5
	3-way stopcock	5
	20Gx1-1/2" needle	10
	25Gx5/8" needle	10
	10cc syringe	10
	Lidocaine vials (1%, 5cc)	10
2	Micropuncture set	10
	Arrow set	3
	Arm boards	10
	12" extension tubing	10
	Radial drapes	5
3	CHG dressings	20
	Ultrasound probe cover	10
	Sterile gauze	5
	Saline flushes	10
	3-0 Silk (Keith needle)	1 box
4	Brachial drape	2
	Body drape	4
	Gown	8
	Blue towels	2
5	Triple lumen kit	2
6	HD catheter 16cm curved	1
	HD catheter 20cm curved	1
	HD catheter 20cm straight	1
	HD catheter 24cm straight	1
Top	Chloraprep sticks	1 box
	Masks with face shield	1 box
	Bouffant caps	1 box

TABLE 3

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


ChloraPrep® With Tint
2% w/v chlorhexidine gluconate (CHG) and 70% v/v isopropyl alcohol (IPA)
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Applicator is sterile if package is intact
HALYARD
L
SPUNBOND BOUFFANT CAP
Blue
SWAT CART
DIVISION OF VASCULAR SURGERY
Armstrong Medical
WARNING
GLOVES
TAPE
10 CC SYRINGES
NEEDLES
LIDOCAINE
MICRO PUNCTURE
RADIAL DRAPE
ARROW CATHETER
ARM BOARD
EXTENSION TUBING
CHG DRESSINGS
ULTRASOUND PROBE COVER
GAUZE
SUTURE
FLUSHES
BODY DRAPES
BLUE TOWELS
GOWNS
TRIPLE LUMEN KITS
HD CATHETERS