Interventional radiology and COVID-19: How to face the challenge?

Sreedhara B Chaluvashetty, Naveen Kalra, Harish Bhujade, Shyamkumar N Keshava, Chander Mohan

Department of Radiodiagnosis and Imaging, Postgraduate Institute of Medical Education and Research, Chandigarh, Department of Radiology, Christian Medical College, Vellore, Tamil Nadu, Department of Interventional Radiology, BLK Superspeciality Hospital, New Delhi, India
Dr Naveen Kalra is a Member of the Interventional Radiology Subspecialty Group of IRIA/ICRI and Dr Chander Mohan is the Head of the Interventional Radiology Subspecialty group of IRIA/ICRI

Correspondence: Dr. Naveen Kalra, Department of Radiodiagnosis and Imaging, Nehru Hospital, Postgraduate Institute of Medical Education and Research, Chandigarh - 160 012, India. E-mail: navkal2004@yahoo.com

Abstract

With the sudden outbreak of Coronavirus disease-19 (COVID-19) in China, and its rapid spread across the continents over a short period of time, healthcare workers are posed with the challenge of managing these patients as well protecting themselves from getting infected. Since interventional radiology deals with both elective and emergency services, wherein close patient contact is a norm, there is a substantial risk of acquiring and transmitting infection. Given the circumstances, it is imperative to develop broadly applicable guidelines to utilize the available resources in an optimal fashion and limit transmission of disease. This brief review deals with infection control measures within the Interventional Radiology department or section and possible recommendations that can be adopted at the institutional level.

Key words: COVID-19; interventional radiology; protocol and guidelines

Introduction

Since the onset of global Coronavirus Disease 2019 (COVID-19) pandemic in December 2019 in Wuhan, China, there has been a rapid and exponential increase in the active infection as well as mortality all over the world. In India, there is gradual to rapid increase in the number of positive cases since March last week with more than 200000 cases reported at the time of this article.[1] With the variability in asymptomatic phase of infection and asymptomatic carriers acting as a source of infection spread, containment of disease spread along with treatment has become the major goal for the government as well as healthcare providers. Like with other surgical and medical departments, Interventional Radiology (IR) section should also continue its services safely and effectively while taking necessary precautions in reducing the risk of transmission to the staff involved in procedures as well as other patients seeking the services within the IR section. With the so far data available about COVID-19 and its mode of transmission, IR needs to make satisfactory and acceptable protocols and guidelines that maintain optimal patient care without compromising on precautionary measures for the IR staff.

Workforce Segregation and Functioning of IR Section

In the context of the rapid increase in COVID positive patients over the last few days, the healthcare system in...
Nonvascular emergencies like all those highlights the require immediate attention. Biliary drainage, and percutaneous nephrostomies also collections and abscesses, percutaneous transhepatic with severe acute pain, percutaneous drainages for large kyphoplasty/vertebroplasty for compression fractures interventional pain management for severe acute pain in non-COVID patients. Greater than 5.4 cm, and massive pulmonary embolism ischemia, symptomatic or abdominal aortic aneurysm iliofemoral deep vein thrombosis (DVT), acute mesenteric inflammatory/infective etiology), vascular complications of acute pancreatitis, critical limb ischemia, acute symptomatic iliofemoral deep vein thrombosis (DVT), acute mesenteric ischemia, symptomatic or abdominal aortic aneurysm greater than 5.4 cm, and massive pulmonary embolism in non-COVID patients. Nonvascular emergencies like interventional pain management for severe acute pain or severe exacerbation of chronic underlying condition, kyphoplasty/vertebroplasty for compression fractures with severe acute pain, percutaneous drainages for large collections and abscesses, percutaneous transhepatic biliary drainage, and percutaneous nephrostomies also require immediate attention. Table 1 highlights the examples of emergency IR procedures; however, the list need not be restricted to what has been mentioned. Whenever there is a doubt, case by case approach is needed. In such situations, interdepartmental discussions will be useful in arriving a suitable decision. Oncological procedures like transarterial chemoembolization, transarterial radioembolization, tumor ablations, biopsies, and port insertions should be spaced evenly to reduce workload. Few of the semiurgent procedures would require an assessment at the individual level for disease morbidity and mortality before any decision is taken [Table 1].

**Elective Procedures**

The nonurgent elective procedures that can be postponed for 1 to 3 months include fine needle aspiration cytology for benign entities like thyroid nodules and granulomas, peripheral arteriovenous malformation embolization, prostate artery embolization, fibroid embolization, varicocele embolization, angioplasty for Rutherford 1-3 (claudication), asymptomatic visceral artery or carotid artery stenosis, asymptomatic DVT, asymptomatic abdominal aortic aneurysms less than 5.4 cm, and CEAP class 1-5 chronic venous insufficiency [Table 1]. All those patients who have been scheduled for elective procedures should be contacted and informed about the decision and counselled about the future course of action depending on the healthcare crisis.

**IR in Suspected or Positive COVID Patients**

**Modes of transmission, precautions, and personal protective equipment**

The standard protocol of infection control and prevention is increasingly relevant in the present scenario. Standard precautions apply to all patients at all times irrespective of their infective status and are the mainstay of infection control. Personal protective equipment is the protective equipment worn to prevent exposure to hazardous biological or chemical agents. Based on the mode of disease transmission, they can be simple, such as face masks and nonsterile examination gloves, or complex, such as positive-pressure isolation suits worn in high-containment laboratories.

Surgical masks are fluid resistant and primarily protect from splashes of body fluids and blood, reducing droplet transmission. Respirators are protective equipment that filters out airborne particles, as well as toxic gases and vapors. The N95 respirators filter out 95% of airborne particles of particulate size less than 0.3 μm, and are the USA equivalent of the European FFP2/FFP3 (filtering facepieces) masks which filter at least 94%/99% of particles, respectively. Alternatively, power air-purifying respirators which contains half-face mask, helmet/hood or
Eye protection devices include goggles or safety glasses and face shield which protect the eye from splashes of body fluids or chemicals.

According to the available data, severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) transmission is primarily through droplet transmission and contact routes (fomite transmission) with chances of airborne transmission in specific circumstances like aerosol-generating procedures.\[^2,3\] Eye protection devices include goggles or safety glasses and face shield which protect the eye from splashes of body fluids or chemicals.

Staff protection measures

Since IR staff are involved in examining, interacting, and treating patients directly, they are at risk of a high degree of infection transmission. COVID being a respiratory infection with droplet and contact transmission, it is imperative to have handwashing and infection control measures in place. All the staff members (faculty, technologists, nursing staff and hospital attendants) should have received adequate training from the hospital and department COVID team for maintaining personal and hand hygiene during and after the procedure, when and what PPE to use, how to don and doff PPE to prevent self-contamination, and how to dispose of PPE.

Hand hygiene should be performed with alcohol-based hand rub containing at least 60%–95% alcohol or by washing hands with soap and water for at least 20 s as described in Figure 1. It should be done before and after all patient interaction or contact with potentially infectious material, and before putting on and after removing PPE. The sequence of putting on and removing PPE is demonstrated in Figures 2 and 3 and is also available online.\[^7,8\] Healthcare personnel should be able to demonstrate competency in performing appropriate infection control practices and procedures before caring for patients. Respirator or facemask should be donned before entry into the patient area. Disposable

### Table 1: Broader classification of IR services for the management of resources and reduction of cross-transmission

<table>
<thead>
<tr>
<th>Emergency IR services</th>
<th>Elective services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vascular Procedures</strong></td>
<td>Peripheral AVM embolization</td>
</tr>
<tr>
<td>Acute ischemic stroke</td>
<td>Prostate artery embolization</td>
</tr>
<tr>
<td>Acutely ruptured aneurysms</td>
<td>Fibroid embolization</td>
</tr>
<tr>
<td>Life-threatening hemorrhages</td>
<td>Varicocele embolization</td>
</tr>
<tr>
<td>Vascular complications of acute pancreatitis</td>
<td>Angioplasty for Rutherford 1-3 claudication</td>
</tr>
<tr>
<td>Critical limb ischemia</td>
<td>Asymptomatic visceral artery or carotid artery stenosis</td>
</tr>
<tr>
<td>Acute symptomatic ilievemoral deep vein thrombosis</td>
<td>Asymptomatic deep vein thrombosis</td>
</tr>
<tr>
<td>Acute mesenteric ischemia</td>
<td>Asymptomatic abdominal aortic aneurysms &lt; 5.4 mm</td>
</tr>
<tr>
<td>Symptomatic abdominal aortic aneurysm &gt; 5.4 cm</td>
<td>CEAP class 1-5 chronic venous insufficiency</td>
</tr>
<tr>
<td>Massive pulmonary embolism</td>
<td>FNAC/Biopsy of suspected benign etiologies like thyroid nodules</td>
</tr>
<tr>
<td>Port placement/vascular access</td>
<td></td>
</tr>
</tbody>
</table>

**Nonvascular Interventions**

Interventional pain management for severe acute pain

Kyphoplasty/Vertebroplasty for compression fractures with severe acute pain

Percutaneous drainages for a large collection and abscess

Percutaneous transhepatic biliary drainage and percutaneous nephrostomies in acutely infected system

Procedures that are semiurgent and can be spaced at individual discretion based on the stage of presentation

Transarterial Chemoembolization (TACE)

Transarterial Radioembolization (TARE)

Ablations of tumors

Biposies of suspected malignant lesions

### Table 2: Aerosol-generating procedures performed in the IR suite

<table>
<thead>
<tr>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung biopsy</td>
</tr>
<tr>
<td>Pleural fluid aspiration and drainage</td>
</tr>
<tr>
<td>Chest tube for pneumothorax</td>
</tr>
<tr>
<td>Lung tumor ablation</td>
</tr>
<tr>
<td>Bronchial artery embolization</td>
</tr>
<tr>
<td>Percutaneous/endovascular embolization of Rasmussen aneurysm</td>
</tr>
<tr>
<td>Bronchial stenting</td>
</tr>
<tr>
<td>Nasogastric tube (NG tube) placement</td>
</tr>
<tr>
<td>Gastrostomy and Gastro-jejunosotomy tube placement</td>
</tr>
<tr>
<td>Gastrointestinal stent placement</td>
</tr>
</tbody>
</table>

---

**Figure 1**

---

**Figure 2**

---

**Figure 3**
Chaluvashetty, et al.: Challenges for interventional radiology in the times of COVID-19

Respirators and facemasks should be discarded after exiting the patient’s care area and closing the door.\(^9\)

**Functional area or procedure room**

To simplify the functioning of IR, the procedures and functional area should be ideally segregated into COVID and non-COVID patients, and all suspected COVID patients should be tested for COVID before considering for any interventions.

All ultrasound-guided procedures for COVID positive patients should be done at the bedside. For fluoroscopic-guided procedures, the patient needs to be shifted to the IR suite. Institutes or hospitals with 2 or more IR suites should earmark 1 IR suite exclusively for COVID positive patients to reduce the chance of cross-transmission.

In a setup with single IR suite wherein complete isolation from rest of the department is not feasible, the interventional area must be separated from the rest of the department with a controlled environment and access, compatible with an ISO 7 level of cleanroom class determined by acceptable maximum concentration limit of particles of size \(\geq 0.5\ \mu m\) and above to be less than 352000, and on an average of 30–60 air changes per hour through the HEPA air filters within the IR suite/cleanroom.\(^9,10\) The interventions for COVID positive patients should be done preferably as follows:

---

**Figure 1:** Hand wash technique

---

**Figure 2:** Steps of donning of PPE in IR suite

---

**Donning of PPE**

- Surgical scrub, shoes, shoe cover, and surgical cap
- Perform Hand Hygiene
- First pair of gloves
- Full body Hazmat suit
- Leg covers and pull them up to mid-calf/knee
- N95 respirator (leak check)
- Goggles
- Surgical hood
- Face shield
- Lead apron
- Disposable long sleeve surgical gown
- Second pair of gloves
- N95 respirator – Checking for air leak

---

**Figure 2:** Steps of donning of PPE in IR suite
the last case of the day with necessary precautions and post-procedure disinfection and fogging of the DSA suite to reduce cross-transmission. If the procedure is done earlier in the day, the room should be kept free after cleaning for approximately more than 1 hour. A similar practice is to be followed for CT-guided procedures also.

There must be separate areas/rooms for donning and doffing. Both areas should have full-length mirrors, lead hangers, and hand sanitizer. The flow chart of steps of donning and doffing should be kept in respective areas. Doffing room should have a separate marking of clean and dirty areas with two labelled containers (yellow color bag for disposable items and red color bag for reusable items) to be placed in the dirty area.

Biomedical waste (BMW) should be collected at one specified place within the lab in a container, which will be disposed of by the support staff wearing full PPE. BMW should be disposed of as per hospital biomedical management guidelines. Specific importance should also be given to developing a patient shifting corridor from the ward/ICU to the IR suite.

Patient requisition, consent, and preparation

All suspected patients should have had COVID testing according to the ICMR/Hospital guidelines before entering the IR department. The clinical teams should be clearly directed to let the IR team know when a procedure is being requested for a confirmed COVID-19 patient. Requisition form should not be accepted physically from the clinical team, instead, the form would be prepared by the IR staff after verifying from the file where the procedure requested should be clearly mentioned. Specific care should also be taken while dealing with patient radiology and documents. A view box and desk should be specifically earmarked for the same, which should be cleaned with alcohol disinfectant after returning the documents. All patients should be wearing N95 or equivalent masks, surgical caps, and gown before entering the IR premises. The patients’ attendants and hospital staff involved in patient shifting should be wearing N95 or equivalent masks and eye protection/face shield. Patient movement should be restricted to designated area, and laboratory/biochemical workup and portable imaging should be performed at the bedside whenever feasible.

Following the patient transfer, entry of all personnel into the procedure room should be allowed only after sufficient time has elapsed for air changes to remove potentially infectious particles. A simplified workflow chart [Figure 4] can be prepared based on the hospital set up for smooth functioning of the section and to protect health care workers and patients from acquiring an infection while at the same time providing IR services to the patients who deserve it.

Cleaning and Disinfection

The IR department should develop a policy to clean, sanitize, and disinfect all the environmental surfaces exposed during interventions. General principles of cleaning and sanitization should be maintained regardless of the COVID positivity. Neutral detergent and warm water solution should be used for all routine and general cleaning purposes.

To disinfect the contaminated area with spillage of blood or body fluids, 1% sodium hypochlorite solution is recommended. The spill should be covered with 1% sodium hypochlorite solution for 10–20 min followed by cleaning up of the spill and discard into the infectious waste bin. Subsequently cleaning of the area with a detergent solution and warm water is recommended, especially to protect metal surfaces from corrosive effects of bleaching solution or

Figure 4: Simplified flow chart for IR services
of clinical status and procedure requested. In case of any
questionnaire and temperature check for COVID status
patients coming to IR should be screened with a standard
transmission from asymptomatic cases or carriers. All
within the IR section with specific precautions to avoid
for non-COVID patients in the routine designated area
IR in Non-COVID Patients

All inpatient and emergency IR services continue to operate
for non-COVID patients in the routine designated area
within the IR section with specific precautions to avoid
transmission from asymptomatic cases or carriers. All
patients coming to IR should be screened with a standard
questionnaire and temperature check for COVID status
at the nursing station before interventions, irrespective
of clinical status and procedure requested. In case of any
suspicion, rapid isolation of the patient, the immediate
contact of hospital infection control committee, and testing
for SARS CoV2 should be contemplated.

All patients and attendants visiting the department should
be wearing surgical masks compulsorily. Not more than one
visitor should be allowed to accompany the patient, and the
visitor should also be assessed regarding travel history and
clinical symptoms. If found to have affirmative history, the
visitor should be asked to leave the premises.

Staff protection measures: Surgical mask is advised in
dealing with low-risk patients without any risk factors for
COVID-19 disease. For patients with moderate to high risks
like patients with pneumonia and those who are under
quarantine for close contact with COVID-19 patients, N95/
FFP2 mask is recommended. Some of the aerosol-generating
procedures (AGP) in IR include pleural drainage, lung
biopsy (chances of hemoptysis during the procedure which
can incite violent coughing and aerosolization), ablation
of lung tumors, and bronchial artery embolization. For
these procedures, eye protection with N95/FFP2 mask is
recommended.[9]

Staff Surveillance and Social Distancing

Temperature monitoring of all staff is recommended at
least twice daily. This surveillance helps to identify fever
clusters among the IR staff which could indicate disease
transmission among HCWs. Staff who are unwell should
be given leave and monitored appropriately.

Many reports have shown that people with comorbidities
like age above 60 years, smokers, hypertensives, diabetics,
chronic kidney disease, chronic heart disease, those with
previous lung damage, and cancer are at higher risk of
acute respiratory distress syndrome if infected. Exclusion
of these IR staff from coming into contact with confirmed
COVID-19 cases is prudent.[9]

Social distancing is one of the key strategies to prevent HCW
to HCW infection. Hence, all referrals to IR should be by
phone or by online request avoiding face-to-face consult as
much as possible. Video or teleconferencing should be used
for meetings, including multi-disciplinary team discussions
tumor board. HCWs are most vulnerable for infection
transmission during lunchtime as masks are removed.
Hence, all staff should be encouraged to have their lunch
individually or in small groups within their respective
teams, maintain a safe distance between them. With
community spread becoming more rampant over a while,
the chances of health care worker acquiring COVID infection
within the community may be higher than at the workplace.
If social distancing measures are not implemented at
the institutional and community level, a large group of HCW
can potentially be infected or quarantined if any of the staff

Ultraviolet (UV) disinfecting devices use UVA or UVC
light to produce a germicidal effect. UV light is capable of
destroying viruses, bacteria, and fungi. The SARS-CoV-2
virus has not yet been specifically tested for its ultraviolet
susceptibility; however, many other tests on related
coronaviruses have concluded that they are highly
susceptible to ultraviolet inactivation. They are intended to
augment disinfection of health care environmental surfaces
after manual cleaning has been performed. These UV
disinfecting devices can also be used to sterilize reusable
protective equipment like face shield and respirators/
masks.[15]

All work stations, IR suites, and departmental areas in use
should be cleaned and disinfected before and after a new
team member uses it. Apart from this, mandatory cleaning
should be undertaken at least 3-4 times a day to reduce any
risk of transmission.

powder. For large quantity spills, it is advisable to use 10% sodium hypochlorite as a disinfectant. Since bleach solution
becomes rapidly unstable, daily fresh preparation or changing on becoming dirty/turbid is suggested. For smooth
metal surfaces, tabletops and other surfaces on which bleach
cannot be used, alcohol (70% and above), isopropyl, ethyl alcohol, or methylated spirit should be used.[11]

While using ultrasound during IR procedures, it is advisable to use probe covers and transparent drapes over the ultrasound system to reduce the contamination from direct patient contact and droplets transmission. Once the patient is shifted, these covers should be discarded and the ultrasound system including keyboard, screen, handlebar, cable, and transducer should be initially cleaned with a mild soft cloth moistened with mild detergent/soap water, followed by water. For chemical disinfection, low-level disinfectant like sodium hypochlorite, 60%-70% ethanol, 0.5% hydrogen peroxide, or 70% isopropyl alcohol can be used, and preferably by using a soaked gauze or cloth to wipe the surfaces rather than direct pouring on these surfaces. The instructions and recommendation for cleaning the particular ultrasound system during COVID-19 are also available at manufacture’s website. Similar cleaning and disinfection protocol is followed to disinfect CT gantry as well.[11-14]

Indian Journal of Radiology and Imaging / Volume 31 / Supplement 1 / January 2021
members acquire COVID-19. At present, there is no strong recommendation for prophylactic drugs.

**Real life challenges**

There are patients with medical and surgical emergencies with asymptomatic COVID positive status requiring emergency interventions like stroke or life-threatening bleeding. In the initial days, we had to perform interventions without knowing COVID status due to limited availability of the testing kits and time required for testing. In such circumstances, we took complete protection using PPE kits with proper donning and doffing, and we did a case of bronchial artery embolization for massive hemoptysis and acute ischemic stroke intervention in one patient without knowing the COVID status. Another common challenge that we encountered was with respect to diagnostic procedures like biopsies and drainages wherein it was impossible to get COVID status checked for all patients due to large volume of cases, and hence we adopted to doing all procedures with N95 mask, face shield, and impervious gowns for self-protection.

Considering the dynamic nature of the COVID pandemic, it is very important to keep up to date with regards to the disease spread, IR society recommendations, as well as government regulations. Some journals have published rapid research and review articles. Regular meetings and trainings are important at the hospital/institutional levels.

**Conclusion**

With a rapid increase in the number of COVID positive patients, it is important to understand the disease, symptoms/presentation, and mode of transmission so that necessary precautions and measures can be taken to protect healthcare workers and prevent cross-transmission while delivering the required IR services. The above recommendations can be used as a framework on which specific protocol can be set at the institutional level to reduce risk to staff and deliver quality patient care. The IR section should continue the service especially for emergency procedures and important elective procedures in these unprecedented times. As the knowledge about COVID-19 infection keeps increasing, the guidelines and recommendations for infection control for this pandemic may also keep changing making it a dynamic process.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**


