Welcoming the First Magnetic Resonance-Integrated Linear Accelerator in Pakistan

Sir,

The discipline of radiation oncology has long been neglected in Pakistan due to lack of support from public health sector and brain drain of skilled professionals. But, the recent past has witnessed an unprecedented rise in the establishment of radiation oncology facilities all across the country.

Linear Accelerator (LINAC) is a device commonly used to deliver external beam radiations to a targeted site in cancer patients. It predominantly utilises the cone beam computed tomography (CBCT) or radiographs to reduce any uncertainties related to the position of target before delivering radiation treatment. CBCT is susceptible to motion-related artefacts and does not offer real-time information about moving targets. These uncertainties are managed by deliberately creating a larger target volume, which unfortunately exposes nearby normal tissues to radiations.

Magnetic resonance (MR) imaging provides an opportunity for accurately delineating target lesions by co-registering it with CT simulation images. Such practice has been associated with improved clinical outcomes and has warranted the use of MR imaging as a standard in radiation treatment protocols and guidelines.

The integration of MR scanner with radiation delivery has the potential to directly monitor all the tumours and tissue types in real-time, virtually eliminating target uncertainty, offering a decrease in planning target volume margins, possible dose escalation and avoiding damage to healthy tissue. Above all, the main advantage of such an amalgam of two state-of-the-art technologies is to assess the real-time anatomical and biological responses evaluated using diffusion-weighted MR images during treatment, leading to online plan adaptation and facilitating the most personalised treatment delivery.[1,2]

Hybrid MR-guided LINACs have been under development since the early 2000s and the first successful prototype was developed and installed in the Netherlands at the University Medical Centre, Utrecht in 2008. To further facilitate multilateral collaborations between clinicians and researchers an MR-LINAC Consortium was established in 2012 with 9 founding members including MD Anderson Cancer Centre Houston, Texas, USA and The Christie Hospital, Manchester, UK. The consortium has now grown up to 73 member institutions globally.[3]

Although the literature suggests an increase of up to 66.7% in fraction treatment time as compared to conventional CT-based LINAC but with MR-LINAC, the total number of treatment fractions is reduced by delivering higher doses of radiation in one fraction. With fewer total numbers of fractions, the cost and complete treatment duration is also reduced.[4]

However, increase in fraction treatment time can sometimes lead to interfraction motion, patient discomfort, and claustrophobia. Care must also be taken in patient selection as MR-LINAC is not compatible with many metallic implants. Lastly, as there are no MR-LINAC establishments in Pakistan, if any downtime does occur, treatment replanning will have to be undertaken before treating the patient on a conventional LINAC.[5]

Dow University of Health Sciences, Karachi, is going to be the first centre in Pakistan to install MR-laden LINAC. This technology will significantly reduce the treatment duration from weeks to a few days as well as the treatment cost borne by the patient. Furthermore, this will also lead to a considerable improvement in the available treatment slots, as currently, patients have to wait for months before the radiation treatment starts and have to suffer from needless fear and anxiety. This technological evolution will greatly change the existing paradigm of radiotherapy, ushering a new era of high precision radiation therapy for the Pakistani population.

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