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MR technology enables high precision single-fraction radiotherapy in mobile lung tumours

Study shows that patients with peripheral lung tumours can be treated with high precision in just one session using magnetic resonance-guided radiotherapy.

- Pioneering study of Dutch scientists confirms suitability of magnetic resonance (MR)-guided radiotherapy in treating peripheral and mobile lung lesions with high precision using stereotactic ablative radiotherapy (SABR) in a single session.
- SABR has already become the standard for treating medically inoperable patients with early-stage lung cancer and in patients with oligometastatic disease.
- Delivery of SABR in just one session requires the highest precision, as mobile tumours are targeted with high radiation doses.
- Real-time MR-guidance reduces uncertainties in treatment delivery, thereby increasing clinician confidence in applying single-fraction SABR for mobile lung tumors.
- Improvements in imaging technology are still needed to facilitate wider use.

Brussels, 28 November 2020 – **Small mobile tumours pose a technical challenge for radiotherapy. Dutch scientists at the Department of Radiation Oncology at the Amsterdam University Medical Center have successfully shown that peripheral lung lesions can be treated with high precision in just one session using MR-guided stereotactic ablative radiotherapy. However, further improvements in imaging technology are needed to enable tumour tracking also for very small tumours.**

Stereotactic ablative radiotherapy (SABR) is the standard treatment for medically inoperable patients with an early-stage non-small cell lung cancer (NSCLC), and it is increasingly used to treat patients with oligometastatic disease. Peripheral lung lesions can also be treated in a single session, which is beneficial for the often elderly and unfit lung cancer patients undergoing SABR. However, single-fraction radiotherapy of mobile tumours requires the highest precision during treatment. Researchers led by Professor Suresh Senan, Amsterdam University Medical Center, have now used MR-guided radiotherapy for the first time to deliver lung SABR in a single session. The novel approach, termed stereotactic MR-guided adaptive radiation therapy (SMART), aims to reduce uncertainties in the delivery of single-fraction radiotherapy for mobile lung tumours.

“Single-fraction radiotherapy is more convenient for patients, and it is established in guidelines as an effective treatment for less fit patients with a peripheral early-stage NSCLC. However, concerns about the accuracy of single-fraction SABR delivery have limited the adoption of this technique. The accuracy which we have demonstrated using MR-guided radiotherapy will increase clinician confidence in applying the technique more frequently.”, said Dr Tobias Finazzi, radiation oncologist and clinical researcher, who presented the results at the annual congress of the European Society for Radiotherapy and Oncology (ESTRO).

Study design: The MRIdian MR-linac (ViewRay Inc., USA) was used in the study. The MR-linac is a novel linear accelerator with an integrated MR scanner which enables more precise radiation treatment. During the MR-guided lung SABR procedure, the planning target volume (PTV) was created by adding a margin of 5 mm around the visible gross tumour volume (GTV). An isotropic margin of 3 mm around the GTV was also defined as the so-called gating window. Radiation was then delivered to the PTV during breath-holds, under continuous MR imaging. Radiation was automatically turned off when the GTV moved outside the gating window, which was detected using MR tumour tracking. The SMART approach also uses so-called adaptive radiation therapy, with the treatment plan being optimised immediately prior to irradiation based on the patient’s anatomy.

An MR simulation was performed in 17 patients during the study. A total of 7 patients were found to be unsuitable for treatment, which was primarily due to insufficient MR tracking of very small tumours. The 10 patients identified as being

suitable were a median age of 73 years (range: 58–80 years) and received a single fraction of 34 Gy. Eight patients were treated for early-stage NSCLC, and 2 patients were treated for lung metastases. The median GTV was 2.9 cm^3 (1.8–6.5) and the median PTV was 10.1 cm^3 (7.5–20.5). The median total in-room procedure was 120 minutes, while radiation delivery during repeated breath-holds took a median of 39 minutes (28–66 minutes).

Results: Despite longer treatment times, MR-guided single-fraction lung SABR delivered during repeated breath-holds was generally well tolerated by patients. According to a geometric analysis of real-time MR imaging, an average gating efficiency of 51% (34–85%) was achieved in the 10 patients. The variable breathing patterns had no influence on tumour dose coverage due to automated beam gating under continuous MR-guidance. The mean beam-on GTV coverage by the PTV was 99.6% (98.0–100.0%), corresponding to a very high level of treatment precision. MR-guided optimisation of the radiotherapy plan improved PTV coverage by an average of 5.2% (from 89.8% to planned 95.0%), but this had only limited impact on the GTV and surrounding normal tissues doses.

Despite the positive results, Dr Tobias Finazzi calls for the next steps in technology: "We are expecting further improvements in MR imaging software, which will enable real-time tracking also in very small tumours. Treatment times should also be shortened in the future, as this will offer patients more comfort and saves valuable resources."

ESTRO wants to strengthen position of radiation oncology in Europe

The annual congress of the European Society for Radiotherapy and Oncology (ESTRO) will strengthen the position of radiation oncology in Europe. In line with ESTRO's vision for 2030 "Radiation Oncology. Optimal Health for All, Together", the Society focuses on innovations and scientific findings from clinical radiation oncology, radiobiology, physics and technology, patient care, radiotherapy and brachytherapy.

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