

Reorganizing Cross-Sectional Interventional Procedures Practice During the Coronavirus Disease (COVID-19) Pandemic

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OBJECTIVE. The purpose of this article is to present strategies and guidelines that can be implemented in the performance of cross-sectional interventional procedures during the coronavirus disease (COVID-19) pandemic.

CONCLUSION. Radiologists who perform cross-sectional interventional procedures can take several steps to minimize the risks to patients and radiology personnel, including screening referred patients to decide which procedures can be postponed, using appropriate personal protective equipment (PPE), minimizing the number of people involved in procedures, preserving PPE when possible, and applying proper room and equipment cleaning measures.



On December 31, 2019, the World Health Organization (WHO) was notified about a cluster of 41 patients in Wuhan, China, who had pneumonia. The pathogen was identified as a novel coronavirus, termed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and its disease manifestation was named coronavirus disease (COVID-19). Since then, SARS-CoV-2 has spread rapidly, and on March 11, 2020, WHO classified the COVID-19 outbreak as a pandemic.

Health care providers and hospitals have had to adapt quickly to this rapidly changing health care challenge. A recent statement on COVID-19 preparedness at the department level [1] highlights the complexity of the changes for a radiology department. The purpose of this article is to provide guidance regarding cross-sectional interventional procedures to minimize risk of spreading the infection to both patients and health care personnel while preserving equipment and supplies during the COVID-19 pandemic. The guidance is drawn from national guidelines and from the expertise of the members of the Society of Abdominal Radiology Cross-Sectional Interventional Radiology Emerging Technology Commission. Information being received about COVID-19 and preventive measures is rapidly changing, however, and can vary depending on institutional and regional circumstances. Therefore, the guidance we present should also be informed by updates from the U.S. Centers for Disease Control and Preven-

tion (CDC) and WHO; consideration of local factors, such as the availability of personal protective equipment (PPE) and hospital beds; and consultation with local experts.

Triage of Cross-Sectional Interventional Procedures Resource Utilization

Cross-sectional interventional procedures are performed under CT, ultrasound, fluoroscopy, or MRI guidance and include fluid aspiration, (thoracentesis, paracentesis, and fluid collections), drainage catheter placement, percutaneous biopsy, and tumor ablation. All cross-sectional interventional procedures require the use of PPE by members of the procedure team, which in many procedures includes one or two physicians (if the procedure is performed with a trainee), a nurse, and a technologist. Though sterile gowns and gloves are typically used by the physicians only, up to four masks may be needed for each procedure (one for each physician, one for the technologist, and one for the nurse). Some cross-sectional interventional procedures require the use of general anesthesia and ventilators, and some may require admitting the patient for observation or management of postprocedure complications, requiring the use of a hospital bed and associated resources.

During the COVID-19 pandemic, resources with regard to PPE, ventilators, and health care workers can be limited and must be preserved [2]. Therefore, in addition to a stan-

dard risk-to-benefit analysis of each cross-sectional interventional procedure request, resource utilization and risk of patient and health care worker exposure to SARS-CoV-2 should be considered.

Urgency and Impact of Procedures

It is unclear how long the current pandemic will last, with its associated judicious use of PPE and ventilators and the need for social distancing to decrease the rate of spread among health care workers and patients. Some procedures can be delayed 1 month but not 3 months, whereas others can be safely delayed even 6 months. If delaying a procedure will not adversely affect patient outcome, postponement should be considered. Furthermore, risk of complications, albeit low, can often result in use of hospital and ICU beds, which can strain an already burdened health care system and potentially expose uninfected patients to COVID-19. Thus, each patient must be evaluated independently for the risk-to-benefit ratio given the host of possible outcomes for each individual.

A tiered approach should be considered with target windows for when to perform the procedures. We propose a five-tier approach: those that are urgent, those that should be performed within 2 weeks, those that should be performed within 2 months, and those that can safely be delayed 2 or 6 months (Table 1). Discussion with the referring service is critical to ensure adequate triage based on combined available clinical and radiologic data. This tiered approach should be applied to both outpatient and inpatient procedures.

Each procedure request must be triaged into a tier on a case-by-case basis, because clinical circumstances can dictate one procedure as urgent, whereas different clinical data may render the same procedure safe to delay. For example, most biopsies of thyroid

nodules can be safely delayed 6 months, but a thyroid mass that appears highly aggressive, suggesting the presence of an anaplastic thyroid nodule, may have to be biopsied within a 2-week window. A transplant kidney biopsy when rejection is a concern may be urgent, whereas a routine surveillance biopsy may be safely delayed. Additional considerations for tumor biopsies and ablations include tumor doubling time: more aggressive biologic characteristics require an earlier procedure.

Many patients with cirrhosis undergo frequent routine therapeutic paracentesis or thoracentesis procedures because they experience great discomfort if drainage is not performed. Therefore, even these palliative procedures may have to be considered urgent. However, placing a tunneled drainage catheter in a patient who needs repeated paracentesis or thoracentesis can be considered prudent in certain cases to minimize exposure to COVID-19 during multiple visits to medical facilities.

In addition to the urgency of the procedure, patient age and overall health status should be considered. Patients at increased risk of adverse outcomes related to COVID-19 include those 65 years old and older; those living at a nursing or long-term care facility; those with high-risk health conditions, including chronic lung disease, moderate to severe asthma, or preexisting cardiovascular disease; those who are immunocompromised; and those with uncontrolled medical conditions, such as diabetes, renal failure, and liver disease [3]. Patients enrolled in clinical trials present unique challenges because some of them have limited therapeutic options if they miss the window of enrollment into the trial [4].

When postponement of a procedure is being considered, we strongly recommend discussing the considerations with the referring physician, who may have insights not avail-

able to the radiologist. Clear and prompt communication with the patient about the rationale for postponing a procedure and addressing patient concerns should be conducted. It is important to emphasize that the delay is for the safety of all involved and that the decision has been made in concert with the patient and the patient’s referring provider. Procedures that may be considered aerosolizing (nasogastric feeding tube advancement, lung biopsy, thoracentesis) may warrant additional discussion.

As the peak of the pandemic passes and consideration is given to a gradual and safe increase in procedural volume, careful discussion of how preprocedure testing for COVID-19 or how PPE is used should be part of planning at the departmental and institutional levels. Situations in which preprocedure testing or more intensive PPE use is warranted remain a subject of debate at many institutions because both test reagents and PPE may still be of limited supply.

Personal Protective Equipment for Cross-Sectional Interventional Procedures During the Coronavirus Disease Pandemic

Proper PPE is essential for radiology professionals to prevent transmission of SARS-CoV-19 from and to health care personnel and patients (Table 2). The current CDC understanding is that SARS-CoV-19 is transmitted via respiratory droplets produced when an infected person coughs or sneezes. It is unclear whether the virus is also transmitted via aerosols over close-contact transmission, such as during intubation. The CDC also states that airborne transmission from person to person over long distances is unlikely [5]. This knowledge drives the following minimal requirements for use of PPE by health care professionals.

Hand Hygiene

Health care workers should use proper and thorough hand hygiene before and after each patient contact and before putting on and after removing gloves, respirators and surgical masks, and gowns. Washing with soap and water for at least 20 seconds or using hand sanitizer containing at least 70% alcohol is needed.

N95 Respirators and Surgical Masks

After proper hand hygiene, a fitted respirator or mask should be worn. The respirator or mask should cover the nose, mouth, and

TABLE 1: Tiered Approach to Cross-Sectional Interventional Procedures

| Tier | Time Frame | Example |
|------|------------------------|--|
| 1 | Urgent | Cholecystostomy Abscess drainage Biopsy for lymphoma |
| 2 | Perform within 2 wk | Organ biopsy for suspected fast-growing malignancy |
| 3 | Perform within 2 mo | Ablation of fast-growing lesions |
| 4 | Can be delayed by 2 mo | Biopsy and ablation of slow-growing lesion Liver biopsy for staging of fibrosis |
| 5 | Can be delayed by 6 mo | Fine-needle aspiration of thyroid nodule |

Note—Examples can vary according to clinical scenario.

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TABLE 2: Current Recommendations for Personal Protective Equipment During Coronavirus Disease (COVID-19) Pandemic

| Patient Status | Recommended Personal Protective Equipment |
|---|--|
| Patient with confirmed or suspected COVID-19 wearing a surgical mask for the duration of the procedure | Surgical mask (N95 respirator after restoration of supplies) Eye protection Surgical cap Gown Gloves |
| Patient with confirmed or suspected COVID-19 not wearing surgical mask for the duration of the procedure <i>or</i> procedure is aerosol producing | N95 respirator Eye protection Surgical cap Gown Gloves |
| COVID-19 not suspected | Surgical mask Eye protection Surgical cap Gown Gloves |

chin and should not be touched once properly positioned. The wearer should remove the respirator or mask after leaving the room by using the ear loops or ties, avoiding contact with the front of the mask. An N95 mask should be properly fitted to the operator in advance. The current recommendation according to CDC guidelines is to use a surgical mask for non-aerosol-producing procedures on patients with suspected or proven COVID-19. However, when supply is restored, these personnel should use N95 respirators rather than surgical masks. N95 respirators should be used for aerosol-producing procedures that can induce a cough, including thoracentesis, lung biopsy, and nasogastric and nasojejunal feeding tube placement and advancement [6].

Eye Protection

Goggles or face shields are necessary to prevent ophthalmic viral transmission. Personal eyeglasses and contact lenses are not considered adequate eye protection. Lead glasses do not necessarily provide sufficient protection against ophthalmic viral transmission; therefore, a face shield should be used over lead glasses. If worn, lead glasses should be appropriately cleaned after each use. Face shields can also be useful for protecting masks and allowing reuse if masks are in short supply.

Patient Screening

During the COVID-19 pandemic, all patients, including outpatients, need to be screened for signs and symptoms of COVID-19 before entering the procedure area. Screening outpatients by telephone before entry into the hospital may be prudent to

assess the risk-to-benefit relation in performance of the procedure and to counsel about special precautions the patient may need to undertake before entering the procedure area. Outpatients with signs or symptoms of COVID-19 should be carefully triaged by the proceduralist to determine whether the required procedure is absolutely necessary at that time. Patients who still need to come in but who have known or suspected COVID-19 should be required to wear surgical masks on entry into the facility.

Some patients, especially those who may have symptoms or those undergoing aerosol-generating procedures, may need to be tested for SARS-CoV-2. As testing for SARS-CoV-2 becomes more rapid, point-of-care screening may become the norm in certain patient populations.

Inpatients with suspected or confirmed COVID-19 should wear a surgical mask for the duration of the procedure and during transport from and to the procedure area to reduce the chance of infection. In general, procedures on patients with COVID-19 should be minimized or delayed, if possible, until the patient is cleared of viral load, to reduce exposure of staff and other patients during the patient's transfer.

For patients without confirmed or suspected COVID-19, standard PPE precautions for health care professionals during procedures include surgical mask, eye protection, disposable medical protective gown, and gloves. This is especially important given the current understanding that a large number of patients may have asymptomatic disease and be carriers of SARS-CoV-2 and able to infect others [7–9]. Therefore, universal requirements for all patients and their accompanying caregivers to

wear a mask and wash their hands are essential, regardless of disease status. We recommend this practice regardless of local pattern of disease, especially during the post-surge, when a second wave of infection may occur as the result of relaxation of social distancing.

Minimizing Patient and Personnel Contacts Before, During, and After Procedures

Cross-sectional interventional workflow requires interaction and direct contact between several health care providers and patients. These providers include CT and MRI technologists, sonographers, transporters, procedural nurses, medical students, resident or fellow physicians, attending physicians, and recovery room nurses. The COVID-19 pandemic is forcing cross-sectional interventional divisions to be nimble and scrutinize and reorganize workflow to minimize the number and instances of contacts between providers and patients while maintaining procedural safety, efficacy, and the patient experience. Consequently, immediate alteration of workflow for procedures on patients with confirmed or suspected COVID-19 and for all patients undergoing cross-sectional interventional procedures is necessary for the short term across all radiology departments.

Minimizing contact between providers and patients with confirmed or suspected COVID-19 is in the interest of patients, providers, and their contacts and communities. Although exact setup and workflow differ across institutions and a single policy is unlikely to suffice for all institutions, the following factors must be considered.

Appropriate hygiene between receptionists and outpatients who may be checking in (time-

sensitive outpatient procedures still need to be performed) is important. This includes the use of pens and clipboards and sanitization of shared surfaces. Family members and caregivers should drop off the patients outside of the hospital. After the procedure, once it is time for the patient to be discharged, hospital personnel should escort the patient to the entrance to be picked up. Only digital communication with the family member or caregiver is recommended, to reduce the number of people in the hospital and waiting rooms.

Appropriate distancing should be practiced, to the extent possible, as patients are escorted to procedure rooms.

Academic institutions should consider limiting personnel in the interventional suite to those who have a direct and essential role in the procedure. This implies that medical students, residents, and fellows should not be in the suite. Although education is an important mission of an academic radiology department, minimizing personnel around infected or potentially infected patients may take precedence at this time. Exception to the rule is procedures with high educational value or those for which a second operator is needed.

Developing a select list of attending radiologists who perform procedures on patients with COVID-19 should be considered. Cross-sectional interventional physicians who are at increased risk of the aforementioned adverse outcomes should remain part of a back-up team if staffing is sufficient. Furthermore, appropriate use of PPE can be detailed and time-consuming, and having a smaller pool of radiologists who are well versed in specific protocols (e.g., donning and doffing PPE, entering and exiting special units, potentially complex consent procedures) will prevent errors and improve use of resources and time.

Procedures should be performed, if possible, bedside in COVID-19 units (or patient rooms when no designated COVID-19 unit is in place). This, of course, can only be done for ultrasound-guided procedures. A mobile ultrasound unit should be left in place in the ICU or the COVID-19 unit, and this can be used for interventional procedures, guidance for vascular access, or point-of-care thoracic and nonthoracic ultrasound of these patients [10].

Patients with COVID-19 who come to the radiology department for a procedure should be transported directly into the procedure room without intermediary holding in prepro-

cedure stations and similarly not sent to the radiology recovery unit and rather be transported directly back to the COVID-19 unit, ICU, or inpatient room for recovery. If recovery in the radiology department is necessary, it should be undertaken in the procedure room. Routes of transport to and from the radiology department should be carefully planned to minimize contact with others and not overlap with outpatient routes or waiting areas.

Interaction with a patient during the informed consent interview should be limited by obtaining consent in the procedure room or using oral consent documented by the physician in the medical records. Both of these modifications to the consent process are outside of standard regulated practice; therefore, establishment of hospital-wide frameworks may be needed.

CT technologists or sonographers who typically assist the interventionalist with handing over and opening supplies during the procedure should not enter procedure rooms. The IR tray should be set up before the patient arrives in the room. All anticipated supplies should ideally be determined before the start of the procedure and opened to the extent needed, and the tray and supplies should be covered with a sterile plastic drape.

Room and Equipment Cleaning After Procedures on Patients With Known or Suspected Coronavirus Disease

SARS-CoV-2 is primarily spread through respiratory droplets, and airborne transmission is considered unlikely. The amount of time for aeration of a room that has been occupied by patients with known or suspected COVID-19 before it is inhabited is unknown, but it varies depending on air circulation, how much a patient has been coughing, and whether aerosol-generating procedures have been performed. Under low-risk circumstances, delay in entering a room on the order of minutes may be sufficient. Under higher-risk conditions, delays may have to be longer. Because air circulation times are room and institution dependent, local input should be obtained.

The CDC recommends limiting the transport and movement of patients outside their rooms to minimize the potential spread of disease [11]. Therefore, if procedures can be performed portably, doing so may be prudent. In such cases, only the equipment transported to the patient's room (most commonly an ultrasound machine and probe)

is disinfected according to routine guidelines. Currently, WHO recommends the use of 70% ethyl alcohol as a disinfectant for small areas between uses and 0.5% sodium hypochlorite solution for disinfecting surfaces after potential exposure to COVID-19 [12]. Ultrasound probes can be cleaned and sterilized according to manufacturer guidelines. WHO recommends that soiled bedding, towels, and clothes from patients with COVID-19 be laundered with warm (60–90°C) water and detergent after safe transport from the clinical workspace. If a lead apron is used for a CT- or fluoroscopy-guided procedure, proper wiping down with disinfectant is required. Similarly, all radiation protection equipment should be cleaned according to institutional protocol.

Conclusion

The fast spread of the COVID-19 pandemic has caused health care providers to rapidly alter their practice. This has been true of radiologists who perform cross-sectional interventional procedures. Several steps can be taken to minimize risks to patients and radiology personnel, including screening referred patients to decide which procedures can be postponed, using appropriate PPE, minimizing the number of people involved in procedures, preserving PPE when possible, and applying proper room- and equipment-cleaning measures.

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