Microbubbles show whether radiotherapy is reaching its target

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Credit: KU Leuven

An interdisciplinary team of researchers at KU Leuven (University of Leuven), Belgium, have developed a new way to evaluate whether a cancer radiation treatment is effective. Their technique uses gas-filled microbubbles and ultrasonic sound waves to determine whether the radiation beams have reached the target area. This makes it easier to

limit or avoid damage to healthy tissue.

Radiotherapy is often used to treat cancer. A downside of the treatment is that the radiation beams damage healthy tissue as well. Various complex systems and methods already exist to target the tumour with as much precision as possible, but there is no remote method to check inside the body - in situ - whether the radiation beams have actually reached their target.

Professor Koen Van Den Abeele and his colleagues have now found a way to change that. Their new technique combines gas-filled microbubbles and sound waves to determine whether the radiotherapy has reached the targeted area. The microbubbles are about the size of a red blood cell and are injected into the bloodstream. Once inside the body, they bind to the tumour. Exposure to radiation makes the microbubbles stiffer. This local change in stiffness is what the researchers detect with ultrasonic sound waves.

Professor Van Den Abeele from the Department of Physics and Astronomy at KU Leuven Campus Kulak Kortrijk explains: "We send ultrasonic sound waves to the gas-filled microbubbles, which makes them vibrate at their natural frequency. We then measure the vibration of the microbubbles before and after the radiotherapy. If the radiation has reached the targeted area, the microbubbles will have become stiffer and thus vibrate at a higher frequency. The change in frequency and attenuation is a measure of the radiation dose."

Oncologists currently have to rely on computer simulations or measuring devices inside a tissue-like phantom or outside the body to check whether the radiotherapy will reach the right area in the right dose. The new measuring technique provides more accurate information based on the actual tumour and the surrounding tissue to help decide whether or not the treatment has to be adjusted.

Microbubbles are already being used as contrast agents for ultrasound-based medical imaging of tissue, organs, and bloodstreams for drug delivery and for gene transfer. This new technique is the first to use microbubbles for dosimetry in the fight against cancer.

The technique has already been tested in vitro and in mice. Further research is necessary before the technique can be translated to human beings as well.

Patent protection has already been established in Europe and the US ("Non-Invasive In-Situ Radiation Dosimetry", publication numbers US 9,035,268 and EP2758130).

Provided by KU Leuven