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Technical Studies -> Data Analysis -> Image Reconstruction

e-Poster Area

EP-295

Yttrium-90 PET imaging with digital photon counting for radioembollization absorbed dose monitoring

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Aim/Introduction: We investigated the accuracy of image-based ^{90}Y PET dosimetry quantification with a SiPM-based PET/CT for radioembolization dose monitoring purposes. Different image reconstruction protocols from published studies [1,2] were used to compare with the clinical protocol in our centre. ***Materials and Methods:*** Three ^{90}Y phantoms were imaged: (1) a NEMA NU 2-1994 PET phantom with an insert filled with an uniform activity concentration (AC) = 1.71 MBq/mL, (2) a cylindrical phantom with AC = 0.29 MBq/mL, and (3) a NEMA body phantom containing six spheres of varying diameters (10-37 mm), with AC = 2.18 MBq/mL in all spheres and a sphere-to-background ratio of 9:1. Listmode PET data were acquired with a Philips Vereos digital photon counting (DPC)-PET/CT for 15 minutes in a single-bed position. Images were reconstructed using OSEM iterative algorithm with 3 iterations, 5 subsets, time-of-flight (ToF) and point-spread function (PSF). 2mm full-width at half-maximum (FWHM) Gaussian post-reconstruction filter was applied to all reconstructions. Phantoms (1) and (2), less influenced by partial-volume effects, were used for absolute quantification measurements. Phantom (3) was used to determine the AC recovery coefficients (RCs) of the hot spheres and background, based on CT-defined VOIs. We compared the results with those obtained from reconstruction parameters proposed by [1] (1 iteration, 21 subsets, ToF, PSF, 4.5mm FWHM filter) and [2] (3 iterations, 12 subsets, ToF, PSF, 5.2mm FWHM filter). Reconstructions were also performed with only the first 11 minutes of the acquisitions. ***Results:*** The relative differences between the reference and measured ACs in phantoms (1) and (2) were less than 1.5% and 2.5%, respectively. RCs for the hot spheres in phantom (3) for all reconstruction sets were between 0.74-0.78, 0.71-0.78 and 0.3-0.4 for the 37, 22 and 13mm spheres, respectively. RCs for the background using our parameters and the ones from [1] and [2] were 0.96, 0.86 and 0.94, respectively. RCs obtained with 11-minutes reconstructions were within 5% of the 15-minutes ones. ACs standard deviations were below 0.8 MBq/mL for the hot spheres. ***Conclusion:*** Reconstructions using 3 iterations provided overall better RCs than 1 iteration. Acquisition duration could be reduced by 30% (15 to 11 minutes) without accuracy degradation, thus improving patient comfort. ***References:*** [1]Pasciak et al. "A comparison of techniques for 90Y PET/CT image-based dosimetry following radioembolization with resin microspheres." Frontiers in Oncology 4(2014): 121
[2]Siman et al. "Dose volume histogram-based optimization of image reconstruction parameters for quantitative 90Y-PET imaging." Medical Physics 46.1(2019): p.229-237

EP-40

Technical Studies -> Dosimetry and Radiobiology -> Clinical Dosimetry

e-Poster Area

EP-296

Analysis of results of effective dose estimation obtained from RADAR 2017 dose assessment model for nuclear medicine procedures

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Aim/Introduction: To analyze the results of effective dose (E) estimation of the most frequent procedures using photon emitters in Nuclear Medicine, obtained from RADAR 2017 dose assessment model. To compare these results with those obtained from ICRP 128 (2015) recommendations, and to assess how using each dose assessment model can change E results. ***Materials and Methods:*** E estimation data was collected from photon emitter procedures performed during the last year in our department, obtained from RADAR 2017 dose estimation model for age groups: ≤ 1 year old; >1-5 years old ; >5- 10 years old, >10- 15 years old and adults. Injected activity was the one recommended by international guidelines and EANM Pediatric and Dosimetry Committees. Hybrid exams (SPECT / CT) and procedures for which there is no RADAR 2017 dosimetry estimation were excluded. Results for (E) were compared with those obtained by using ICRP 128 (2015) recommendations. ***Results:*** With RADAR 2017 dose evaluation model we obtained a lower mean value of E on most of the procedures that were analyzed, being significantly lower for Renogram, Renal scintigraphy on >10-15 years old, Thyroid scintigraphy, Meckel's scan and Bone Scan (0.12 to 1.16 mSv, 25% to 67%). Brain perfusion and Renal scintigraphy on ages under 10 obtained a significantly greater difference for E (0.33 to 2.85 mSv, 26% to 29%). ***Conclusion:*** These results are an updated collection of estimated E values for photon-

emitting radiopharmaceuticals commonly used in Nuclear Medicine, considering RADAR 2017 dose assessment model compared to ICRP 128) recommendations. Methodological changes on estimation lead to lower E for most of diagnostic procedures using photon emitters, this is of special interest for patients undergoing repeated ionizing radiation (dosimetry history). ***References:*** None

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Patient Radiation Doses from hybrid NM/CT Scans: Manitoba, Canada Vs. Europe

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Aim/Introduction: This study documented patient radiation doses from common clinical hybrid nuclear medicine / computed tomography (NM/CT) procedures in the Canadian province of Manitoba (population 1.34 million). Results were compared to European values and used to establish diagnostic reference levels (DRLs). ***Materials and Methods:*** All hybrid NM/CT facilities in Manitoba participated, comprising of eight SPECT/CT systems and one PET/CT system. Data were collected for six clinical SPECT/CT procedures and three PET/CT procedures: Bone (Torso only), Myocardial Perfusion, Lung V/Q, Parathyroid, Octreotide, Sentinel Lymph Node / Melanoma Mapping, then PET/CT brain, Near Whole Body(NWB), and Head/Neck (H/N) + NWB. DLP (mGy·cm) and administered activity (MBq) data were collected for 10-20 patients weighing 70+/- 20kg. Paediatric and pregnant patients were excluded. Comparison was drawn to relevant values presented in recent European publications. ***Results:*** Provincial CT DRLs have been established for the following procedures; Bone (190 mGy.cm), Cardiac MPS (55 mGy.cm), Lung V/Q (140 mGy.cm), Parathyroid (115 mGy.cm), and In-111 Octreotide (155 mGy.cm) SPECT/CT procedures. Site DRLs were established for the following PET/CT procedures; Near Whole Body (NWB 335 mGy.cm), H/N + NWB (525 mGy.cm), and Brain (645 mGy.cm). Provincial NM DRLs were calculated for Bone (815 MBq), Cardiac MPS (1490 MBq), Lung V/Q (40/210 MBq), Parathyroid (785 MBq MIBI), and In-111 Octreotide (135 MBq) SPECT/CT procedures. Site DRLs were calculated for all F-18 FDG PET/CT procedures; NWB or H/N +NWB (435 MBq), and Brain (270 MBq). The Sentinel Lymph Node/Melanoma procedures were too varied to establish DRL values. These values are comparable to values published in the literature. CT DRL ranges observed were Bone (150-200mGy.cm), Cardiac MPS (36-70mGy.cm), Lung V/Q (100mGy.cm, perfusion only), Parathyroid (160-170mGy.cm), In-111 Octreotide (240mGy.cm) and PET/CT NWB (400-750mGy.cm). For the radionuclide administration, the observed activity ranges were as follows; Bone (600-800 MBq), Cardiac MPS (950-1600 MBq), Lung V/Q (40/120-200 MBq), Parathyroid (700-900 MBq MIBI), In-111 Octreotide (220 MBq) F-18 FDG Near Whole Body PET (350-400 MBq), and F-18 FDG PET Brain (250 MBq). ***Conclusion:*** Several dose optimization opportunities were identified and are being pursued. For example, one system had average DLPs equal to or higher than the provincial DRL for all but cardiac studies, almost 1.5 times larger for parathyroid imaging, and double the DRL for octreotide imaging. Ongoing optimization work focuses on standardizing CT protocols. Results of the survey, comparison to European values and initial optimization efforts will be presented. ***References:*** None

EP-298

Quantification of myocardial dosimetry and glucose metabolism using a 17 segment model of the left ventricle in esophageal cancer patients receiving radiotherapy

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Aim/Introduction: Previous studies have shown that increased cardiac uptake of 18F-fluorodeoxyglucose (FDG) from positron emission tomography (PET) may be an indicator of myocardial injury after radiotherapy. The primary objective of this study was to quantify cardiac subvolume dosimetry and 18F- FDG uptake in oncologic PET using a17-segment model of the left ventricle (LV) and to identify dose limits related to changes in cardiac FDG uptake after radiotherapy (RT). ***Materials and Methods:*** Twenty-four esophageal cancer (EC) patients who underwent consecutive oncologic 18F-FDG PET/CT scans at baseline and post-RT were enrolled in this study. The radiation dose and the 18F-FDG uptake were quantitatively analyzed based on a 17-segment model. The 18F-FDG uptake and doses to the basal, mid and apical regions, and the changes in the 18F-FDG uptake for different dose ranges were analyzed. ***Results:*** A heterogeneous dose distribution was observed, and the basal region received a higher median mean dose (18.36 Gy) than the middle and apical received the highest doses, all of which were greater than 10 Gy. Three patterns were observed for the myocardial 18F-FDG uptake related to the radiation dose before and after RT: an increase (5 patients), a decrease (13 patients) and no change (6 patients). In the pairing analysis, the 18F-FDG uptake after RT decreased by 28.93% and 12.12% in the low-dose segments (0-10 Gy and 10-20 Gy,respectively) and increased by 7.24% in the high-dose segments (20-30 Gy). ***Conclusion:*** The RT dose varies substantially within LV segments in patients receiving thoracic EC RT. Increased 18F-FDG uptake in the myocardium after RT was observed