New treatment techniques in radiation therapy, challenges and perspectives

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The main objectives in radiation therapy of cancer are to give a high dose to the tumor while sparing the healthy tissue surrounding the tumor. These objectives seem contradictory especially since most radiation therapy is performed with high energy photons and since the characteristics of a photon field is not at all advantageous for the above objectives. A single photon field delivers more dose to the first few centimeters as the photons enter the tissue compared to the dose deeper in the tissue. To avoid this unwanted behaviour of the photon field, often more photon fields are used from different directions around the patient. By adding the dose from fields from different directions the high dose region can be moved from the superficial area to deeper lying areas. Another positive consequence of adding more fields is that the dose gradient between the high dose region covering the tumor, and the surrounding low dose region, can be made very steep. Modern treatment techniques like IMRT, VMAT and RapidArc improve on this effect and modulate the photon intensity across each field direction to make the dose gradients even steeper. To take full advantage of the precise dose distribution the initial contouring of the tumor volume and critical organs is essential. Different imaging modalities like MR, PET and CT are fused in order to optimally visualize the tissue. After the image fusion, it is possible to outline the different structures precisely and calculate a precise dose distribution to the outlined target volume. Therefore treatment planning is a multi disciplinary teamwork between specialists in diagnostic imaging, dose planning, oncology and physics.