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Early Experience in the COVID-19 pandemic from a Vascular Surgery Unit in a Singapore Tertiary Hospital

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1 **Early Experience in the COVID-19 pandemic from a Vascular Surgery Unit in a Singapore**

2 **Tertiary Hospital**

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1 Singapore has been preparing for further pandemics since the 2003 Severe Acute Respiratory
2 Syndrome (SARS) pandemic where Tan Tock Seng Hospital (TTSH), a 1700 bedded tertiary
3 hospital in central Singapore, was the epicenter of the battle against SARS. This led to the
4 opening of the National Centre for Infectious Disease (NCID) in September 2019 which is
5 adjacent to Tan Tock Seng Hospital in the same campus. NCID is a 330-bed purpose-built
6 facility, consisting of a screening centre, isolation and cohort wards, high-level isolation unit,
7 intensive care units, radiology suite, imaging facilities, operating theatres, and an independent
8 laboratory. ¹ NCID together with TTSH is currently leading the national effort for screening and
9 management of COVID-19 patients in Singapore.

10 23 January 2020 marked the day Singapore became one of the first countries outside China to
11 report a case of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) which causes
12 the coronavirus disease (COVID-19). By 6 February 2020, Singapore had the highest confirmed
13 number of cases outside China. ² However, Singapore's sustained multi-pronged efforts in early
14 detection and containment has led to a control in COVID-19 cases and received
15 acknowledgement by Harvard University ³ and World Health Organisation. ⁴

16

17 **Manpower considerations**

18 As the tertiary hospital linked to NCID, TTSH supplies manpower and resources to staff NCID
19 in times of Pandemic outbreaks. This is especially pertinent as NCID caters to 70% of
20 Singapore's COVID-19 screening workload. Till today, it has screened more than 14,000 people
21 and admitted more than 2,000 suspect and confirmed cases. The Department of General Surgery,
22 which the Vascular Surgery Service is part of, has been deploying up to 25% of our staff in 10

1 days cycles to the NCID Screening Centre which also functions as a full-fledged Emergency
2 Department as some patients may have symptoms of both COVID-19 and a concurrent medical
3 or surgical presentation and diagnosis. Deployed surgeons are required to also manage
4 conditions outwith their speciality.

5 To ensure continuity of an elective and emergency Vascular Surgery Service, we maintain at all
6 times at least 2 to 3 Vascular Surgery Consultants within TTSH while the rest of manpower can
7 be deployed out to NCID. As we anticipate that there is already community transmission of
8 SARS-CoV-2, it is vital to have another Vascular Surgery Consultant on standby in case the On
9 call Vascular Surgery Consultant develops symptoms of COVID-19 and requires isolation.

10 Measures to ensure continuity and viability of our service include suspending all annual leave,
11 overseas travel and conference leave. This was implemented early in February 2020, once it was
12 clear that a pandemic was imminent. Healthcare workers returning from China and subsequently
13 other affected hot spot countries were also put on a mandatory leave of absence of 14 days
14 following overseas return to reduce the risk of imported infection. As the pandemic dragged on,
15 staff were allowed to take 3 day breaks of annual leave but must remain contactable and
16 recallable in the event of a surge in COVID-19 patients or Vascular Surgery Emergencies.

17

18 **Social distancing measures**

19 At the start of the outbreak, mask up policy with a surgical face mask was implemented in
20 clinical areas and then further extended to the entire hospital premises. All non-essential
21 Department and Unit meetings including educational plenaries and journal clubs were suspended
22 since early February 2020. We have also been exploring electronic platforms such as Zoom for

1 large group meetings where face to face contact is less important such as residency teaching,
2 undergraduate teaching and some administrative department meetings.

3 Meetings essential for clinical decision making such as the weekly Vascular-Radiology Multi-
4 disciplinary meeting has continued with a mask up policy and attendees sitting 1 metre apart
5 with less than 10 staff attending this meeting.

6 Daily ward rounds are now conducted in 3 separate smaller teamlets, each led by a Consultant
7 comprising 2 to 3 junior staff (Residents and Interns) so as to introduce some segregation
8 amongst healthcare workers of the same specialty. SARS-CoV-2 positive or suspect patients are
9 usually seen by the Consultant alone to reduce exposure to other members of the team.

10

11 **Vascular Surgery Clinics**

12 Clinic resources have been reduced by 50%, but a rapid access Diabetic Foot Clinic remains
13 open as we felt Diabetic Foot patients usually require earlier and more urgent attention. Clinic
14 visits are reviewed and triaged by doctors two to three weeks prior to scheduled visit. Patients
15 with time-sensitive results, needing emergent surgery, or are symptomatic are booked into clinic
16 slots while those on follow-up for chronic conditions or with non-urgent results have their
17 appointments postponed. Phone consults are not infrequently carried out for non-urgent results
18 to allay the anxiety of patients who are going to have their clinic visits postponed. Provisions are
19 made for patients to obtain top-up of chronic medications without clinic consultation, with an
20 option for a home delivery service. New referrals are screened by consultants and appointments
21 deferred depending on the acuity of the presenting complaints.

22

1 **Elective Vascular Surgery**

2 As the pandemic deepens, we not only have new COVID-19 patients but also a duty of care
3 towards our Vascular Surgery patients, many of whom have life or limb-threatening conditions.
4 We continue to perform selected Elective Vascular Operations and all listed elective operations
5 are reviewed and triaged by a Consultant. For each elective operation performed, we ask
6 ourselves these questions

- 7 1) Is this an essential surgery without which the patient will have a catastrophic morbidity or
8 mortality if denied this?
- 9 2) If surgery is denied, will this patient be admitted with a life or limb threatening condition
10 which will utilize more resources if performed in an emergency setting?
- 11 3) Do we have the expertise and resources to perform this surgery taking into consideration
12 that some surgeons may be deployed to manage COVID-19 pandemic patients?

13 Types of elective operations still currently being carried out

- 14 • Limb salvage surgery (Bypass and lower limb angioplasty) for critical limb ischaemia.
- 15 • Aortic aneurysm surgery (Open AAA surgery, Conventional and complex Endovascular
16 Aneurysm Repair including Fenestrated and branched grafts).
- 17 • Vascular Oncology surgery (e.g. Inferior Vena Cava Leiomyosarcoma) or Oncological
18 surgery requiring Vascular reconstruction.
- 19 • Major and minor Amputations.
- 20 • Endovascular salvage of Arteriovenous Fistula/Grafts.
- 21 • Creation of Arteriovenous Fistula (AVF) – We have increasingly started to perform most
22 primary radiocephalic and brachiocephalic AVF surgery under local anaesthetic (LA)

1 during this Pandemic. Tertiary Arteriovenous Access Surgery unfortunately will still
2 require Anaesthesia support for Regional or General Anaesthesia and these are triaged
3 according to how urgent the vascular access needs are (e.g. pre-dialysis patients versus
4 patients on long term indwelling dialysis catheter).

5 As we assume that SARS-CoV-2 is likely to be circulating in the community, patients
6 undergoing essential elective surgery are screened on arrival to the hospital for fever, upper
7 respiratory tract (URTI) symptoms and contact/travel history. Patients with symptoms will be
8 turned away from surgery and be sent to the emergency department for further investigations.

9 We have also taken an additional precaution for the surgical team to remain outside the operating
10 theatre while the patient is being intubated or extubated. The anaesthesiologists intubate and
11 extubate patients wearing Full Tier 2 PPE (N95 masks) or powered air-purifying respirator
12 (PAPR) and the surgical team only enters the operating theatre room 3 minutes after the patient
13 has been intubated and stay outside the operating theatre room when extubation is carried out.
14 The air cycling time in our operating theatres in TTSH are between 25 to 30 air cycles per hour
15 hence 3 minutes will ensure that there has been at least one complete air cycle. This precaution is
16 taken in all patients undergoing elective or emergency surgery even if they have no symptoms
17 suggestive of COVID-19.

18 We are also fortunate to have a close working relationship with our interventional radiologists
19 and this has allowed our patients to continue receiving endovascular therapies including limb
20 salvage procedures in a timely fashion, despite their other pandemic duties.

21

1 **Our experience with COVID-19 positive and suspect patients with Vascular Surgery**

2 **Conditions**

3 We had been involved with COVID-19 suspect and positive patients early in the course of the
4 pandemic. All surgery for COVID-19 suspect and positive patients are performed in a negative
5 pressure operating theatre. When operating on COVID-19 suspect and positive patients, we don
6 Full Tier 2 Personal Protective Equipment (PPE) consisting of N95 mask with goggles for eye
7 protection or powered air-purifying respirator (PAPR) and waterproof sterile gown and double
8 layer of sterile gloves. The operation will be consultant led and surgical team kept lean in order
9 to minimize exposure of the virus to others. Most operations can be performed in full PPE and
10 N95 masks, but our experience suggests that PAPR may be more ideal for prolonged surgery
11 beyond 3 hours as it is more comfortable for the surgeon resulting in less fatigue. We have also
12 found that it is rather cumbersome to wear surgical magnifying loupes when operating with Tier
13 2 Personal Protective Equipment (PPE) or PAPR and vascular surgeons should be aware of this
14 when operating on COVID-19 suspect or positive patients. If the surgery is non-urgent and can
15 be delayed for between 24 to 48 hours, then we will perform two SARS-CoV-2 PCR tests 24
16 hours apart and take direction from our infectious disease physicians about the feasibility of de-
17 isolating the patient if both swabs are negative.

18 A small proportion of COVID-19 patients will have a protracted stormy Intensive Care Unit
19 (ICU) stay requiring prolonged ventilation and inotropic use. This can result in inotropic-related
20 peripheral vasoconstriction and gangrene of upper and lower limbs. One of our COVID-19
21 positive patients had peripheral gangrene of all 4 limbs due to high dose noradrenaline and
22 dopamine use. This was treated conservatively with daily application of povidone-iodine in

1 alcoholic solution to keep the gangrene dry. The patient eventually succumbed to the sequelae of
2 COVID-19 and passed away.

3 We were also called to manage a COVID-19 suspect patient with past medical history of
4 Langerhans cell Histiocytosis who was in the ICU with pneumonia and recent travel history to
5 COVID-19 endemic country. He had bilateral acute lower limb ischaemia and CT Aortogram
6 performed showed an aortic bifurcation saddle embolus and bilateral iliac artery occlusion with
7 the embolic source from a large 3 cm free floating thrombus in the aortic arch just distal to the
8 left subclavian artery. The left lower limb was unsalvageable with mottling and fixed staining up
9 to the groin crease. At the time of surgery, his COVID-19 status was inconclusive and hence
10 surgery was performed in Full Tier 2 PPE. Right femoral embolectomy was performed and a
11 Valiant Navion low profile thoracic stent-graft (Medtronic, Santa Rosa, California) was chosen
12 as his iliac artery diameter measured only 5 to 6 mm. This was deployed just distal to the left
13 subclavian artery to jail the clot in to prevent further embolic events. A left hip disarticulation
14 was then performed as there was ischaemic muscle in the left upper thigh, which would be
15 unsuitable for an above knee amputation. He was eventually found to be COVID-19 negative
16 and de-isolated. He is currently undergoing intensive rehabilitation.

17 Some COVID-19 patients may eventually require Extracorporeal Membrane Oxygenation
18 (ECMO) late in the course of their disease if they develop Acute Respiratory Distress Syndrome
19 (ARDS) or develop pulmonary infiltrates or early fibrosis and their lungs become progressively
20 ineffective for gaseous exchange.⁵ Some of the complications of ECMO which a Vascular
21 Surgeon may be called upon to manage include Deep Vein Thrombosis, Acute Limb Ischaemia,
22 and groin complications such as bleeding from ECMO access. We have been fortunate not to
23 have encountered any of these problems yet.

1

2 **Future Considerations**

3 It is becoming clear that the COVID-19 pandemic will be a long drawn war. As we go further
4 into the COVID-19 pandemic, resources in terms of Operating theatre manpower (anaesthetists,
5 operating theatre nurse and technicians), Critical Care beds, Anaesthetic drugs and Personal
6 Protective Equipment (PPE) may start to become scarce due to disruption of traditional supply
7 chains of such equipment coupled with the possibility of staff being infected requiring quarantine
8 or on sick leave.

9 Some considerations in term of resource preservation include

- 10 • Availability of PPE – Further cuts in elective surgery for PPE rationing will mean setting
11 aside such precious life-saving equipment for healthcare workers in frontline COVID-19
12 facing patients.
- 13 • Availability of Operating Theatres – Operating theatres may be turned into pandemic
14 ICU to meet the needs of COVID-19 critically ill patients. The remaining operating
15 theatres may only be running emergency surgery lists, requiring further reduction in
16 elective surgery
- 17 • Availability of essential drugs eg anaesthetic agents. This may again necessitate scaling
18 back of elective surgery, especially complex major operations.
- 19 • Increase in need for ICU beds for COVID-19 pandemic patients – This situation will
20 mean that there are less anaesthesiologists available to run elective operating theatres and
21 also less ICU beds available for post-operative management following major vascular
22 surgery.

- 1 • Availability of surgical manpower – More surgeons may be called away to perform
2 pandemic duties including staffing screening centres, emergency departments and ICUs.
3 Some surgeons may unfortunately fall ill and require quarantine or admission to hospital.

4

5 **Conclusion**

6 Many of the measures described were a result of the lessons learnt from the 2003 SARS outbreak
7 and were enforced early in this current pandemic. We have not had any SARS-CoV-2
8 transmission amongst surgeons in TTSH yet and believe the stringent measures applied have
9 helped to achieve this.

10 Surgical services form an essential component of the healthcare system but as surgeons we need
11 to be versatile and be able to respond to the ever evolving pandemic situation. We need to step
12 forward and take up arms as an Emergency Physician or Intensivist or whatever roles are
13 required of us to tide our fellow colleagues and patients through these challenging times.

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