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Managing Endovascular Workload during COVID-19 Outbreak—The Singapore Experience

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At the outset and during the throes of the COVID-19 pandemic, as valuable resources are channeled to combat the pandemic, challenges in timely delivery of non-COVID-19-related health care services such as endovascular service arise. As such, this article looks at a tertiary institution's experience in managing its endovascular workload—referenced to the American College of Surgeons' triage of vascular surgery patient acuity-based case classification.

As the COVID-19 pandemic intensifies globally, challenges in timely delivery of non-COVID-19-related health care services such as endovascular service arise because of infection control matters, resource conservation/diversion, and patient/physician movement restrictions. To this end, guidelines on triage of vascular surgery patients were recently published by both the American College of Surgeons (ACS) with the endovascular component adapted by the Society of Interventional Radiology (SIR).^{1,2}

The purpose of this communication is to describe our experience and highlight our approach with reference to the ACS and SIR recommendations in provision of endovascular services during the first ten weeks as the hospital attending to the highest number of COVID-19 patients in the country. This article fulfills our institutional criteria for waiver of ethics board approval.

On January 23, 2020, Singapore confirms her first case of coronavirus patient, and within two weeks reported the highest confirmed number of cases outside of China. Since, our institution is

experiencing the fourth wave of infection—first wave, imported cases from China (<100 cases, February to mid-March); second wave, occurrence of limited isolated local clusters (<1,000 cases, February to mid-March); third wave, returning overseas local and sustained community transmission (>1,000 cases, early April); and fourth wave, decreasing community transmission but explosion of foreign worker dormitory cluster (>5,000 cases, mid-April) which constitutes >60% of the total cases.³ Singapore imposed islandwide limited lockdown, termed “circuit breaker”, in early April.

Our institution, a 1,700-bed tertiary hospital in central Singapore, is co-located with National Centre for Infectious Disease (NCID) and provides manpower and resources to NCID. NCID is a 330-bed purpose-built facility with a screening center, isolation and cohort wards, high-level isolation unit, intensive care units (ICUs), a laboratory, radiology suite, and operating theaters (OTs)—the angiography suite in radiology and OTs have dedicated negative pressure system. This design allowed for

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Table I. Summary of our institution's endovascular case-mix with reference to the ACS and SIR acuity-based case classification

Endovascular case-mix (10-week period during COVID-19 outbreak vs same period in 2019)	Our approach (ACS and SIR recommendation)
Limb ischemia: progressive tissue loss, acute limb ischemia, wet gangrene, ascending cellulitis (<i>n</i> = 67 vs <i>n</i> = 79)	Do not postpone (Do not postpone)
Peripheral vascular disease: chronic limb-threatening ischemia—rest pain or tissue loss (<i>n</i> = 15 vs <i>n</i> = 9)	Do not postpone (Postpone if possible)
Dialysis access: thrombosed, nonfunctional, infected, renal failure with need for dialysis access, tunneled dialysis catheter (<i>n</i> = 186 vs <i>n</i> = 170)	Do not postpone (Do not postpone)
Fistula/dialysis access interventions for thrombosis (<i>n</i> = 2 vs <i>n</i> = 3)	Do not postpone (Do not postpone)
Surgery/embolization for uncontrolled bleeding in unstable patients (<i>n</i> = 4 vs <i>n</i> = 5)	Do not postpone (Do not postpone)
AAA—EVAR	
Scheduled elective (AAA < 6.5 cm, AAA/TAAA > 6.5 cm) (<i>n</i> = 8 vs <i>n</i> = 8)	Do not postpone (AAA < 6.5 cm postpone; AAA or TAAA > 6.5 cm, postpone if possible)
Emergent (symptomatic, dissection, aneurysm associated with infection or prosthetic graft infection) (<i>n</i> = 3 vs <i>n</i> = 2)	Do not postpone (Do not postpone)
Fistula/dialysis access interventions for suboptimal function (<i>n</i> = 69 vs <i>n</i> = 68)	Do not postpone (postpone if possible)
IVC filter placement (<i>n</i> = 9 vs <i>n</i> = 10)	Do not postpone (postpone if possible)

The comparison has shown similar number of cases performed when compared with the same 10-week period in 2019 in brackets (), despite the ongoing outbreak.

AAA, abdominal aortic aneurysm; ACS, American College of Surgeons; EVAR, endovascular aortic reconstruction; IVC, inferior vena cava; SIR, Society of Interventional Radiology; TAAA, thoracoabdominal aortic aneurysm.

physical segregation of infectious cases and is based on our prior experience with SARS-CoV in 2003.

From the outset and during the course of the pandemic, in tandem with the national response to the outbreak, there is rationalization and consequent impact on endovascular service in the form of: i) up to 50% reduction in clinic resources—vascular specialists screening time sensitive versus nonurgent results for all clinic patients as well as new referrals before scheduling of any visits, and provisions made for accessibility to chronic medications without clinic consultations; however, Diabetic Foot Clinic remains accessible as these patients usually require early attention; ii) significant reduction in routine anesthesia support (to free up this valuable resource for ICU and ventilation service); iii) reduced high-risk surgery listing to conserve intensive resources, for example, we postponed a case of migrated thoracic stent which is to be remedied with a customized thoracic arch branch device as there is an inherent

increased risk of aortic dissection or stroke necessitating ICU stay; iv) exposure protection for admitted patients who are at increased risk for COVID-19 mortality⁴; v) finally, manpower redeployment (nurses and doctors to augment COVID-19 work in NCID).

In our institution, the endovascular service is provided jointly by vascular surgery (VS) and interventional radiology (IR). Apart from access to NCID angiography suite, there are two angiography systems sited within radiology department. Our unit conducted a retrospective review of the endovascular procedure case-mix in the 10 weeks since the start of the outbreak and compared with the same period last year; this is then referenced to the ACS and SIR acuity-based case classification (Table I). As per the guidelines, high-acuity cases with life- or limb-threatening conditions are not postponed. Case in point, a patient with history of Langerhans cell histiocytosis developed acute bilateral lower limb ischemia with CT-proven saddle embolus,

bilateral iliac artery occlusion sequelae, and a 3 cm aortic arch free-floating thrombus just distal to the left subclavian artery as the embolic source. Patient underwent right femoral embolectomy and endovascular thoracic stent graft placement to jail the clot and prevent further embolic events.

Our institutional case-mix showed no significant change in the number of endovascular cases in the same 10-week period this year and 2019. The presence of a separate infection center, NCID, to handle bulk of COVID-19 cases notwithstanding the other critical factors that contribute to maintenance of caseload include i) a workflow that promotes nonterritorial collaboration between VS and IR for efficient use of valuable resource, that is, angiography suite, endovascular trained manpower; ii) allocated protected daily endovascular list in the radiology department in its workflow, a necessity to relieve the ever increasing vascular cases; iii) a streamlined workflow to minimize the burden on inpatient hospital bed utilization, most endovascular procedures are performed on an outpatient/short-stay basis under local anesthesia and moderate conscious sedation, latter will minimize reliance on anesthesia—formal and continual accreditation is mandatory in our institution.

To conclude, provision of endovascular service will require a certain degree of rationalization to dovetail with the over-riding medical effort during this pandemic. From our experience, the ACS and SIR case-based classification is a feasible guide, but as this pandemic drags on and looks set to be protracted, innovative solutions will be needed, in resource constrained health care systems, to reduce the impact on patients requiring endovascular care.

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