

Impact of Covid-19 outbreak on radiotherapy of cancer patients: Institutional experiences

Verma Teerthraj¹, Pandey VP², Tiwari Arnav²

¹ King George Medical University, Department of Radiation Oncology, Lucknow, India

² All India Institute of Medical Sciences, Department of Radiotherapy, Bhopal, India

Abstract—

Introduction: The novel corona virus pandemic caused a dilemma into healthcare to facilitate the best possible management with safe practices. Radiotherapy treatment may include the radical and palliative intent(s) which should be given as early as possible to provide relief to patients. Cancer patients are already at increased risk of infection due to lack of immunity power. Different centres have developed institutional policy to combat the COVID-19 without breaking the radiotherapy treatment services.

Materials and Methods: The administrative department of the institutes released the protocols and strategies for effective management of patients undergoing radiotherapy treatment. Head of department summons online meeting for implementation of effective strategy to provide unhindered services to patients and safe practices amongst staff.

Results: Effective measures were taken to decrease the risk of contamination amongst staff and patients. Proper staffing rotation with reduced strength, use of personal protective kits, remote consultation, hypofractionation, radiotherapy treatment schedule management, online meetings, scheduled corona testing of the patients, attendants, sensitisation of units, use of mask and regular hand wash practices were key aspects of strategies during pandemic. Time to attend per patient for treatment was increased due to the inclusion of appropriate safety guidelines prescribed by management committee.

Conclusion: The remedial solutions assisted in maintaining the balance in work and effectively implementing the plans for radiotherapy treatments. The physical presence and contact duration was reduced for better outcomes. This practice ultimately helps in reducing the spread of infection amongst staff, patients and attendants.

Keywords— Radiotherapy department, COVID-19 Pandemic, Patient Management, Hypo fractionation.

I. INTRODUCTION

1.1 Novel Coronavirus Pandemic

The World health organization (WHO) had declared global pandemic due to the coronavirus contagious [1]. A person suffering from COVID-19 can infect at least two people as per its metric score of 2-2.5. First case of corona virus were declared in Wuhan city, China in December 2019 [2]. In March 2020, the Indian

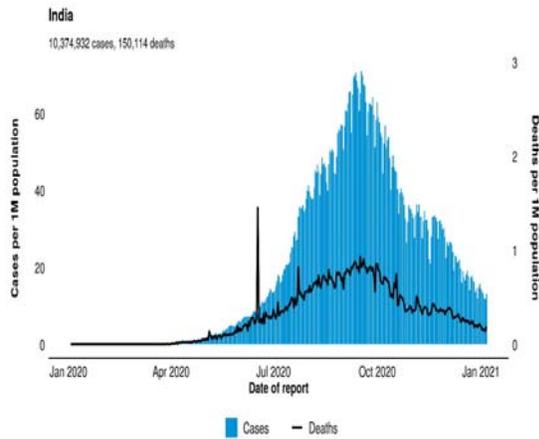
government had declared the Covid-19, a pandemic situation and initially complete lockdown was suggested to control the infection rate. In Mid November 2019 more than 1,300,000 deaths had been confirmed and 53,700,000 cases of infected people were identified worldwide [3]. The COVID-19 virus are enveloped, single stranded, positive strand RNA having characteristics of rapidly spreading, contagious and evolving in humans. Quarantine was the prime facia treatment practice for infected person at least for 14 days and, if required, necessary medicines for fever and multivitamins were recommended. The transmission of the virus was particularly suggested by contact with the infected person through droplets from cough, sneeze and verbal interactions. Regular hand wash, maintaining social distance of at least 1 meter and facemask was recommended by Indian Council of Medical Research (ICMR) to regulate infection rate. Person having symptoms of fever, headache, nausea, dizziness, running nose and eye are suspected case of COVID-19 and confirmation is subject to test results. COVID-19 was classified under acute respiratory syndrome by WHO [4].

1.2 Covid-19 infections in India

In India the first case of COVID-19 was reported in a student from Kerala who had returned from Wuhan China on the 30th of January, 2020. India reported its first death on 12th March 2020 of a 76 year old man who had returned from Saudi Arabia.

Subsequently, these numbers gained unimaginingly high access to the continent through travelers returning from hotspots in different parts of the globe. Since then, all the 54 countries in the region have reported confirmed cases [5]. The number of infections together with its pattern in India till 6th January 2021 could be summarized in figure no. 1.

Fig 1: Death and Infected Cases per 1 million Population in India



As per WHO data, 2021 has crossed 10,374,932, with 350,753 associated deaths. From the observations of initial cases, it was mainly confined to capital cities, however a significant number of cities in India have now reported confirmed cluster of cases as the mode of transmission in multiple provinces found[6,7].

Indian Council of Medical research (ICMR) & Ministry of Health and Family Welfare and the India Centers for Disease Control and Prevention (India CDC) graded Level 4 Very High Covid-19 in India for travelers which established the India Task Force for Novel Coronavirus to oversee preparedness and response to the global pandemic of Covid-19 [7]. The strategy to defeat this global disease in India was focused on rapid detection and rapid control of the disease through lock-down and isolation. The ICMR has worked with governments across India to scale up their capacities in critical response areas such as coordination, surveillance, testing, isolation, case management, infection prevention, contact tracing, and control, risk communication and community engagement, and laboratory capacity [8].

Among others, the establishment of a task force to deal with the situation, other measures include training to increase surveillance on countries' borders, mobilization of outbreak response teams, education and sensitization of the continent on Covid-19, and cooperation of various national International government agencies to accelerate tracing, testing and tracking and partnerships with many international agencies to reinforce the Indian response, as never before.

Agencies such as the Indian Council of Medical research (ICMR) & Ministry of Health and Family Welfare, have also assisted government agencies to fight the pandemic by

donating equipment such as real-time PCR, rapid test kits and personal protective equipment (PPEs). The IAEA, International Organization for Medical Physics (IOMP), American Association of Physicists in Medicine (AAPM), among other international and national agencies have recommended several Covid-19 safety measures to be implemented in radiotherapy facilities to guarantee safety of patients, care-givers and staff [9-11].

1.2 What is Radiotherapy

Radiation therapy is one of the effective methods for the treatment of cancer; in which ionizing radiation is delivered with the primary intention to kill the tumour cells and at the same time spare the normal cells as much as possible within the tumouricidal and tissue tolerance dose. With continuous technological improvement in cancer treatment, high energy x-ray and gamma photon beam of the order of MeV or MV is being used. Apart from its use for the treatment of cancer cells, radiotherapy is also useful for few non-malignant benign conditions. Sometimes it is used in combination with surgery, chemotherapy or hormone therapy. Broadly radiation therapy can be divided in two categories viz External Beam Radiotherapy (EBRT) and Brachytherapy (BT). BT uses sealed or unsealed sources placed in the vicinity of disease either temporarily or permanently whereas EBRT uses radiation beams originating from the sources located outside the patient. The most common radiation beam used in EBRT is of photons but it can be of electrons, heavy ions or some heavy particulate radiation. Radiotherapy is given either with curative intention or with the primary aim to relieve the pain and symptoms as well as to enhance the quality of life; commonly known as palliation.

Thus success of radiotherapy that can be quantified in terms of therapeutic gain (Eqn. 1) is the direct result of exposed dose.

$$\text{Therapeutic gain} = \frac{\text{Tumour Control Probability}}{\text{Normal Tissue Complication Probability}} \quad (1)$$

1.3 Radiotherapy treatment process

Typically radiotherapy treatment process consists of sophisticated steps starting from counselling and mould preparations, simulation, contouring, planning, quality assurance (QA) and finally treatment of patients. The mentioned steps may take two to three days or more, depending on other factors, to commence the radiation delivery of patient. Errors in any one of these steps may results into the large deviation in treatment outcome of patient. Figure 2 indicates the radiotherapy treatment

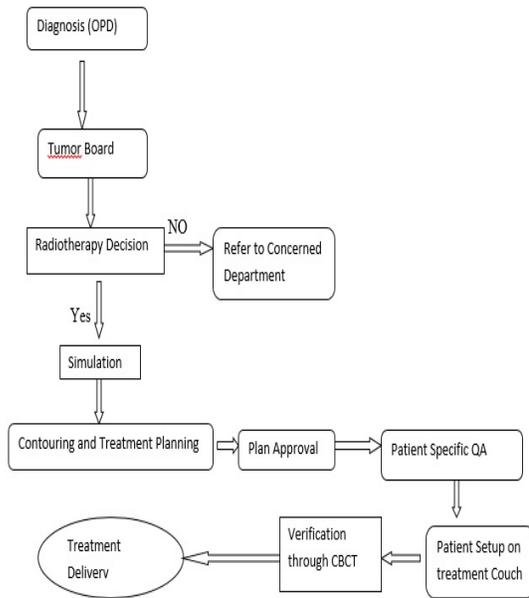


Figure 2.: Steps in Radiotherapy Treatment Process

chain process in the typical radiotherapy department from the beginning.

Team of Radiotherapy includes the Radiation Oncologist, Medical Physicist, Technologist, Nurses and other supporting auxiliary staff. Table 1 clearly indicates the key staff requirement and roles in department of radiotherapy. Patient first walks into the outpatient department (OPD) for necessary clinical workups relate do diagnosis and management. In addition, patients who are scheduled to undergo radiotherapy visit the campus of the radiotherapy department for later stages. Decision taken for check-ups and after inspecting all the reports the suitable patient selected for radiotherapy treatment course. Counselling to the patients and attendants for the various steps and procedures is appropriately given. CT Simulation is the next step in treatment procedure which starts with immobilization device mask preparation and subsequently computed tomography (CT) of patient taken and DICOM images send to the treatment planning system. Clinician will contour and delineate the target volume and normal structures and prescribe the dose to the tumour target. Medical Physicist makes the optimised arrangement of radiation delivery of the treatment considering all parameters of normal tissue structure and tumour volume and give best possible treatment plan with better coverage. The selected approved plan will be executed, with the

verification and quality assurance, by the technologist into therapy machine which finishes the whole course of radiation delivery.

Staff	Role
Radiation Oncologist	Patient Selection, Dose Prescription, Contouring, Plan Approval, CBCT matching, First day treatment, Follow-up
Medical Physicist	Quality assurance of linear accelerator, patient specific quality assurance, treatment planning, Verification, Treatment plan execution (first day or SOS), Modification in the plan for the maximum benefit of radiotherapy
	e.g.Phase-2
Technologist	Simulation, Treatment
Nurse	Primary care to patients undergoing radiotherapy, Simulation, Treatment
Hospital Attendant	Assist in patient preparation
Security Guard	Abide the rules furnished by management committee to allow persons

Table 1: Staffing in Radiotherapy Department

Despite the outbreak of pandemic worldwide, the mainstay radiotherapy treatment for cancer patients was not discontinued, in almost all radiotherapy centres, for patients undergoing daily fractionation and new cases. Cancer patients are mostly immuno compromised stage and there is a fair chance for all stages to become infected even with these adverse conditions treatment should not be discontinued. Therefore, it is a fairly ambiguous situation for cancer patients to provide health professional in this risk situation without putting employees at risk. The appropriate modus of operandi may help each RT centres for optimizing the activity of radiotherapy department to continue their services in such difficult conditions.

Since this kind of pandemic had never been experienced so far, we would share our planned strategy for smooth functioning of departmental work and patient treatment. To achieve the above objective,

we had focused on changing the work practice to perform the tasks better.

II. MATERIALS AND METHODS

The hospital administration organized meetings to combat the crisis by consensus which would serve as an execution recommendation plan in the department. The main objective was to prevent any source of transmission of infection to staff and patients. Committee had recommended to follow the guidelines furnished by Indian council of medical research (ICMR) time to time and apply in every department.

At OPD, patients are allowed with only one attendant after proper infra-red thermal scanning and temperature assessment. It was mandatory to maintain a distance of at least one meter and check the patient's health status and reports with the appropriate safety kits taken by physician etc. Patients selected for radiotherapy treatment after recommendation of tumor board committee sent to the department for simulation procedure where RTPCR negative report was mandatory to execute further procedures. At one time, only one patient was allowed in CT simulation area and rest patients was asked to wait for their turn and maintain proper social distancing with others. At one time, about five patients were allowed to sit in the waiting area with an alternate seat arrangement. Digital Imaging Communication in Medicine (DICOM) images from the simulation console were sent to the treatment planning system (TPS) for contouring and treatment planning. In TPS 3 contouring workstations and 2 planning systems were available and recommended not to over crowd the TPS room. At one time, a minimum number of oncologists and physicists were recommended to be in the TPS room for effective social distancing without compromising the quality of treatment and its workflow and may use related systems.

Remote planning was encouraged where the software like Team viewer and Any Desk was used for performing basic planning and calculation. Scheduling of patient on Mosaik system was performed onsite on the Saturday before performing patient specific Quality assurance check. During the daily QA process, only medical physicists and technologists were allowed in

the treatment room area with appropriate social distancing and personal protective wears. Five days in a week treatment protocol for patients were scheduled and Saturday was kept for patient specific QA check and scheduling.

Patients who were residing far places and due to administrative issues of transportation failure facility of "e hospital portal" was started where patients can upload their reports and obtain the consultants opinion. Patients were encouraged to talk on phone with respective duty senior resident/ junior resident in case of any problem faced by them. The duty of technologist staff was scheduled rotation wise to minimize any impact of the pandemic. At a time only one technologist will be available in treatment machine room to treat the patient. After every 2 weeks the duty rotation was kept on change. Three Senior residents and five junior residents were also scheduled on duty rotation wise to provide uninterrupted medical services to patients. After treating every patient treatment couch of linear accelerator was cleaned by hypochlorite solution to avoid any risk of transmission of infection through the droplets secreted by the patient.

III. RESULTS

Protocols developed and implemented are found to be effective in reducing the effects of pandemic disease that can be summarized in the following domains.

1. Reduction in transmission of infection

As per the directives of Ministry of health and family welfare and Indian council of medical research, the protocols were made by the administrative department were to be followed in all departments against COVID response. In radiotherapy department the directives were implemented after having electronic meeting on Zoom application for common consensus.

Minimum staffs were posted in the area prone to risk of contamination with proper PPE kits. Duties were scheduled in rotation to have backup staff in case of any covid infection amongst staff. Daily mopping of the radiotherapy facility with the sanitizer was performed by the staff before arrival of any patient into the department. Waiting area with proper sitting arrangements were made in

order to maintain the social distance of 1 meter amongst two patients. In one hour only four patients were scheduled and asked to enter into the waiting room premises. Only one attendant was made allowed into the department with every patient if needed. Patients and attendants were instructed clearly to have face mask, infra-red thermal scan and temperature assessment daily and noted into patient chart. Foot operated hand sanitizer was kept in entry and exit of department.

It was mandated to produce a negative Covid-19 report by each patient on the first day of radiation treatment that was valid for the next fourteen days. And it was scheduled to do on every 12th day over the total duration of visit to department.

In case of any suspected symptoms, patients were sent to get PCR report before getting treatment. The days of CT simulation was also kept on Saturday to minimise the strength of patients in waiting area. The cardinal principle of radiation safety was applied in order to avoid any chance of infection and time, distance and shielding principle of radiation safety was used appropriately by staff. Minimum patient contact time, distance of 1 meter and use of proper personnel protection kit was the key practice in the radiotherapy department. Patients was instructed to strictly follow the social distancing, use face mask and regularly wash hands with sanitizer. Being immune compromised they were advised to avoid crowded place and maintain basic safety and hygiene standards.

In OPD consultants and residents were provided with proper PPE kit and patient chair was maintained at a proper (minimum) distance of 1 meter. All symptoms of patients were advised to confirmed before proceeding for physical examination in a shortest possible time. History of patients were taken through the short verbal communication and from the available old reports. Telemedicine consultation was encouraged to decrease physical presence and travelling of patients. Patients were counselled only for the symptoms raised due to radiotherapy treatment.

2. Treatment Priority

Patients prescribed radical intent of radiotherapy session having aggressive tumour classification was preferred to get the therapy on priority basis .

Delay in treatment of such patients may results into repopulation of tumours. Moderate preference was given to patients having history of less aggressive tumour but tried to start the treatment within a week to avoid any chance of growth. Patients having history of good surgical resection of disease with good margins and less aggressive tumour type were categorized into the low risk bracket and accordingly therapy was scheduled.

Hypofractionation treatment regimen were followed for patients were implemented as much as possible based on the guidelines available. For Breast cases with the nodal irradiation 40 Gy in 15 fraction was practiced instead of 50Gy in 25 fraction [12-15]. Since our facility was newly started, there was less patient load and so was practiced for the conventional fractionation regimen for other sites. Biological equivalence dose was balanced for every change in treatment. Time taken to complete the treatment of patients were increased compared to before covid situation and almost increment by 10 minutes per patient was scheduled. High end treatment methodology was preferred to have large outcome with best possible accuracy. Major patients were planned with VMAT and IMRT treatment techniques to avoid more time with patient and better results.

Due to sudden announcement of pandemic there was loss of public transportation and public fear about the risk and patients undergoing for treatment started breaking the session. There was a sudden break taken by patients scheduled for radiotherapy sessions. The figure 3 shows the trend in the patient load into the radiation oncology department. After announcement of pandemic in march 2020 by government of India there was up-down in the treatment break of 15 running patients and decreases later on as the situation was improved.

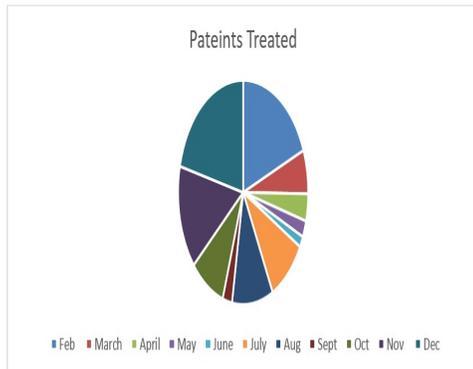


Figure 3: No of patients treated during pandemic

3. Teaching Schedules and Chart Round

A lot of webinars were scheduled based on a number of professional and super specialty health topics, which cater to the knowledge requirement of health professionals, students, to balance the damage caused by a sudden outbreak situation.

In our department regular classes of junior residents were taken by faculty, medical physicist through ZOOM application and all the course curriculum was effectively covered for the students. The online technology of hosting meetings were proved boon for the society as all the lectures, conferences, meetings and teachings were scheduled easily on it [16-17].

In radiotherapy department on every Saturday we had a provision of checking the charts of patients and cross checking if anything is missed during treatment by two to three members. Same practice was done using online web meeting system and one person from the treatment planning room gives the information of presence of particulars into the checklist and if anything is missed was pointed out and same was rectified in next working day.

IV. STATISTICAL ANALYSIS

The developed strategy was validated through a pilot study conducted with different institutions and based on the feedback from the participants. The Croanbach's alpha test for the adopted strategy was greater than 0.92

which reveals goodness of fit in methodology practiced [18].

V. DISCUSSION

The main objective of this research was the to assess the efficacy of implementing a protocol for the management of radiation oncology department at the time of COVID-19 pandemic and assessing the smooth functioning of department in terms of patient treatment outcome and covid positive cases in staff. The study clearly states to use the basic principles of time, distance and shielding (PPE kits) applied for consultant oncologist, medical physicist, nursing officer, technologist and even applies for patients to avoid any risk of infection from one personnel to another. Our no staff had any complaints of fever, headache, running nose, nausea etc till date although continues services to patients was given on priority. Rotation of duty was also very successful ways to handle the situation as any asymptomatic cases can have a break of 2 weeks and again can join the duty on his turn. Rotation was made after every 2 weeks with a mindset to allot the appropriate time for quarantine of staff who had provided unhindered services to patients. Use of teleconsultation through e hospital portal was also proved beneficial for patients who were staying in far away regions and due to administrative issues of failure in public transport could not manage to come for opinion and followups. Patients treated on couch were also advised to call on the mobile number of senior resident/junior resident if any adverse symptoms arises. Medical Physicist started doing planning using any desk and team viewer software. These practices ultimately reduce the physical presence of person and simultaneously all works were performed. Treatment strategy of initiating hypofractionation for breast patients were performed based on the evidences which results into shortening of treatment days with equivalent radiobiological outcome. Treatment modalities like Intensity modulated radiotherapy (IMRT) and volumetric modulated radiotherapy (VMAT) was encouraged to reduce the physical contact time with patient, more throughput and better treatment outcome of higher end technology. Patient specific quality assurance checks using PTW Octavius 4D was performed on Saturday before commencement of any

new patient. After the appropriate gamma pass results the scheduling was done to treat the patients on subsequent working days.

Teaching and chart rounds in department plays a pivotal role to cater the need of junior residents and quality checks of treatment respectively. The curriculum of M.D radiotherapy students was taught through online mode and no physical presence was required which may decrease the risk of transmission of contamination. The allocated time for teaching with the respective staff allows unhindered teaching services to the students. Seminars from residents side on the planned topics was also scheduled online using zoom to compensate for any loss in teaching classes. Students were benefitted by clearing all the doubts through online session in the form of audio and text messages mode. To check for any error in any step of prescription, planning, charts attachment, signature of personnel and running chemotherapy drugs were cross checked through online mode. One junior resident will be present with all the charts and one by one he may check the parameters as per the checklist and point out if any anomaly is found which may later be rectified for the respective patient. The chances of treatment error may be avoided using the above practice.

The protocols used in the department were helpful in reducing the physical presence of staff near to the risk area by 70% after implementing the remote access strategy and rotation of duty. As per the literatures this reduction in the physical presence and personnel encounter with the patients makes transmission of infection control very high in the department. The used methodology can be utilised as a reference for any management to counter the effect of outbreak and manage the patients treatment, follow-up and consultation smoothly. The crisis management policy adopted by our department helped in running the department with unhindered termination of services to patients along with keeping the safety of staff and public too.

Some studies have suggested to delay the treatment of patients and selecting only the emergency patients for treatment[17]. The disadvantage of such policies are the tumour repopulation, stress on patient and family, increased chances of metastasis and radiobiological challenges. Another studies had adopted the methodology of hypo fractionation schemes applied for all the patient treatment that reduces the physical presence of patients in the department. The major

disadvantages of this strategy are the radiobiological limitations, availability of linear accelerators and other auxiliary equipments needed to for the accuracy in hypofractionation regimen treatment[18].

Abide by the regulations and safety tips suggested by ICMR and MoHFW to use facemask, regular hand sanitization, PPE kits , gloves, goggles by the staff are key aspects of primary safety from infection shown in fig 4 . One disadvantage of these suggestions was unavailability of too much consumables in the department as supply from the government to all the sites was not much hence chances of propagation of transmission of increases due to repeated use of consumables.



Fig 4: Staff cleaning the couch after every patient treatment using hypo solution.

Moreover, the study developed protocol results into the important aspect for effective quality care of patients and staff with substantial effect on clinical implementation during pandemic of COVID-19.

VI. CONCLUSION

During pandemic situation world wide radiation oncology departments are required to step appropriate precautions to avoid any transmission of infection due to COVID-19. Patients undergoing into treatment sessions are more likely to be carrier because of lowered immunity level and necessary steps required to ensure smooth functioning of department. Proper social distancing, use of face mask, regular hand sanitization,

rotation wise duty scheduling, use of platforms like teleconsultation, teleplanning and reduction of physical presence may ultimately reduces the risk of contamination of staff and patients. These possible strategy adoptions may help the center to avoid any delay of patients treatment and regular running of department.

CONFLICTS OF INTEREST

There is no conflict of interest.

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Contacts of the corresponding author:

Author: Dr. V P Pandey
 Institute: All India Institute of Medical Sciences
 Street: Saket Nagar
 City: Bhopal
 Country: India
 Email: aryanbarc@gmail.com