

Vascular and Interventional Radiology Workflow Management During the COVID-19 Pandemic: Position Statement by the Saudi Interventional Radiology Society

Preface

Coronavirus disease pandemic (COVID-19) is caused by a novel virus from the *Coronavirus* family. The virus was identified on December 31, 2019, as a cause of pneumonia in Wuhan City, China. It was labeled as COVID-19 on January 7, 2020.

The disease is transmitted from human to human through droplet with a high communicability causing a rapid spread. On January 26, 2020, the World Health Organization (WHO) categorized the global risk from COVID-19 as high. By March 11, 2020, the WHO declared COVID-19 as a pandemic.^[1]

On January 21, 2020, the Government of Saudi Arabia started to take precautionary measures to control COVID-19 and limit its spread to ensure the safety of its citizens and residents. Through collaboration of several governmental bodies (The Ministry of Health [MOH], The National Center for Disease Prevention and Control, The Saudi Patient Safety Center, The Ministry of Interior, The Ministry of Municipal and Rural Affairs, The Ministry of Human Resources and Social Development, Medical Societies, etc.), progressive measures and decisions have been implemented including:

- Suspension of travels to and from countries where COVID-19 is endemic on January 26, 2020. On March 15, 2020, all international flights have been suspended, followed by domestic flights and transportation suspension on March 21, 2020
- Suspension of public presence in all sport competitions and games on March 5, 2020, followed by suspension of all sports activities and shutting down

private gyms and sport centers on March 14, 2020

- Suspension of Umrah, then prayers in mosques to prevent gathering on March 4, 2020, and March 17, 2020, respectively
- Suspension of public and private schooling on March 8, 2020
- A daily curfew from 7:00 pm to 6:00 am for 21 days starting from March 23, 2020.

The first reported case in Saudi Arabia was on March 2, 2020, for a citizen arriving from Iran. Until the day of this document (March 22, 2020), there are 511 reported cases, 17 of which have recovered, and no deaths.

As healthcare institutions remain at the frontline during such an outbreak, highest levels of preventive and precautionary measures must be taken to ensure staff and public safety. Vascular and Interventional Radiology (VIR) as a specialty represents a fundamental part of this framework and plays an essential role in its integrity. VIR covers a wide spectrum of disease pathologies, ranging from emergency to elective procedures. In addition, it interconnects several departments in the healthcare system, which can potentially result in unnecessary exposure to both staff and patients. As the influx of critically ill patients may increase, VIR teams will need to adjust workflow to minimize elective procedures and accommodate more emergency interventions. Therefore, the Saudi Interventional Radiology Society (SIRS) is offering this guide to better manage VIR preparedness and workflow during outbreaks, such as COVID-19.

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Hospital Preparedness

This section is covered by the Saudi MOH^[2], WHO^[1], and the Center of Disease Control and Prevention (CDC).^[3] However, the society recommends that hospitals should:

- Initiate a COVID-19 team to deal with suspected and confirmed COVID-19 cases, in addition to providing daily updates and guidance
- Ensure proper staff education regarding infection control measures, hand hygiene, N-95 mask fitting, and careful donning and doffing of appropriate personal protective equipment (PPE)
- Maintain adequate supply of PPE.

Patient Care

- Cancel outpatient VIR clinics and reschedule patients according to their medical needs
- Instruct patients to call the VIR coordinator should their condition necessitates further attention.
- Maintain a list of canceled patients to reschedule them once the outbreak resolves to ensure proper follow-up
- Cease all research activities that involve patients visiting the hospital solely for research purposes
- Minimize mobilization and transfer of COVID-19 patients to VIR suites for procedures and perform bedside procedures whenever possible.

Healthcare Workers

Healthcare workers include physicians (interventional neuroradiologists, vascular interventional radiologists, and nonvascular interventional radiologists), nurses, technologists, trainees, and administrative personnel.

- Assign a team leader for daily two-way communication with the hospital administration to receive updates and plan accordingly
- Move reporting workstations from reading rooms to offices
- Maintain enough workforce according to your institutional needs
- Create separate teams, at least two, with a 1-week on to 1-week off rotations. Each team should be able to function independently to avoid cross coverage. Ensure no physical interaction between the on-site team and the off-site team
- Halt all unnecessary meetings and switch the crucial ones from physical to virtual platforms
- Perform virtual morning rounds or limit staff involvement to the minimum requirement while maintaining social distancing
- Use standard precautions and proper PPE with suspected or positive COVID-19 patients
- Practice social distancing and hand hygiene at all times
- Refer to the Saudi MOH, CDC, and WHO guidelines for proper use of PPE.

Visitors

- Stop visitors from accessing the VIR recovery
- Prevent families and friends from accompanying patients to the VIR department.

Supply

Optimization of resources utilization is a requisite to maintain services sustainability. As suppliers are shutting down and travels are suspended, proper allocation of resources is important to ensure availability of these resources when needed.

- Maintain adequate supply of PPE within the department
- Plan and maintain adequate supply of VIR materials within the department
- Preserve critical and low supply items to critical cases
- Optimize utilization of materials and use the minimum requirement when possible.

Procedure Room

- Designate a VIR suite/procedure room with negative pressure for COVID-19 patients when possible
- Use the standard precaution and follow the guidelines for the periprocedural room and equipment preparation and cleaning
- Limit the number of people involved in the procedure to the minimum safe requirement.

Procedures

In daily practice, balancing between patient care and optimal utilization of resources is imperative. With patient safety in mind, appropriate scheduling of the patients and procedures according to their clinical urgency can be challenging. This becomes more apparent during crisis and outbreaks. The Saudi Patient Safety Center (SPSC) proposed a list of categories to prioritize all surgical and medical interventions performed in Saudi Arabia in collaboration with the corresponding societies [Table 1]. Therefore, SIRS has created the following priority list as guide and reference to the interventional radiologists to better prioritize their patients/procedures [Tables 2-6]. This list was endorsed by the SPSC and is accessible at (<https://spsc.gov.sa/Arabic/pages/guidelines.aspx>).

In addition, the society recommends to:

Table 1: Categories of procedure priority according to the Saudi Patient Safety Center

Priority category	Definition
Priority 1	Emergent: Intervention is required within 24 h
Priority 2	Urgent: Intervention is required within 7 days
Priority 3	Nonurgent: Intervention is required within 30 day
Priority 4	Elective/routine: Intervention can be performed after 30 days

Table 2: Prioritization of vascular, nonvascular, and neurointerventional procedures according to disease category

Category of disease	Vascular and interventional procedures/cases	Priority
Aortic/Arterial	Angiogram with/without embolization for acute bleeding (abdominal, bronchial pulmonary, GI, postpartum, etc.)	1
Aortic/arterial	Embolization of peripheral/visceral AVM	4
Aortic/arterial	Endovascular management of renal artery stenosis	4
Aortic/arterial	Endovascular management of aortic/arterial aneurysm (asymptomatic)	4
Aortic/arterial	Endovascular management of aortic/arterial pseudoaneurysm	1
Aortic/arterial	Endovascular management of aortic/vascular injury/trauma	1
Aortic/arterial	Endovascular management of aortic aneurysm (ruptured)	1
Aortic/arterial	Endovascular management of aortic aneurysm (symptomatic or large)	2
Aortic/arterial	Endovascular management of limb ischemia (acute)	1
Aortic/arterial	Endovascular management of limb ischemia (critical)	2
Aortic/arterial	Endovascular management of limb ischemia (noncritical)	3
Venous	Central or peripheral venous lines	2
Venous	Embolization of female pelvic varices	4
Venous	Embolization of scrotal varicocele	4
Venous	Endovascular management of acute DVT	2
Venous	Endovascular management of acute pulmonary embolism	1
Venous	Endovascular management of chronic venous occlusion	4
Venous	Endovascular management of dialysis fistula, acute occlusion	2
Venous	Endovascular management of dialysis fistula, malfunctioning	3
Venous	Intravascular foreign body retrieval	1
Venous	IVC filter insertion	2
Venous	IVC filter retrieval	3
Venous	Management of varicose veins (endovenous ablation/sclerotherapy)	4
Venous	Portal vein recanalization	4
Venous	Temporary dialysis catheter insertion for acute renal failure/leukopheresis	1
Venous	TIPSS/BRTD for variceal bleeding	1
Venous	TIPSS for ascites	4
Venous	Transjugular liver biopsy/pressure measurement	3
Venous	Tunneled dialysis catheter insertion for ESRD	2
Venous	Venous sampling (adrenal, renal, petrosal, etc.)	4
Venous/lymphatic	Management of low flow malformation (venous/lymphatic)	4
Lymphatic	Lymphatic thoracic duct embolization	3
Oncology	Benign tumor, percutaneous ablation (thyroid, bone, etc.)	4
Oncology	Benign tumors, embolization (uterine fibroids, prostate enlargement, renal AML, etc.)	4
Oncology	Malignant tumor ablation/chemoembolization/radioembolization (liver, renal, lung, etc.)	3
Oncology	Portal vein embolization	3
Body/nonvascular	Airway/GI stenting (acute obstruction)	2
Body/nonvascular	Airway/GI stenting (nonobstructing)	3
Body/nonvascular	Fallopian tubes recanalization for infertility	4
Body/nonvascular	Percutaneous antegrade ureteral stenting	4
Body/nonvascular	Percutaneous biliary drainage for biliary obstruction	2
Body/nonvascular	Percutaneous biliary drainage for biliary obstruction (septic cholangitis)	1
Body/nonvascular	Percutaneous drainage of abdominal/pleural collection	2
Body/nonvascular	Percutaneous drainage of abdominal/pleural/others collection (septic)	1
Body/nonvascular	Percutaneous insertion of feeding tubes	3
Body/nonvascular	Percutaneous insertion of tunneled peritoneal or pleural catheters	3
Body/nonvascular	Percutaneous needle biopsy (solid organs, lungs, thyroid, bone, etc.)	3
Body/nonvascular	Percutaneous needle biopsy of transplanted solid organs (liver, renal)	2
Body/nonvascular	Percutaneous nephrostomy for renal obstruction	2
Body/nonvascular	Percutaneous nephrostomy for renal obstruction (septic)	1
Body/nonvascular	Tube change (biliary, nephrostomy, gastrostomy, cecostomy, etc.)	4
Neuro	Endovascular assessment of epilepsy	4

Contd...

Table 2: Contd...

Category of disease	Vascular and interventional procedures/cases	Priority
Neuro	Endovascular management of acute intracranial aneurysm rupture	1
Neuro	Endovascular management of acute intracranial AVM rupture	2
Neuro	Endovascular management of acute stroke	1
Neuro	Endovascular management of asymptomatic intracranial AVM/aneurysm/dural fistula	4
Neuro	Endovascular management of carotid artery stenosis (asymptomatic)	4
Neuro	Endovascular management of carotid artery stenosis (symptomatic)	3
Neuro	Endovascular management of carotid/vertebral dissection (asymptomatic)	3
Neuro	Endovascular management of carotid/vertebral dissection (with hemorrhage or stroke)	1
Neuro	Fluoroscopy-guided lumbar puncture	2
Neuro	Management of CNS tumors (ablation, embolization, chemoinfusion)	3
Pain management	Facet, nerve root, joint injections, and plexus block/neurolysis	4
Pain management	Percutaneous vertebroplasty/kyphoplasty for spinal fractures/tumors	4

TIPSS: Transjugular intrahepatic portosystemic shunt, BRTO: Balloon-occluded retrograde transvenous obliteration, DVT: Deep venous thrombosis, CNS: Central nervous system, GI: Gastrointestinal, AVM: Arteriovenous malformation IVC: Inferior vena cava, ESRD: End-stage renal disease, AML: Angiomyolipoma

Table 3: Priority 1 interventions (emergent intervention is required within 24 h)

Category of disease	Vascular and interventional procedures/cases	Priority
Aortic/arterial	Angiogram with/without embolization for acute bleeding (abdominal, bronchial pulmonary, GI, postpartum, etc.)	1
Aortic/arterial	Endovascular management of aortic/arterial pseudoaneurysm	1
Aortic/arterial	Endovascular management of aortic/vascular injury/trauma	1
Aortic/arterial	Endovascular management of aortic aneurysm (ruptured)	1
Aortic/arterial	Endovascular management of limb ischemia (acute)	1
Venous	Endovascular management of acute pulmonary embolism	1
Venous	Intravascular foreign body retrieval	1
Venous	Temporary dialysis catheter insertion for acute renal failure/leukopheresis	1
Venous	TIPSS/BRTO for Variceal bleeding	1
Body/nonvascular	Percutaneous biliary drainage for biliary obstruction (septic cholangitis)	1
Body/nonvascular	Percutaneous drainage of abdominal/pleural/others collection (septic)	1
Body/nonvascular	Percutaneous nephrostomy for renal obstruction (septic)	1
Neuro	Endovascular management of acute intracranial aneurysm rupture	1
Neuro	Endovascular management of acute stroke	1
Neuro	Endovascular management of carotid/vertebral dissection (with hemorrhage or stroke)	1

TIPSS: Transjugular intrahepatic portosystemic shunt, BRTO: Balloon-occluded retrograde transvenous obliteration, GI: Gastrointestinal

Table 4: Priority 2 interventions (urgent intervention is required within 7 days)

Category of disease	Vascular and interventional procedures/cases	Priority
Aortic/arterial	Endovascular management of aortic aneurysm (symptomatic or large)	2
Aortic/arterial	Endovascular management of limb ischemia (critical)	2
Venous	Central or peripheral venous lines	2
Venous	Endovascular management of acute DVT	2
Venous	Endovascular management of dialysis fistula, acute occlusion	2
Venous	IVC filter Insertion	2
Venous	Tunneled dialysis catheter insertion for ESRD	2
Body/nonvascular	Airway/GI stenting (acute obstruction)	2
Body/nonvascular	Percutaneous biliary drainage for biliary obstruction	2
Body/nonvascular	Percutaneous drainage of abdominal/pleural collection	2
Body/nonvascular	Percutaneous needle biopsy of transplanted solid organs (liver, renal)	2
Body/nonvascular	Percutaneous nephrostomy for renal obstruction	2
Neuro	Endovascular management of acute intracranial AVM rupture	2
Neuro	Fluoroscopy-guided lumbar puncture	2

DVT: Deep venous thrombosis, IVC: Inferior vena cava, ESRD: End-stage renal disease, AVM: Arteriovenous malformation

Table 5: Priority 3 interventions (nonurgent intervention is required within 30 days)

Category of disease	Vascular and interventional procedures/cases	Priority
Aortic/arterial	Endovascular management of limb ischemia (noncritical)	3
Venous	Endovascular management of dialysis fistula, malfunctioning	3
Venous	IVC filter retrieval	3
Venous	Transjugular liver biopsy/pressure measurement	3
Lymphatic	Lymphatic thoracic duct embolization	3
Oncology	Malignant tumor ablation/chemoembolization/radioembolization (liver, renal, lung, etc.)	3
Oncology	Portal vein embolization	3
Body/nonvascular	Airway/GI stenting (nonobstructing)	3
Body/nonvascular	Percutaneous insertion of feeding tubes	3
Body/nonvascular	Percutaneous insertion of tunneled peritoneal or pleural catheters	3
Body/nonvascular	Percutaneous needle biopsy (solid organs, lungs, thyroid, bone, etc.)	3
Neuro	Endovascular management of carotid artery stenosis (symptomatic)	3
Neuro	Endovascular management of carotid/vertebral dissection (asymptomatic)	3
Neuro	Management of CNS tumors (ablation, embolization, chemoinfusion)	3

CNS: Central nervous system, GI: Gastrointestinal IVC: Inferior vena cava

Table 6: Priority 4 interventions (elective/routine intervention can be performed after 30 days)

Category of disease	Vascular and interventional procedures/cases	Priority
Aortic/arterial	Embolization of peripheral/visceral AVM	4
Aortic/arterial	Endovascular management of renal artery stenosis	4
Aortic/arterial	Endovascular management of aortic/arterial aneurysm (asymptomatic)	4
Venous	Embolization of female pelvic varices	4
Venous	Embolization of scrotal varicocele	4
Venous	Endovascular management of chronic venous occlusion	4
Venous	Management of varicose veins (endovenous ablation/sclerotherapy)	4
Venous	Portal vein recanalization	4
Venous	TIPSS for ascites	4
Venous	Venous sampling (adrenal, renal, petrosal, etc.)	4
Venous/lymphatic	Management of low flow malformation (venous/lymphatic)	4
Oncology	Benign tumor, percutaneous ablation (thyroid, bone, etc.)	4
Oncology	Benign tumors, embolization (uterine fibroids, prostate enlargement, renal AML, etc.)	4
Body/nonvascular	Fallopian tubes recanalization for infertility	4
Body/nonvascular	Percutaneous antegrade ureteral stenting	4
Body/nonvascular	Tube change (biliary, nephrostomy, gastrostomy, cecostomy, etc.)	4
Neuro	Endovascular assessment of epilepsy	4
Neuro	Endovascular management of asymptomatic intracranial AVM/aneurysm/dural fistula	4
Neuro	Endovascular management of carotid artery stenosis (asymptomatic)	4
Pain management	Facet, nerve root, joint injections, and plexus block/neurolysis	4
Pain management	Percutaneous vertebroplasty/kyphoplasty for spinal fractures/tumors	4

TIPSS: Transjugular intrahepatic portosystemic shunt, AVM: Angiomyolipoma

- Limit procedures to inpatients and ambulatory priority category 1 and 2
- Limit interventions to patients whom intervention may affect their management/outcome
- Perform bedside procedures when possible for COVID-19 patients
- Use your clinical judgment for patients under priority category 3
- Reschedule patients under priority category 4.

Future Directions

This pandemic may change how medicine is going to

be practiced across the globe. It may affect businesses, hospitals' design, patients' triage, etc. Developing a healthcare system and infrastructure that can function smoothly during crisis is imperative. Telemedicine and virtual meetings represent an excellent advantageous surrogate of a helpful infrastructure.

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Conflicts of interest

There are no conflicts of interest.

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