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The importance of curve parameters of renography in following of nephrotoxicity caused by radiotherapy in gastric cancer patients

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Introduction: postoperative chemoradiotherapy improves locoregional control and survival in gastric cancer patients. Renal toxicity is one of the most serious complications of upper abdominal radiotherapy, which should be reduced as low as possible. The aim of this study was to analyse the changes of separate kidney function and the assessment of damage based on curve parameters in patients undergoing postoperative chemoradiotherapy in gastric cancer. **Methods:** between 2006 and 2011 baseline radiorenography (99mTc-ethylene-dicysteine) was performed in 33 patients with gastric cancer (age: 60.51±11.60 years) after surgery, but before postoperative chemotherapy and conformal radiotherapy. The in-damage kidney to in-safe kidney (D/S) ratio was used as an index of relative kidney function and curve parameters (T1/2 and Tmax values) were examined, which were taken in account during the planning of radiotherapy. In-damage kidneys received an average of 26.5±10.1Gy, while in-safe kidneys received an average of 5.6±3.0Gy dose. Control renography was performed within 6-24 months in 23 patients after postoperative radiotherapy (group I.), in-damage kidney of 8 patients received less than 20Gy (group I./a), 15 patients more than 20Gy (group II./b). Control renography was performed within 24-60 months in 13 patients (group II.), absorbed dose was less than 20Gy in 4 patients (group II./a), more than 20Gy in 6 patient (group II./b). **Results:** In group I. T1/2 values became significantly elongated after radiotherapy (p=0.032) indicating mild impairment of renal function. The change was the greatest in group I./b. In group II. the decrease of the D/S ratio dominated (p=0.001). The decrease depended on received dose, and it was the most significant in group II./b. Tmax value of the in-damage kidney was significantly deviated from Tmax value of in-safe kidney (p=0.005) in the whole patient group. The change of Tmax value proved to be independent of received dose. Curve parameters of in-safe kidney did not show change compared with baseline study (harmful effect of chemotherapy was not detected). **Conclusion:** Despite receiving some radiation dose, the function of in-safe kidney did not worsen. The relative function impairment of the in-damaged kidney in patients following postoperative radiotherapy for gastric cancer is demonstrated. After postoperative radiotherapy renography is useful to monitor the condition of the damaged kidney in case of long survival. Curve parameters indicate nephrotoxicity caused by radiotherapy earlier than decrease of D/S ratio, which can be interpreted by early deterioration of tubular cell function and latter cell-death. The radiotherapy planning could be improved by our investigation.

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Comparison of usefulness of FDG-PET/CT and colonoscopy in evaluating the local efficacy of preoperative neoadjuvant chemoradiotherapy for locally advanced rectal cancer

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Purpose: The aim of this study was to investigate the usefulness of FDG-PET/CT in comparison with colonoscopy in evaluating the local efficacy of preoperative neoadjuvant chemoradiotherapy (NACRT) for locally advanced rectal cancer (LARC). **Materials and Methods:** The subjects were 56 patients with LARC who received NACRT between July 2008 and April 2011. Regarding radiotherapy, 40 Gy were delivered to the lesser pelvis at 20 fractions. The concurrent chemotherapy consisted of 5-fluorouracil and Leucovorin. Of the 56 patients, 31 underwent FDG-PET/CT before NACRT, while 47 underwent PET/CT after NACRT to evaluate the efficacy of NACRT before surgery. Colonoscopy was conducted for all patients to preoperatively evaluate the efficacy of NACRT. In sequential PET/CT, we analyzed the SUVmax of the local tumor and considered the percentage of SUVmax reduction as the response index (RI) (RI = Pre-CRT SUVmax - Post-CRT SUVmax / Pre-CRT SUVmax×100). While considering the final pathological response as the gold standard, we compared the sensitivity and specificity of RI with the colonoscopic findings. **Results:** Colonoscopy revealed that the clinical responders (CR+PR) were 50 cases (89.3%), while the pathological assessment indicated that the pathological responders (G2+G3) were 25 cases (44.6%). In colonoscopy, the sensitivity and specificity were 100% and 19.4%, respectively. In 22 patients who underwent PET/CT before and after CRT, the mean RI was 63.9. The mean RI was significantly higher in the responders than in the non-responders (74.9±13.2% vs. 50.7±14.7%, p=0.006). Using an RI cutoff value of 65% for defining the response to therapy, the sensitivity was 75% and the specificity was 80%. **Conclusions:** In evaluating the efficacy of NACRT for LARC, colonoscopy showed higher sensitivity

while FDG-PET/CT (represented by the parameter RI) showed higher specificity. RI value seems to be a useful predictive factor for the efficacy of NACRT.

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A simplified approach to define the Biological Target Volume for radiotherapy planning based on 18F FDG-PET/CT. Results on 44 patients.

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Aim: Clinical implementation of a particular procedure to contour the Biological Target Volume (BTV) on the 18F-FDG PET/CT acquisition for planning a personalized radiotherapy treatment. **Materials and Methods:** During 2011, 44 patients (age range: 30-80 years) were referred to our centre to perform 18F FDG-PET/CT for radiotherapy treatment planning. In 18 patients the "target" was localized in the thorax (mediastinum, lung, oesophagus), in 4 in the abdomen (pancreas, stomach, liver) and in 22 in the pelvis (rectum, uterus, pelvic lymph nodes). FDG PET scans were performed following standard procedures: i.v. administration of 2.2 MBq/kg/bw followed by a whole body acquisition 1 hour later using a flat radiotherapeutic bed. A BTV was contoured on the PET/CT hybrid images through a SUV (Standard Uptake Value) segmentation process using a dedicated workstation for the analysis of metabolic images. The BTV, associated only to the CT image set of the hybrid PET/CT scanner, was exported as a DICOMRT structure to the Treatment Planning System (TPS), where the image registration between this study and the primary CT series (used for dose calculation) was performed. The primary CT series were acquired using a big-bore scanner to accommodate the immobilization devices used during radiotherapy and to perform the virtual simulation procedure through a dedicated software. **Results:** This contouring approach allowed, in all 44 patients, to overcome limitations on PET window/level representation in the TPS workstation, due to the different pixel value dynamics of PET and CT data and, at the same time, to obtain an accurate target volume based on SUV distribution. Moreover, in 11 patients with thoracic pathology, the PET/CT data were utilized not only to accurately contour BTV and Planning Target Volume (PTV) but also to evaluate the treatment effectiveness after the standard radiotherapy sessions, by observing the tumour reduction and thus to plan a subsequent boost; in these cases the image coregistration between CT series derived from PET/CT before and after treatment was used to calculate the target reduction in cm3. **Conclusions:** The BTV contouring procedure developed in our centre allowed an accurate definition of sub-volumes of PTV in which maximum dose or a boost was applied. Moreover the comparison of PET/CT images before and after the radiotherapeutic treatment resulted very useful for an accurate management of the patients to whom consequent radiotherapeutic treatments were planned in reduced volumes.

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Use of Four-Dimensional - Fluorodeoxyglucose - Positron Emission Tomography for Radiotherapy Planning in Lung Cancers: Preliminary Results

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Aim: The main objective is to assess prospectively the impact of four-dimensional (4D) [18F]-fluorodeoxyglucose positron emission tomography (FDG-PET) on the radiotherapy target volumes for lung cancers when using automatically PET segmented volumes previously corrected for respiratory motion and partial volume effects (PVE). **Materials and methods:** Four patients with histologically proven lung cancers, treated by thoracic irradiation without surgery and without initial chemotherapy underwent computed tomography (CT) simulation followed by 4D-FDG-PET/CT in treatment position. Prior to the automatic volume delineation using the fuzzy locally adaptive Bayesian (FLAB) method, PET images were first corrected for motion (phase rebinning associated to a non-rigid transformation) and PVE (deconvolution algorithm associated to a wavelet-based denoising). Several volumes comparisons were performed: (1) between PET segmented volumes before and after respiratory motion correction, (2) between PET segmented volumes before and after PVE correction and (3) between CT simulation volumes and PET segmented and corrected volumes. For the first two comparisons, the maximal activity (Amax) inside the tumor was analyzed. **Results:** For three patients, the tumor was located in the left upper lobe with attachment to the chest and for one patient in the middle lobe. The stages were two T1N0M0, one T2N3M0 and one T4N0M0. For the first comparison, between PET segmented volumes without or with respiratory motion correction, no difference was observed with a mean volume without and with correction of 45.5 and 45.2ml respectively and a mean Amax of 29328 and 29154 Bq/ml respectively. For the second comparison, the