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Radiomics in Liquid Biopsies
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In view of the growing trend in personalizing medicine and with the development of sophisticated equipment and algorithms for guiding radiotherapies, more precise doses and/or particle beams can be delivered to the target tumor while minimizing side effects to the surrounding healthy tissue, which opened up access to new delivery modalities and clinical protocols. Although many clinical studies are trying to evaluate the differential effects between different types of radiotherapy on patients' outcomes, the biological response at the cellular level, and the different cellular pathways involved, are yet inadequately be explored. Novel technologies to evaluate genomics or proteomics-based effects in tumor tissue, but also in bodily fluids, have revealed molecular information that will open the doors for new clinical understanding in Oncology. This lecture will discuss these omics applications in the context of the most recent technologies.

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Small fields dose calculation algorithms in the presence of lung inhomogeneity
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In radiotherapy, dose calculation algorithms are used to calculate dose distribution in human body.
Different algorithms are used by several treatment planning and differ in the accuracy of dose calculation.
In this study, a dose calculation accuracy of two commercial treatment planning systems (TPS) were evaluated regarding Monte Carlo method.
The Linac head of Primus Simens was modeled using MCNPX Monte Carlo code based on manufacturer information. Four analytic dose calculation algorithms including PBC, AAA from Eclipse TPS, convolution and superpostion from XiO treatment planning system were evaluated for a small solid tumor in lung. A solid tumor with diameter of 1.8 cm was considered in a thorax phantom and calculations was performed for 1×1, 2×2, 3×3, 4×4 cm^2 field sizes for 6MV and 18 MV energies. The results of TPSs were compared with the results of MC method as a most reliable method.
A dose overestimation of up to 110% inside lung region and 25% for tumor was found for field size of 1×1 cm in the 18 MV photon beam for PBC and convolution methods, comparing to MC results.
For AAA, superposition a close agreement was seen with Monte Carlo simulation in all studied field sizes.
Our results showed that the PBC and convolution methods overestimate the lung dose as well as the solid tumor dose significantly and large errors could arise in treatment plans of lung region and change the outcome of treatment. The Use of MC based methods, AAA and superposition methods are recommended for lung treatments with small fields.

Keywords: Lung dose, Small fields, Treatment planning algorithms, Monte Carlo method

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The mobile PET insert for simultaneous PET/MRI imaging
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Purpose: The purpose of the presented research is the development of the new type of device being a mobile (portable) and flexible (adaptable) PET scanner, which will play a role of an insert to the existing MR scanners, providing a unique worldwide solution for simultaneous (at the place and time) functional and anatomical PET-MRI imaging.
Material and methods: Presented solution of a mobile-PET scanner will enable simultaneous registration of PET and MRI images utilizing existing MRI scanners, without need of any modifications. The developed device is based on the strip-PET concept [1-4], consisting of individual detection modules, each build from a plastic scintillator strip connected optically at both ends with the photoelectric converter. In the proposed solution we utilize the array of the silicon photomultipliers which plays a role of light to electric signal converter. The signal readout and processing system together with the fast front end electronic modules will allow to reconstruct time and place of the annihilation [5,6]. In the proposed solution determination of the point of annihilation along the direction of the gamma quanta flight path, is based on the time difference registered in various detection modules.
It is important to stress that the utilized silicon photomultipliers are insensitive to the MR scanner magnetic field therefore its work will not be disturbed with the presence of high magnetic field. Also small electronic elements will not cause the inhomogeneity of the magnetic field in the diagnosed volumes. Important from the point of view of the simultaneous PET/MRI diagnosis is a matter of positioning of two tomographic images with respect to each other. Therefore we will implement the method of positioning by usage of watermarks, seen by MRI system. For the proposed mobile PET scanner this method appears to be effective and at the same time simplest solution of this problem. Since this method explicitly specify the position of the MRI with respect to PET scanner therefore it enables to synchronize both tomographic images.
The advantage of this solution is the elimination of artifacts in tomographic images hindering the identification of potentially cancerous lesions. At the same time, the proposed solution allows using the existing MRI scanners currently held by hospitals, without interfering in their structure and parameters, which should significantly improve the availability of this combined diagnostic method, taking into account the lower cost of such adaptation in relation to the market price of a new PET-MRI device.
Conclusion: In the talk we will present developed solution of a mobile-PET insert to MR scanners. The presentation will include the characteristics of a proposed device together with the advantages over present solutions [7].

Keywords: PET, MR, mobile PET, hybrid PET-MR, strip-PET,

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Urethra-sparing SBRT for prostate cancer: dosimetric optimization with VMAT *vs.* IMRT and the learning curve effect

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Purpose/Objective: To compare the dosimetric results of intensity-modulated radiotherapy (IMRT) and volumetric modulated arc therapy (VMAT) and to assess the learning curve effect on dosimetric optimization in patients randomized in a prospective multicenter phase II trial of urethra-sparing stereotactic body radiotherapy (SBRT) for localized prostate cancer.
Materials/Methods: Dosimetric data of the first 40 patients randomized between 07/2012 and 03/2014 in 9 different centers were analyzed. The SBRT protocol consisted of 36.25 Gy in 5 fractions of 7.25 Gy to the planning target volume (PTV=prostate with (*n*=20) or without (*n*=20) seminal vesicles (SV) with a 5-mm anisotropic expansion, except 3-mm posteriorly). The prostatic urethra with an additional margin of 3 mm (urethral planning risk volume, uPRV) received simultaneously 5 x 6.5 Gy = 32.5 Gy. Plans were generated using either VMAT (*n*=20) or IMRT (*n*=20) technique, with each modality including (n=10) or not (n=10) SV in the PTV. All plans were optimized until the dose prescription parameters and organs at risk (OAR) dose-volume constraints were obtained. Mean doses (± SD) to the PTV, uPRV, and remaining OAR were analyzed. The PTV homogeneity index (HI) and the dice similarity coefficient (DSC) were also assessed. To evaluate the learning curve effect in VMAT optimization, VMAT plans of the first 20 patients were compared with VMAT plans generated in the last 20 randomized patients (05/2014-08/2015).
Results: Compared to IMRT plans, VMAT required a lower number of MU (2245 *vs.* 3685, *p*=.0001) and resulted in a better HI (0.90 *vs.* 0.11, *p*=.002) and uPRV coverage ($D_{98\%}$ 31.2 *vs.* 30.1 Gy, *p*=.001). Regardless of the RT technique, dose constraints were respected for all OAR. The V_{100}, V_{90} and V_{80} for the rectal wall were 1.6±1.4% *vs*. 2.5±1.9% (ref. <5%), 10.3±3.0% *vs*. 11.0±3.3% (ref. <10-15%) and 16.2±3.7% *vs*. 14.8±4.2 (ref. <20-25%) for IMRT and VMAT patients, respectively, with no significant differences between the two techniques. For the bladder wall, the V_{100} and V_{90} were similar for IMRT and VMAT (7.8±3.7% *vs*. 7.0±3.8%, ref. <10-15% and 15.3±4.0% *vs*. 13.1±4.8%, ref. <20%), while VMAT performed better than IMRT for the V_{50} (28.4±11.6% *vs.* 37.2±9.2% (ref. <50%), *p*=.011). Compared to the first VMAT optimizations, plans generated in the last part of the study showed a better PTV DSC value (0.88 vs 0.78, p=.009), a reduced V_{100} (1.3 *vs.* 2.5%, *p*=.023) for the rectal wall, and an overall better bladder sparing (V_{100}, V_{90} and V_{80}, *p*<.05).
Conclusions: For all participating centers, urethra-sparing SBRT plans met all the dosimetric endpoints in terms of PTV coverage as well as OAR sparing, irrespectively of the technique used. Compared with IMRT, VMAT plans resulted in more homogeneous dose distribution, reduced number of MU, and better uPRV coverage. Conformality and OAR sparing with VMAT may be improved after gaining experience in SBRT plan optimization.

Keywords: prostate cancer; SBRT; learning curve