Abstract

Multiparametric imaging of prostate cancer and evaluation of biological activity

Objective: The objective of this work is to compare the accumulation of 68Ga-PSMA-11 during PET/MR examination and to determine the level of PSMA expression during immunohistochemical examination. Furthermore, to find out whether the intensity of PSMA expression on the surface of tumour cells is somehow related to the Gleason score and how PSMA expression correlates with MRI and PET/MR findings. The question is whether the expression of PSMA correlates with ADC maps, pharmacokinetic parameters (K trans and iAUC and possibly also with extracapsular spread. An important indicator of the progression of the finding or its aggressiveness in patients with CaP is the PSA level. Another goal of the work is to find a relationship in the tumour behaviour and uptake of ^{68}Ga-PSMA-11, when compared with Gleason score and PSA levels.

Material and methods: The study is prospective in nature and includes 40 patients with an average age of 65.7 years in the range of 50-74 years. These were patients with newly diagnosed CaP, which was confirmed in all patients after ultrasound-guided transrectal biopsy of the prostate. The serum of all patients was tested for PSA, proPSA levels and the healthy prostate index (PHI) was calculated. Subsequently, attention was focused on performing hybrid PET/MR imaging of the prostate with subsequent whole-body scans as part of the staging examination. ^{68}Ga-PSMA-11 tracer was used for PET/MR, which at that time was only available in the Czech Republic in our hospital at the Imaging Methods Clinic.

Each subject underwent radical prostatectomy (RAPE), and prostate samples were evaluated by a specialized pathologist using full-surface sections to assess the extent and grade of the tumour. Further histopathological evaluation was based on immunohistochemical expression of PSMA tissue. For comparison, the resulting samples of benign tissue and tumorous tissue with Gleason scores 3, 4 and 5 were evaluated.

Subsequently, the data was analysed using the Syngovia mMR software, including the fusion of MRI and PET sequences, and the criteria of local prostate involvement were evaluated using the PIRADS score during the PET/MR staging evaluation.

It came from evaluating data such as SUV max and analysing minimum ADC values in the area of interest. Pharmacokinetic analysis was performed using the Syngovia Tissue4D module to generate parametric maps of transfer constant (Ktrans), rate constant (kep), extracellular volume (in)initial area under the curve (iAUC). The region of interest defined by the increased accumulation of ^{68}Ga-PSMA-11 was analysed to calculate the minimum ADC value (ADC min) and Ktrans, kep, v_e and iAUC values.

Conclusion: The study shows that the accumulation of ^{68}Ga-PSMA-11 correlates very well with the expression of PSMA in tumour-altered tissue. Gleason scores 3 and 4 have a higher correlation with ^{68}Ga-PSMA-11 levels than Gleason score 5. The results support the use of ^{68}Ga-PSMA-11 and PET/MRI in the evaluation of tumour tissue aggressiveness and show the possibility of guiding biopsy according to the level of drug accumulation in prostatic tissue for PET/MR imaging.