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Short communication

Active involvement of Radiologist in radiation oncology practice

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ABSTRACT

Advancements in Radiation Oncology from conventional to 3D conformal radiotherapy treatment demands expertise in many steps of radiation planning, the horizon of radiologist is now expanded by many folds and made radiologist as a integral part of the Radiation Oncology Department. A critical aspect of radiotherapy treatment planning (RTP) is determining how to deliver the required radiation dosage to cancer cells while minimising the exposure to normal tissue for which the prerequisite is identification and accurate delineation of tumour volume as well as normal structure resulted in an increase in the therapeutic ratio by reducing complication associated with normal tissue and allowing for higher target dosage and better local control. In modern radiotherapy CT images are the standard set of imaging modality required for the radiotherapy planning along with it many other modalities like MRI, PET or DSA are used by superimposing on original CT images in order to contour or delineate the structures defined by International Commission on Radiation Units and Measurements in Reports 50, 62 and 71 (ICRU) for radiotherapy planning which comprise of Gross tumour volume, clinical target volume, planning target volume, irradiated volume, Internal target volume and the normal structures as Organ at risk. It is self-evident that the contribution of a radiologist with a thorough knowledge of the development of these new modalities is critical for optimising the potential of these novel modes of radiation treatment delivery.

Keywords: Active, Radiologist, Radiology, Oncology.

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INTRODUCTION

Incidence of cancer is at rise globally irrespective of age, sex, race and class. Multimodality treatment is almost inevitable for better outcome wherein radiotherapy, chemotherapy, surgery, targeted therapy, immunotherapy and hormonal therapy is integral part of such treatment. Radiation therapy remains one of the most important and commonly used modalities. Statically, around 50% of all cancer patients need radiation therapy during their course of illness; where it contributes towards 40% of curative treatment for cancer [1].

The goal of radiotherapy is to deliver precise tumouricidal dose with reduced normal tissue complications without compromising safety and quality. Team of radiotherapy includes mainly radiation oncologist, medical or radio physicist and radiotherapy technologist with many supportive professionals like, nurses, social worker, physiotherapist, dietician and psychologist etc. Modern day radiotherapy involves multiple steps, immobilization, image acquisition, contouring, planning, quality assurance and treatment delivery. Radiation Oncologist delineates target and normal tissues. This step may involve fellow colleague Radiologist. Medical Physicist does the complex radiation planning to ensure high radiation conformity and low normal tissue irradiation [2,3].

Optimal identification of patient target quantities is the fundamental stage in radiation therapy preparation process. Inaccuracy may lead to insufficient coverage of tumour, leading to recurrence and death in adjacent normal tissue areas. As various imaging sources and locations are interpreted, the process of identifying the tumour target volume has become increasingly complex yet detailed. Substantive technological advancements in the preparation and application of radiation therapy have made exquisite adaptation of three-dimensional dosage distribution that complies with the amount of tumour therapy while eliminating neighbouring normal tissues feasible. While this

highly accurate treatment will improve the clinical ratio, it also presents risk of missing tumour expansion beyond the target because of reduced preparation ranges. The radiation oncologist thus devotes his greatest attention to subjecting tumour with suitable amount of radiation on required areas [4].

Commonly radiation planning is done on CT images and used for both contouring as well as radiation planning. Communication between diagnostic radiologists and radiation oncologists is hence essential during contouring in collaboration with medical physicist in some cases, particularly given the subtleties that accompany image interpretation, to optimize care of the cancer patient [5].

The increased conformality of modern radiotherapy planning techniques necessitates improved means of defining target volumes for treatment. International Commission on Radiation Units and Measurements in Reports 50, 62 and 71 have given contouring guidelines and rise to the concept of gross, clinical and planning target volumes (GTV, CTV and PTV), which is well accepted and widely used in radiation planning. The use of this nomenclature allows uniformity in designing treatment volumes and is prerequisite for progress in development of radiation therapy. One of the most important geometrical uncertainties in preparation of radiotherapy is known as targeted volume specification (TVD). Most of this can be minimised if the image is optimised, proper imaging modality is chosen, multi-mode imaging and a professional TVD-known radiologist are involved. In recent years, the pace of technological progress has ensured that radiation therapy preparation and implementation systems need to be radically redesigned. A Radiologist provide his expertise by helping in in reviewing images in oncology.

(i) identifying target volumes [Tumour volume] and normal tissues during contouring,

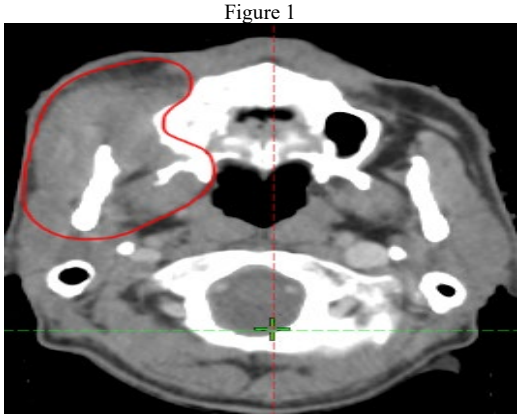
(ii) cross reference on various fused modalities like PET CT and MRI,

(iii) reduce systematic errors in delineating tumours [6,7].

Following are some practical scenarios where radiologist expertise was appreciated in first case, head and neck cancers patients with recurrent disease after surgery when patient has to undergo radiation therapy on planning scan it is difficult to identify the residual disease from the post-operative changes, in such cases radiologists identify the residual disease form its various typical characteristics from the post-operative changes thus helping the radiation oncologists in perfectly planning the residual disease treatment as shown in figure 1 [8].

Likewise In case of gynaecology malignancies (endometrium, cervix and vagina) it is extremely important to identify vital structures such as small bowel, large bowel, and rectum, anal canal from tumour / post-operative bed and nodes. The radiologist may help in identifying these [10].

Figure 1



Similarly in another case of intracranial space occupying lesions like glioblastoma multiforme after surgery where there is great dilemma to identify tumour from adjacent edema and post-operative changes in MRI, radiologists help to identify the tumour by viewing various sequences and correctly identify the lesions as shown in figure 2 [9].

Figure 2

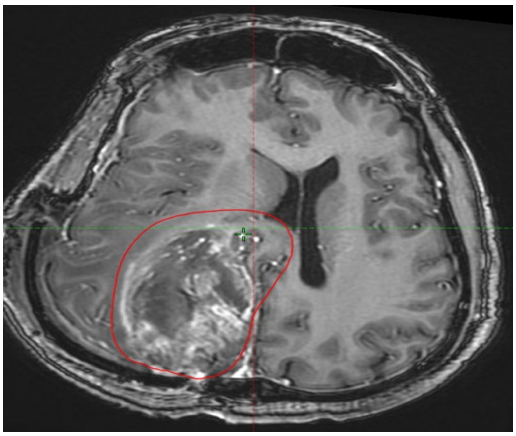
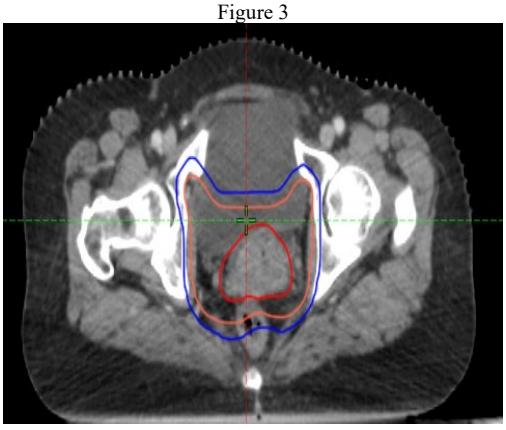


Figure 3



In case of stereotactic radiosurgery [SRS] where tumour volume is particularly small i.e, 1-2 cc, it needs to be delineated very accurately for medical physicist to plan further and getting rapid step dose gradient fall off. In case of small tumours like schwannoma as shown, radiologist plays important role in identifying tumour and the surrounding cerebrospinal fluid and other critical structures thereby reducing risk of adverse events like hearing loss, facial nerve paralysis and brainstem injury [11].

Similarly, in most of head and neck malignancies at times it is difficult to understand extent of primary tumour infiltrating into various facial planes and bony involvement. Radiologist will help in identifying these on CECT images or MRI and delineating tumour volumes better, thereby improving local control post radiation [8].

Also, in case of lung malignancies at times it is difficult to differentiate primary tumour from atelectasis. A radiologist will again help in identifying these with the help of PET CT images thus better target volume identification [12].

In case of male genitourinary malignancies, mainly prostate. Radiologist may provide assistance in identifying primary tumour extension in periprostatic space with the help of MRI. Also difficult to identify areas like the apex. Hence preventing either tumour miss due to under contouring or penile bulb injury due to over contouring [13].

A radiologist hence should be integral part of contouring activity and eventually part of radiation oncology department. Helping in better identification of target areas and normal tissue. Thus, improving local control and decreasing adverse events. Which results in better oncology outcomes. Radiologist assisting must have good exposure to oncology imaging as they could be unique and challenging.

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