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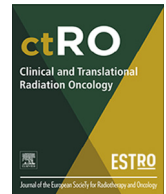
Editorial

Online MR-guided radiotherapy – A new era in radiotherapy

Technical progress has repeatedly heralded new eras of radiotherapy. Over the last decades, 3D-treatment planning, intensity modulated radiotherapy, 4D-radiotherapy, complex dose calculation algorithms and image guided radiotherapy have been game-changers permitting increasingly precise target coverage and sparing of normal tissues. Stereotactic radiotherapy for lung cancer is just one example where these new technologies have led to improved outcomes and increased use of radiotherapy. Currently we are witnessing the implementation of the latest technological revolution: The MR-Linac. The level of precision that can be achieved in radiotherapy is limited by the imaging available. Until recently we had to rely on cone-beam imaging to detect anatomical inter- and intrafractional changes. MR images with their superior soft-tissue contrast are already in use for many years in radiotherapy treatment planning. The union of a linear accelerator and an MRI in a single device to facilitate online adaptive MR guided radiotherapy was complex and required almost 20 years from an idea to a clinically available system [1]. The reasons for this were manifold: Unlike with cone-beam CT guided radiotherapy; the magnetic field of an MR-linac is permanent and impacts the dose distribution [2]. In addition, the moving linear accelator influences the magnetic field. Besides superior soft tissue imaging, the MR-linac enables us for the first time to continuously acquire images while the beam is on. Plan adaptations strategies had to be developed to account for day to day changes in anatomy [3,4]. However, these tasks have been mastered and first centers are now treating patients using the new technology [5,6].

In the current special issue of *ctRO* world-renowned experts in the field will give insights in opportunities and challenges of online MR guided radiotherapy. Uulke van der Heide, Benjamin Knowles and Joakim Jonsson will discuss what a radiation oncologist needs to know about MRI physics and MR based treatment planning, while Dennis Winkel and Sebastian Klüter will provide an overview of the MRI Linac by Elekta and Viewray, respectively [7–11]. The RTT perspective on the online adaptive workflow will be discussed by Robin Botman [12]. Which tumor sites might benefit most from online adaptive MR guided radiotherapy? Sonja Stieb shares her view on the potential repetitive imaging and changes to organs at risk in head and neck cancers [13]. Can higher doses be applied in pancreatic cancer with MR guidance? Anna Bruynzeel [14] will provide her initial experience from this field. Advantages and disadvantages of MRgRT in prostate cancer will be balanced against by Julia Murray [15]. Cihan Gani and Giuditta Chiloiro will discuss new opportunities of online MR guided treatment in rectal cancer and report the first experience of online MRgRT for this tumor site [16–17]. Oligometastatic disease is now widely considered an indication for local treatment - Dennis Winkel will shed a light on how to optimally tackle individual lymph nodes [18]. And finally, Matthias Guckenberger [19] will introduce online MRgRT as alternative to surgery in renal cell carcinoma.

The opportunities of online MR guided radiotherapy appear plenty and we are excited to discuss these in this issue and in the future.

COI statement

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