Algorithms for automated standard contouring

At the Hospital del Mar in Barcelona, radiation oncologists are successfully testing AI-based algorithms to automatically contour organs at risk and irradiate tumors faster and more precisely.

Text: Manuel Meyer | Photos: José Colón

Treatment of cancer patients cannot be delayed, says Manuel Algara López, MD, even in times of SARS-CoV-2.

The view through the clinic's huge window front is soothing to the eye. Waves break gently on the shore, the sun glistens on the sea. Barcelona's Hospital del Mar is located right on the seafront of the Spanish coastal city. Palm trees, a wide sandy beach, the Mediterranean Sea – it's a picture-postcard view. But radiation oncologist Manuel Algara, MD, has no time to admire it.

Since the outbreak of the COVID-19 pandemic many operations have been postponed and the treatment of patients with the virus has been prioritized. "But the treatment of cancer patients can't be delayed, even in times of SARS-CoV-2," says the head of the Radiation Oncology Department. Instead of operating as usual on tumors, particularly otorhinolaryngological ones, doctors turned to radiation therapy first.

Hypofractionated radiation as a standard method

However, tumor patients' visits to the clinic still need to be kept to a minimum and be as short as possible, given the high risk of infection with SARS-CoV-2. The strongly hypofractionated treatment that the Radiation Oncology Department traditionally uses has proved beneficial in this situation. With this method, the tumors are irradiated with an increased daily dose, but the total dose is lowered, which ultimately reduces the treatment time. "Hypofractionation is our standard method for treating breast, prostate and, since recently, also lung cancer," explains department head Algara.

CT scans and contouring

In order to plan radiation therapy, the patient typically undergoes a computed tomography (CT) scan in the treatment position. The doctors and radiation therapists use the resulting images to mark the tumors and the surrounding organs. The radiation is targeted at the tumors and they should receive the highest possible dose. The surrounding areas are considered organs at risk (OARs) that should be protected as much as possible. Contouring all organs at risk is a lengthy and time-consuming process, but a very important one, explains Algara. "A high-precision CT scan, followed by the contouring of the tumor

volume and marking of the OARs, is essential for the radiation plan and dose calculation – and thus the key to successful patient recovery," explains the radiation oncologist.

This is why his team put their trust in the SOMATOM Confidence RT Pro CT scanner and the *syngo*.via image processing software from Siemens Healthineers. "This allows us to work with dual energy, which provides us with high-quality and precise CT images, especially when scanning with contrast media as we do with almost all head and neck tumors," says Manuel Algara.

More precise tumor definition using dual energy scanning

Together with Siemens Healthineers, his team has been testing dual energy scanning of various tumors for the past year, especially head and neck tumors, which make up around 10 percent of all radiation therapy treatments at the Hospital del Mar. The results are encouraging. "Thanks to dual energy, when we scan using contrast media, we get much more precise delimitations of the tumors than before," says Algara. In addition, with its adaptable DirectDensity kV settings,

The SOMATOM Confidence RT Pro CT scanner at the Hospital del Mar is used for imaging in radiation therapy.

Striving for the most precise imaging of tumor boundaries: medical physicist Enric Fernández-Velilla.

SOMATOM Confidence delivers high quality and, above all, personalized images of radiation therapy patients.

"The high-precision CT images are the starting point for AI-based contouring of the organs at risk and for the subsequent calculation of the optimal dose. Together they lay the groundwork for the technical planning and implementation of the radiation therapy treatment," explains Enric Fernández-Velilla, medical physicist in the Radiation Oncology Department at the Hospital del Mar. He particularly emphasizes dual energy imaging and the software's modern 4D simulation of lung tumors that provide very precise imaging of the tumor boundaries.

Looking ahead: a study on automatic contouring

Algara and Fernández-Velilla are convinced that the new, enhanced software will blaze a trail in radiation therapy. Powered by AI-based algorithms the software now automatically recognizes and outlines the OARs surrounding the tumor.

In a first test study, Manuel Algara's team used the latest version of the software on 50 tumor patients with complicated cancers. The organ autocontouring was then checked by two physicians. "For over 90 percent of patients the contours were very satisfactory," says radiation oncologist Algara. The contours were particularly precise for tumors in the lungs, thyroid, and eyes. There was less precision when it came to heart contouring. But this is where deep learning comes in – the algorithm can be continuously improved when more data becomes available. Hospital del Mar is also working on this with Siemens Healthineers.
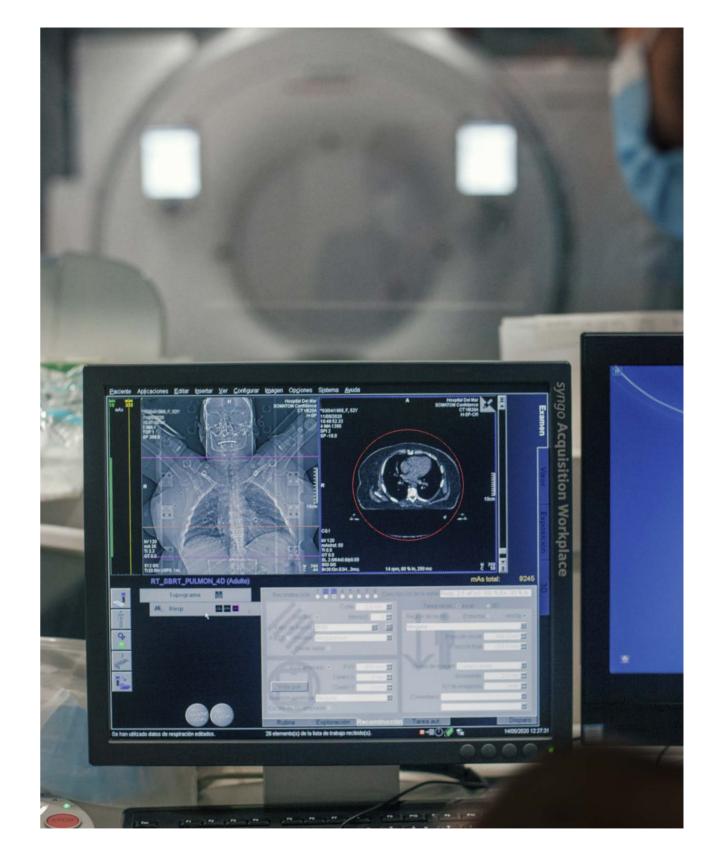
Automation helps to contour tumors faster and more consistently

Now, in cooperation with Siemens Healthineers, a second test study with 60 new tumor patients is set to begin. The image processing software will retrospectively and prospectively contour organs – primarily in breast, lung, and pelvic cancer patients – and up to four physicians will check to see how precise the automated results are. But one thing has already become apparent: "The standardized algorithms are constantly improving and deliver the same precision as an experienced radiation therapy expert – always returning consistent results. Manual contouring can vary from user to user, which affects treatment. This is not the case with the software," says Manuel Algara.

In particular, the software contours much faster than a doctor or a technician, says medical physicist Enric Fernández-Velilla. On average, a time saving of up to 30 minutes per patient can be assumed – not an insignificant factor when optimizing the workflow and the care of 1,200 tumor patients per year. "We can use this time for patient consultations or for even more precise work in other phases of radiation treatment," says the medical physicist.

The time can also be used for research. Because although the Radiation Oncology Department has just six doctors, three medical physicists, two nurses and 15 radiation therapists, according to Algara it competes with the research output of much larger hospitals and works closely with the neighboring and internationally renowned Pompeu Fabra University. Incidentally, the team's ongoing research and innovation work was also the reason why Siemens Healthineers chose the Hospital del Mar as a reference clinic for test studies. ●

Freelance journalist **Manuel Meyer** reports for the German Medical Newspaper *Deutsche Ärztezeitung* and other media from Spain.

The statements by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption) there can be no guarantee that other customers will achieve the same results.