USNS COMFORT (T-AH 20) Surgical Services Response to the COVID-19 Pandemic in New York City

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USNS COMFORT deployment New York city: The U.S. Navy Medicine response to the COVID-19 pandemic is the first time a hospital ship has been deployed to address an infectious disease outbreak. The hospital ships, USNS COMFORT (T-AH 20) and USNS MERCY (T-AH 19), were primarily designed as a trauma platform but have been deployed frequently and successfully for global humanitarian assistance and disaster response.[1] The USNS COMFORT (T-AH 20) was activated from a maintenance period and in less than 7 days arrived in New York City (NYC) on March 30, 2020.

The USNS COMFORT (T-AH 20) is a converted oil tanker. She is 894 feet long and the flight deck sits 75 feet above the waterline. The hospital ship has twelve operating rooms including 1 interventional radiology suite, a blood bank, pharmacy, and a central sterile processing department. The radiology department has four x-ray rooms and a computed tomography scanner.

Within the 1000 bed capability of the hospital ship, 80 are configured for critical care.[2] Eleven of these intensive care unit (ICU) beds are isolated in a negative pressure room. The remaining ICU beds are split into open bays with 20 to 23 in each ICU. The remaining beds are in 8 open bay wards that hold 110 to 120 patients in a bunk bed configuration and are ideal for what military triage would term ''walking wounded.''

When the USNS COMFORT (T-AH 20) is fully staffed, there are 1214 military personnel and 63 civilian mariners.[2] Of the 1214 military personnel, 956 are medical staff and 258 support staff, and this includes 330 officers and 826 enlisted. The officers are roomed in 6 or 8 person rooms with bunkbeds for the sleeping arrangements. The enlisted are housed in open bay quarters, also with bunkbeds, and can room over a hundred people.

The ship was launched with the initial objective to offload SARS-CoV-2 negative patients requiring inpatient care from overwhelmed NYC hospitals. By April 6, 2020, the mission expanded to include treatment of patients with known SARS-CoV-2 infection. To prevent spread of infection, the bulk of the health care workers were relocated off the ship and the crew was instructed to wear face masks at all times. The curve of new cases in NYC flattened and the ship discharged or transferred all patients off by April 26, 2020.

To understand how large the medical footprint for the COVID-19 pandemic response was, it can be compared to the recently completed humanitarian mission that spanned 12 countries over 5 months at sea. The surgical specialties represented on that mission included general surgery (3 surgeons), orthopedics (1), plastic surgery (1), ophthalmology (2), urology (1), pediatric surgery (1) and oral maxillofacial surgery (3). There were 1259 surgeries completed on this mission. There were 8 anesthesia providers, 11 perioperative nurses, 4 recovery room nurses and 20 surgical technicians.[3]

The surgical contingent for the COVID-19 pandemic response included 5 general surgeons, 3 orthopedic surgeons, 1 dual-boarded cardiothoracic and intensive care surgeon, 1 urologist, 1 gynecologist, 1 vascular surgeon, 1 neurosurgeon, 1 otolaryngologist, 1 ophthalmologist, and 1 plastic surgeon. There were 15 anesthesia providers, 26 perioperative nurses and 41 surgical technicians. This staffing allowed for anesthesia, general surgery and perioperative services to institute a night float system to prevent provider burnout.

Anesthesia providers manned the pier to stabilize, resuscitate, and transport patients to the ICU and responded to emergencies onboard. One anesthesiologist manned the ICU 24 hours a day split into 12-hour shifts and aided in ventilator management, endotracheal tube exchange, emergent intubations, and central and arterial line placements.

Compared to a typical humanitarian mission there were high volume requirements of unique equipment such as central lines, percutaneous tracheostomy and endoscopic gastrostomy tube sets, consumable surgical packs, large bore drains, stoma appliances and long-term wound care supplies. Additionally, critical ICU supplies for the large volume of patients intubated included prone pillows, tubing and catheters for arterial and central lines, pressure bags, and portable ultrasound machines.

When the USNS COMFORT (T-AH 20)'s mission expanded to include treatment of SARS-CoV-2 positive patients, a team of medical liaison officers (LNO) were deployed in New York City. The surgical members of the LNO team included an orthopedic surgeon, general surgeon, and 3 perioperative nurses. They integrated into the Multi-Agency Command Center at Javits to serve as the primary Navy shore-based point of contact for USNS COMFORT (T-AH 20). The Javits Center Federal Medical Station was established as the Department of Defense (DoD) primary facility for low-acuity, convalescing COVID-19 patients. The LNO team identified appropriate patients from numerous regional referral sources then facilitated communication, logistics, and finally transportation with

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resultant admission to the hospital ship. They instituted outreach teams who would go directly to NYC hospitals on a daily basis, including the hardest hit neighborhoods of the five boroughs. Their knowledge of ship capabilities greatly enhanced the ability to admit those patients who were most appropriate for care on board USNS COMFORT (T-AH 20).

Prior to arrival in NYC, the onboard surgical services discussed the published guidelines for surgical intervention in the era of COVID-19.[4–8] The decision was made to minimize personnel in the operating room during intubation and extubation to only key anesthesia providers. Anesthesia and nursing services also devised a system using a Mayo stand and a clear plastic covering to help limit the spread of aerosolized respiratory excretions. Personal protective equipment was worn per Centers for Disease Control and Prevention and Anesthesia Patient Safety Foundation guidelines to include protective gowns, hair coverings, gloves, face shield or goggles, P-100 respirators during intubation and extubation, and N-95 respirators worn during the maintenance phase of anesthesia.[7]

Anesthesia was completed in 2 provider teams. The ''hands on'' provider was responsible for airway management, medication administration, and patient positioning. The ''clean'' provider charted, handled supplies, and operated equipment that needed to stay clean. An Ultipor-25, mechanical, hydrophobic filter was placed between the Y piece and the circuit to prevent viral contamination of the anesthesia machine and operating room. All patients were preoxygenated for 5 minutes per ASPF recommendations and rapid sequence intubations were completed using video laryngoscopy.[7]

The initial intention of the Directorate of Surgical Services (DSS) was to limit surgical cases to life, limb, eyesight, and damage control surgery with efforts made to minimize use of laparoscopy per SAGES recommendations.[5] After the first intensive care patients arrived, DSS expanded this list in an effort to admit and discharge patients quickly. Due to the extensive community spread of SARS-CoV-2, all patients were treated as if they were positive or asymptomatic shedders. Known positive patients were brought directly into a designated Operating Room (OR) that was only used for SARS-CoV-2 positive patients. These patients were recovered in the OR or returned to the ICU immediately. All operating rooms underwent a terminal clean after every case.

There were over 110 operations and procedures done on the USNS COMFORT (T-AH 20). All airway and facial procedures in SARS-CoV-2 positive patients were completed with portable OR equipment in the negative pressure rooms in the ICU. 46% of total procedures took place in the ICU and 54% of the procedures were performed on SARS-CoV-2 positive patients. Table 1 shows the distribution, volume, and complications of major surgical cases. The remainder of procedures were flexible endoscopy, percutaneous gastrostomy, tube thoracostomy and central line placement. Although there were no deaths in the major surgical cases, the 30-day morbidity and mortality data are not known due to the short nature of the mission.

Patients with complicated appendicitis, diverticulitis and acute cholecystitis initially managed with nonoperative management as recommended by guidelines from the American College of Surgeons were transferred to the USNS COMFORT (T-AH 20).[4] Half of these patients failed nonoperative management after transfer. It is unclear if this was due to initial late presentation due to fear of contracting SARS-CoV-2 or if patients that were selected for transfer to the USNS COMFORT (T-AH 20) were already failing nonoperative management. As noted in Table 1, all of these patients experienced a complication requiring further intervention. Despite extended hospital stays, isolation techniques appeared to be successful in protecting patients from contracting the virus while onboard as verified by negative admission and discharge tests.

TABLE 1. Description of Major Surgical Cases

Surgical Case	Volume (Complication)	SARS-CoV-2 Positive
Operative wound debridement	9	33%
Tracheostomy (percutaneous and open)	7 (†)	71%
Laparoscopic appendectomy	2	0%
Exploratory laparotomy with colectomy	3 (††,*)	0%
Laparoscopic cholecystectomy	3	33%
Miscellaneous	5	0%

*Clavien-Dindo Grade IVa complication.
†Clavien-Dindo Grade IIIa complication.[11]

Communication and collaborative discussion of best practices between surgical and anesthesia services with review of local, national and international guidelines was key to a broad, shared understanding for patient admission and consultation. An area for further refinement would be a preestablished ship-based guideline for triage as the ship did not have the same resource constraints as many hospitals which may have implemented different parameters for triage.[9,10]

Leadership support and emphasis on personal protection and acquisition of appropriate PPE was key. No OR personnel tested positive for SARS-CoV-2 at the conclusion of the mission after performing the vast majority of high-risk aerosolizing procedures as well as surgical intervention on SARS-CoV-2 positive patients. There was 1 positive test in the DSS at the end of a mandatory 14-day quarantine for all USNS COMFORT (T-AH 20) personnel.

The USNS COMFORT (T-AH 20) rapidly shifted from a maintenance period to a fully functional high-acuity medical mission focused on the COVID-19 pandemic. Essential surgical capability is required for a fully functional ICU and to manage acute care emergency surgical procedures. Other key insights include medical liaisons knowledgeable in the ships capabilities to coordinate appropriate patient transfer.

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