Revision in Standard Operating Procedures of Radiation Oncology Department and Quality Assurance Schedule under COVID-19 Pandemic

Sir,

Epidemic diseases affecting substantial population of the world is not new and the list of epidemics and pandemics are reported as early as 429 BC.[1] A pandemic is defined as "an epidemic occurring worldwide, or over a wide area, crossing international boundaries and usually affecting a large population." In late December 2019, China reported cases of patients with pneumonia of unknown etiology which was classified as epidemic and later upgraded as pandemic. The virus was previously known as "2019 novel coronavirus" and the disease it caused is named as coronavirus disease (COVID-19) which appears to be of zoonotic origin.[2] The World Health Organization (WHO) raised a global alert on the need of containment, surveillance, detection, isolation, and contact tracing.[3] Countries across the world responded to this unprecedented pandemic by harsh containment measures. The Indian government responded with the invocation of Disaster Management Act and Epidemic Diseases Act; closing the entire establishment except essential services on March 24, 2020, which was termed as lockdown.

The outbreak of COVID-19 has provided many fold challenges for Radiation Oncology Department worldwide as the treatment is scheduled over weeks (typically 5–7 weeks). It was interesting to study the reported radiotherapy precautions from the Chinese experience,[4,5] where the outbreak was severe. Personnel-protective equipment (PPE) was provided to the selected staffs of Radiation Oncology Department according to hospital infection control policy for droplet precautions as recommended by the WHO.[6] Patients were required to wear a surgical mask for the entire duration of the radiation oncology procedure, and the mask was especially required for head and neck patients. Italian experiences have also been reported where the prevention of infection spread has been given sufficient weightage, but infection control measures for radiotherapy accessories have not been discussed.[7] The impacts of corona pandemic have also been reported from the USA and Europe.[8,9] The USA report discussed the various measures adopted for controling the infection while the report of Europe is summary of a questionnaire-based survey conducted to know the influence of the pandemic on the practice of radiotherapy. However, the specific information pertaining to change in the practice for quality assurance (QA), treatment planning, dosimetry, overall workflow for existing and new patients, and policy for managing the gap in the treatment are missing from these publications. It is true that the overall philosophy of radiotherapy practice will remain the same, but technical and operational aspects of the Radiation Oncology Department need to be revised for controling the infection to patient, public, staff, equipment, and the environment.

The unfolding events warranted our hospital administration to respond to any eventual emergency. Since many cancer patients are already immunocompromised, the radiation oncology department required to revise the standard operating procedure (SOP) for the continuation of treatment under the COVID-19 situation. Being an international and national accredited hospital, the protocols and guidelines are in place with regard to general infection control in our hospital. However, the unprecedented situation of this pandemic warranted formulation of specific operational guidelines for radiation oncology practice based on the principle of the prevention of COVID-19 infection and lockdown situation. A committee of the radiation oncology department discussed the issue in detail and consensus was arrived to formulate the guidelines covering complete workflow, including technical and administrative aspects for the inclusion in SOP. Specifically, it was decided to revise the SOP of the radiation oncology department by including components on (i) Staff education and safety, (ii) Patient education and safety, (iii) Safe handling of radiotherapy accessories, and (iv) QA/quality control (QC) schedules. As the revision in SOP is linked with equipment, personnel and practices, a brief introduction of the infrastructure of radiation oncology department of the hospital will add clarity in subsequent discussions.

Our radiation oncology department is equipped with flattening filter free (FFF) TrueBeam STx Linear accelerator (Varian Medical System, USA) having photon energies of 6, 10, 15, 6FFF, and 10FFF MV and electron energies of 6, 9, 12, and 15 MeV. The department has active stereotactic treatment program aided by HD120 multileaf collimator (MLC) and ExacTrac X-ray monitoring system (BrainLab AG, Germany) for noncoplanar imaging. Brachytherapy treatments are performed with 18 channel microSelectron high-dose rate (HDR) (Elekta AB, Sweden). On an average, 50–55 patients receive treatment daily. Staffs of radiation oncology department includes 3 full-time radiation oncologists, 2 medical physicists (MPs), 4 radiation therapy technologists (RTTs), 2 nurses, and 2 patient attainders. While formulating the guidelines for inclusion in SOP, the recommendations of individual, institutional, and professional societies were given due considerations.[4-11] Following are the brief descriptions of the

additional components included in the SOP of the radiation oncology department and their implementation aspects:

Since COVID-19 has incubation period of 5–14 days,[12] it was recommended to use PPE while treating patients who may or may not be symptomatic. National and international recommendations are followed regarding the use of mask and PPE during the treatment and disposal thereafter.[13-15] As the primary mode of COVID-19 transmission is through droplets, universal precaution for droplet transmission was identified and the staffs of the department were educated accordingly (hand hygiene; respiratory hygiene; avoid touching eyes, nose and mouth; and judicious use of PPE). In addition, staffs were specially advised to have minimal interaction with the patients. Grouping and rotation of staffs without affecting the efficiency of the department were also incorporated in the SOP. For example, in place of 2 MPs and 4 RTTs, 1 MP, and 2 RTTs will only be available at a time. Further as a matter of policy, treatment by hypofractionation in case of new patients, wherever clinically applicable, is given preference over long duration fractionated treatments. Unless otherwise necessary, brachytherapy treatments (both low and HDRs; temporary or permanent implants) should not be prescribed as it requires long duration dealing with the patients.

The patients were educated for COVID-19 infection mode and infection control measures. Seating arrangement in the waiting area was made to have at least 1 m distance between two patients. The chairs are frequently cleaned with 5% sodium hypochlorite solution. The major source of infection for patients or staff is through contact with radiotherapy accessories. Since most of the accessories are reused for patients over treatment period, frequent cleaning and disinfection were important to control cross contamination. In general, thermoplastic masks are used for the treatment site of brain and head and neck cancers. The masks in use are equipped with nonstick surface coating with antibacterial properties. Guidelines from manufacturer were considered and suggestions from infection control team of the hospital were incorporated (e.g., disinfect the masks before use with alcohol-based disinfectant, wipe the inner and outer surface with sufficient amount of solution, and disinfect the mask after use with 0.5% sodium hypochlorite solution). Head and neck patients or patients having excess mucous secretion were required to wear either a surgical or N95 mask for the entire duration of the radiation oncology procedure (starting from imaging to treatment delivery).

Head support, base plate, armrest, breast board, and any other accessory are wiped after every use with 70% alcohol-based disinfectant. Vacuum cushions were used for the treatment site of thorax, breast, abdomen, and pelvis treatment sites. Each cushion contains small polystyrene spheres surrounded by a durable polyurethane coated nylon fabric. Since these cushions may not directly come into droplet contact, large size paper towel were placed over the cushions. The treatment couch was disinfected after each use with 0.5% sodium hypochlorite solution.

QA/QC of the radiotherapy equipment and accessories is an important component of quality radiotherapy practice. Our QC programme for the accelerator is based on AAPM TG142[16] and IAEA TRS398[17] recommendations. However, the list of QA test parameters recommended by AAPM TG142 is quite long requiring revision in existing QA schedule for this period without compromising the quality of performance. This revision in QA schedule is required because of the reduction in human resources due to grouping and rotation. A thorough study of the past performance of the accelerator was carried out and performance results of last 600 measurements were analyzed. Table 1 presents the list of test parameters and their maximum deviation from the baseline value in the last 600 measurements.

It is observed from this table that the deviations are well within the limit all the time which provided us the confidence that even if these tests were eliminated from the QA schedule for a limited period, it will not affect the performance of the accelerator. Accordingly, QA schedule of the accelerator was revised [Table 2] to minimize the resources required for conducting QA/QC on periodic basis.

Some of the monthly tests recommended in AAPM TG142 report were skipped as most of our treatments are IMRT/VMAT. The tolerance levels for laser and optical distance indicator are relaxed because majority of patients were treated under image guidance. MLC QA has been reduced because pretreatment QA for IMRT/VMAT patients is the mandatory requirement as quality service policy of the department. The pretreatment QA is staggered over a week and any failure is considered as potential deterioration of MLC performance. Image quality tests were skipped till the images are suitable for localization. The method of quadratic summation to set the tolerance values to achieve an overall uncertainty of 5% and 5 mm was further refined in AAPM TG142 report. We hope to achieve the tolerance of 5% and 5 mm with recommended tests and frequency. AAPM TG142 allows flexibility in the QA/QC program considering the quality, costs, equipment condition, available test equipment, and institutional needs. Daily/weekly tests can affect dose to the patient and were

Table 1: Test parameters of medical electron linear accelerator and their maximum deviation in last 600 measurements

Test parameters	Maximum deviation from baseline
Output constancy (X-rays) (%)	3.0
Beam uniformity (%)	2.8
Jaw position indicators (mm)	0.1
MLC leaf position accuracy (mm)	0.14
Gantry/collimator indicator (degree)	0.1
Shift in isocenter (mm)	0.37
kV/MV isocenter displacement (mm)	0.16
Couch displacement in lateral/ longitudinal/vertical (mm)	0.30

MLC: Multileaf collimator

Table 2: Revised quality assurance/quality control schedule for medical electron linear accelerator along with recommended tolerance, test frequency, and personnel required

Test parameters	Method/instrument	Prescribed tolerance	Recommended tolerance	Test frequency	Personnel required
Dosimetry					
X-ray output constancy	MPC[18]	3%	3% (5% AL)	Daily	1
Electron output constancy	MPC	3%	3% (5% AL)	Daily	1
Reference dosimetry	Ion chamber and water phantom	3%	3%	Weekly	2
X-ray profile constancy	MPC	3%	3% (5% AL)	Monthly	1
Electron profile constancy	MPC	3%	3% (5% AL)	Monthly	1
Mechanical					
Laser localization	MPC phantom and couch value	1.5 mm	2 mm (3 mm AL)	Daily	1
ODI	Couch value indicator (vertical=0)	2 mm	2 mm (3 mm AL)	Daily	1
Collimator size indicator	Radiological image based	2 mm	4 mm	Daily	1
Safety					
Door interlock	During MPC	Functional	Functional	Daily	1
Door closing safety	During MPC	Functional	Functional	Daily	1
Audiovisual monitors	During MPC	Functional	Functional	Daily	1
Beam on indicator	During MPC	Functional	Functional	Daily	1
Laser guard interlock test	MPC Phantom	Functional	Functional	Weekly	1
Respiratory gating	-	Functional	Functional	Patient based	1
MLC	Skip, if patient specific QA is carried out (5%/5 mm AL)				1
Imaging					
Collision test	Software restriction	Functional	Functional	Daily/skip	1
Image quality	Perform calibration if image quality is degraded				1

ODI: Optical distance indicator, MPC: Machine performance check, which is an automated and integrated image-based tool for the verification of beam and geometric performance of the TrueBeam, AL: Action level, QA: Quality assurance

carefully tested maintaining minimum standard. Monthly tests include those parameters that have lower likelihood of changing over a month, hence were carefully chosen considering likelihood that this pandemic may be over in next few months. The reference dose measurement and patient specific QA are directly linked with precision and accuracy of treatment delivery (may affect treatment outcome drastically) and hence their measurement frequency were left unchanged. However, care should be taken that minimum personnel are involved, and the safe infection control policy is adhered to. Action levels are specifically mentioned keeping in mind that rectification of the fault may not be possible immediately as engineer movements are also restricted. Hence, we may need to continue treatment even though specific test breaches threshold tolerance and would be mitigated by increasing planning target volume and planning risk volume margins. We have tried to balance minimum standards of QA with infection control aspects. Notable limitation in the QA schedule is the MPC[18] based tests which is exclusive feature of TrueBeam accelerator.

Since our hospital is a multi-specialty healthcare unit with national and international accreditation, we have infection control policy in place. This provision may not be available in stand-alone centers, and hence, the operational procedures outlined here may serve the purpose to mitigate the operational challenges faced with continuation of radiotherapy treatment in such centers. Further, the operational procedures and QA schedules discussed in this letter are consistent with droplet precautions policy which has been discussed in various reports.[4-11] However, we have made an effort to make COVID-19 specific guidelines following the radiation protection principle of time, distance, and shielding. Accordingly, the message is spend minimum time by cutting down nonessential physical meetings/interactions, adhere to social distancing, and use PPE judiciously.

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Conflicts of interest

There are no conflicts of interest.

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