RAPID COMMUNICATION

Approach to Protecting Patients and Staff in Nuclear Cardiology Laboratories in Response to the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic has altered all aspects of performing medical procedures throughout the world. It is important to stratify patients into categories according to the likelihood that a requested exam will result in a change in acute management. Health care staff should maintain adequate distancing and engage in frequent hand washing, and personnel who are patient-facing should put on PPE at all times. All patient-touching apparatus should be disinfected between patients according to the Infection Control protocols of the institutions. Most labs have chosen to have patients wear surgical masks to afford some level of protection for them. Efforts should be implemented to enable remote reading and remote reporting of study results. The guidelines presented in this paper are based on the currently available information regarding SARS-CoV-2 (COVID-19) viral infections, but it is essential that all laboratories comply with evolving recommendations of their institutions and public health authorities.

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The appearance of SARS-CoV-2 (COVID-19) viral infections in December 2019 has had a drastic impact on the provision of healthcare services throughout the world. On March 11, 2020, at the time of it being declared a pandemic by W.H.O., and coincident with a review (1), there had been a total of 175, 000 cases world-wide, with 6, 700 fatalities. Approximately 4 months later, there have been over 12 million cases and over 500,000 deaths (2).

Cardiovascular complications of COVID-19 infection are common, and secondary to a thrombotic diathesis. Acute myocardial infarction (often with normal coronaries), inflammatory myocarditis, peripheral vascular occlusion and stroke have been reported, and thought to be potentiated through an inflammatory cytokine storm (3). Cardiac complications and elevated cardiac biomarkers are associated with an adverse prognosis (4). However, these syndromes are not readily evaluated by mainstay nuclear cardiologic procedures, such as stress perfusion imaging or radionuclide ventriculography, due to the acuity of the accompanying systemic illness.

In the worldwide experience, fear of exposure to the corona virus, inaccessibility of the health care system, and other factors led to a 40–90% decrease in patients presenting with cardiologic syndromes routinely evaluated by nuclear cardiology procedures, such as angina pectoris and chronic heart failure (5). This led to a temporary reduction in demand for nuclear cardiology services. Concern has also arisen among cardiologists and nuclear medicine specialists that diagnostic nuclear labs may be overwhelmed by the rebound in demand for cardiac testing when the prevalence incidence of COVID-19 falls in recovering regions (6, 7).

The resumption of active nuclear cardiology practice presents the challenge of providing high quality diagnostic service, while at the same time protecting the safety of the laboratory staff and patients from the spread of the virus. The recommendations in this paper, and the operational implementation in any laboratory, must be considered in the light of multiple prevailing factors. These include the speed at which pre-test PCR testing can be performed, the availability of personal protective equipment, the imaging technology available to the nuclear laboratory, and the policies of governmental and public health care agencies. It should also

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be recognized that many of the approaches are based on practical solutions or expert consensus, with a paucity of data to support them (8). The preponderance of the following discussion will apply primarily to stress myocardial perfusion studies, but the general concepts introduced apply to all nuclear medicine procedures.

General principles

The cornerstones of staff protection early in the pandemic consisted of the maintenance of adequate distancing and frequent hand washing, either in bactericidal or alcohol-based solutions. These strong recommendations have arisen from the concept that COVID-19 was spread directly from close individual contact with patients, or from surface contamination. Increasing recognition has now been given by W.H.O. policy to the persistence of airborne virus in less well-ventilated public areas or within hospitals (9). Personal protective equipment, especially face masks, was originally emphasized mainly for direct patient encounters. It now may be reasonable for the health care staff to consider putting on some PPE during their entire time in patient care areas. The other basic principle includes minimizing the contact between health care personnel and patient. All patient-touching apparatus, including but not limited to camera, imaging table, stretchers, leads, blood pressure machines, etc., should be disinfected between patients according to the Infection Control protocols of the institutions.

Managing the selection of patients

During periods in which a region is at pandemic levels of COVID infection, patients with active disease are rarely referred for nuclear cardiology procedures. The severity of their illness usually precludes this testing. Our laboratory has performed only a small number of radionuclide ventriculographic studies in patients whose cardiac function could not be adequately assessed echocardiographically. For non-COVID patients, a broad range of cardiac diagnostic labs agree that during periods of high COVID-19 activity, elective and semi-elective nuclear procedures should be postponed (8, 10, 11). The intention of this consensus is to conserve physician manpower, PPE, and decontamination personnel and materials. Only tests which will change near-term prognosis, or alter acute management, should be performed.

ASNC/ SNMMI have suggested that patients be stratified into categories according to the necessity of the nuclear procedure (8). Thus, a patient with accelerating, undiagnosed chest discomfort, who is an unfavorable candidate for coronary angiography because of co-morbidities, would be high priority for stress myocardial imaging. The patient would be scheduled immediately. A second patient, referred for routine follow-up evaluation of chronic stable angina, would be considered low priority, and could be postponed for 2-4 months.

As COVID-19 activity subsides in a local community, cardiology practices and clinics resume operations, and referrals of patients (non-COVID) for routine cardiologic indications begin again. In addition, 20–40% of patients who have recovered from COVID-19 have residual chest pain or dyspnea on exertion (12). In an older age group, these patients also may be referred for evaluation. It is the responsibility of the nuclear lab to establish an environment which is safe for health care personnel, and for patients, as they move through the lab and complete their procedures.

Screening of patients

Once the medical information has been reviewed and the decision to perform the test has been made, the patient should be screened for possible COVID-19 activity prior to arriving at the laboratory. This is preferably done via telephone, and includes exclusion of any COVID-19 symptoms or close exposure to individuals with documented COVID-19 (within one meter, for a period of >10 minutes). Depending on the institution, registration procedures and even verbal informed consent may be obtained remotely. At the entrance to the lab or hospital in the U. S., patients are again questioned for symptoms or contacts, and also screened to eliminate those with temperatures above 38° C or oxygen saturation <94%.

In regions and countries in which COVID-19 testing is widely available with rapid turn-around, patients may be required to have PCR antigen testing 48–72 hours prior to nuclear studies. This is especially true if exercise nuclear exams are requested, because of the increased risk of viral spread from higher respiratory rate during these tests. Patients who are asymptomatic, but test positive, are treated in accordance with protocols of the local Department of Health.

Personal protective equipment (PPE)

Health care personnel who are patient-facing should put on PPE at all times. The level of equipment worn should be calibrated to the risk posed by the patient and by the procedure. For patients who are presumed COVID-negative by clinical or testing criteria and are undergoing lower risk nuclear test (such as a pharmacologic stress MPI study), standard care would include gloves, surgical mask, and frequent hand washing in disinfectant solutions. For patients under investigation, or who are having higher risk tests, droplet precautions must be followed, which should include N95 masks, hair coverings and eye shields. PPE protocols should be used in compliance with institutional and health care agency policies. In terms of safeguarding the patients themselves, most labs have chosen to have patients wear surgical masks to afford some level of protection for them.

Stress testing and imaging protocols

Stress testing and imaging protocols should be chosen to limit the exposure of the medical staff, and reduce patient's time in the laboratory, considering that increased throughput promotes better social distancing. For stress testing, pharmacologic stress testing is preferred, because of lower ventilator requirements and less chance of generating infectious aerosols. Of the pharmacologic stress agents, regadenoson may be preferred because its brief 10 second injection period requires lower direct nursing exposure. For other agents, long tubing may reduce staff exposure.

For myocardial perfusion studies, the following imaging protocols are advantageous for reducing patients' time in the laboratory: stress first imaging (possibility of omitting rest imaging), attenuation correction (may eliminate need for prone imaging), normal dose rapid imaging (short acquisition time). If available, PET imaging requires the least time patient may spend in the laboratory, and the greatest safety distance between health care personnel and patients.

Reporting of results

The advent of electronic medical records and computer reporting algorithms have allowed many nuclear labs to have a rapid turn-around for reports. This is as important in the pandemic era as previously. In the COVID-19 era, however, greater efforts should be made to enable remote reading and reporting of studies. This reduces the contact of health care staff and patients. Also, it allows more space for safe, appropriate social distancing among those physicians who must remain on site to support stress testing operations. One concern is that teaching post-doctoral fellows will suffer, as this often occurs one-on-one at the reading console. Attention should be given to computer algorithms that allow screen sharing and on-line communication to preserve the teaching function. Internet-based and cloud-based distributed reading systems that duplicate the experience of reading patient studies at a workstation, while enabling this capability anywhere on earth, are ideally suited for this purpose (13).

For PET cameras with CT scanners capable to higher resolution, the transmission CT attenuation scan may provide a readable chest CT. A radiologist with experience in chest CT should review these data, to determine if any signs of COVID-19 chest infection exist, such as ground glass pattern, other infiltrates or effusions (14, 15).

Test substitution

In certain circumstances, it may be prudent to substitute other radiologic exams for nuclear stress tests. In patients with a lower coronary risk but a higher COVID-19 risk profile, who must have coronary disease excluded, a coronary CTA may present a lower overall risk to staff. The contact time of technologists and nurses with the patient may be considerably less than for a nuclear study. Conversely, some authors have suggested that for the diagnosis of endocarditis, a PET FDG may be substituted for transesophageal echocardiography, a procedure known to generate extensive, potentially infectious aerosols (16).

Conclusion

The COVID-19 pandemic has drastically altered all aspects of the performance of medical procedures, and health care in general, around the world. The summary above represents a snapshot of best practices for providing high quality nuclear cardiology services, while at the same time protecting our staff and our patients against avoidable infection. These general principles are based on our current understanding of the pathophysiology of the virus, and how best to protect against it. Inevitably, as more knowledge is gained, these protocols will need modification and adaptation to regional conditions. The authors urge all laboratories to track and comply with the recommendations of their institutions and public health authorities as the pandemic evolves.

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Conflicts of interest

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