Schlussfolgerungen/Conclusions: Der unter Stimulationsbedingungen gemessene Tg-Wert ist, wenn er sechs Monate nach Therapie unter der Nachweisgrenze liegt, ein verlässlicher Prädiktor dafür, dass der Patient im weiteren Krankheitsverlauf tumorfrei bleibt. Wir schlagen vor, die Nachsorgefrequenz bei diesen Patienten zu verringern.

V56 Bestimmung der Lage von Schilddrüsenresten nach Thyreoidektomie mittels SPECT/CT

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Ziel/Aim: Bei Patienten mit Schilddrüsenkarzinom erfolgt zunächst eine Thyreoidektomie, um die Schilddrüse vollständig zu entfernen. Allerdings lassen sich bei der anschließend durchgeführten ablativen Radiojodtherapie in den meisten Fällen noch Schilddrüsenreste nachweisen. Ziel dieser Studie war es, mit Hilfe der SPECT/CT diese Schilddrüsenreste genau zu lokalisieren und mögliche Gründe für den Verbleib dieser Herde zu prüfen.

Methodik/Methods: Es wurden die Daten von 57 aufeinanderfolgenden Patienten (35 Frauen/ 22 Männer) mit differenziertem SD-Ca (39 pT1, 7 pT2, 12 pT3; 10 pN1, 47 pNx oder 0), die nach der ablativen Therapie mit 3,96 + 0,5 GBq 131-Jod eine SPECT/CT des Halses erhielten, ausgewertet. Die SPECT/CT wurde mit einer Doppelkopf-SPECT-Kamera kombiniert mit einem zwei - bzw. sechszeiligen Spiral-CT (Symbia T2 bzw. T6, Siemens, Erlangen, Deutschland) durchgeführt. Alle jodspeichernde Herde, die als Schilddrüsengewebe identifiziert wurden, wurden bezüglich ihrer Lage in 4 Kategorien eingeteilt: K1: SD-Lager kaudal (Höhe Thoraxappertur, paratracheal), K2: SD-Lager zentral (direkt unterhalb des Kehlkopfes, paratracheal), K3: SD-Lager kranial (Kehlkopf), K4: Zungengrund und Lobus pyramidalis. Die Lokalisation der Herde im Schilddrüsenlager wurde korreliert mit der Lage des Tumors und mit der Größe des Schilddrüsenrestes.

Ergebnisse/Results: Bei allen Patienten fanden sich Schilddrüsenreste entweder im Schilddrüsenlager oder/und als Lobus pyramidalis bzw. im Zungengrund.101 Schilddrüsenreste fanden sich direkt im Schilddrüsenlager, davon lagen 73 (72%) zentral, 16 (16%) kaudal und 12 (12%) kranial. Das Vorhandensein von Restschilddrüsengewebe korrelierte weder mit der Lage des Tumors ($c^2 = 0.19$; $p = 0.66$) noch mit der Größe des entfernten Schilddrüsenlappens (p=0.33, t-test).

Schlussfolgerungen/Conclusions: Weder die Lage des Schilddrüsentumors noch die Größe des Schilddrüsenlappens hatte einen Einfluss auf die Radikalität der Operation. Am häufigsten verbleiben Schilddrüsenreste paratracheal unmittelbar unterhalb des Kehlkopfs. An dieser Stelle verbindet das Ligamentum Berry die hintere Fläche der Schilddrüse mit der Trachea, was die komplette Entfernung des Schilddrüsengewebes erschwert. Außerdem verläuft hier der N. recurrens nach kranial bis zum Eintritt in die Kehlkopfmuskulatur, so dass der Chirurg hier häufiger zum Schutz des Stimmbandnervs auf eine komplette Resektion verzichtet.

EDV/Modelling

V57 Improved SPECT MPI rest/stress analysis workflow through automated image registration

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Ziel/Aim: Myocardial SPECT rest/stress examinations are usually acquired a few hours apart and are therefore not spatially aligned. However, precise spatial alignment is mandatory in order to evaluate on a regional level scar, ischemia and normal myocardium. Therefore, the technologists manually align both images by reorienting each dataset separately along the left ventricular axis and defining the apical and basal planes. This method is time-consuming and operator dependent. As alternative, we propose and evaluate the impact of using an automatic image registration of the rest-stress data prior to the further processing.

Methodik/Methods: A mutual information based image registration application was implemented using the ITK toolkit [1]. 96 consecutive patients (age 68±10 y, 15% with a transient ischemic dilation ratio above 1.2) undergoing a single-day ^{99m}Tc-MIBI rest/stress examination on a Siemens E.cam were processed with the standard workflow and using the workflow based on the automatic registration. Two experienced reading physicians compared the report pages containing the reoriented cardiac views generated using the manual and automatic processing. Both observers, blind to the processing method used in each case, determined which report page showed a superior spatial matching between the rest and stress examinations and whether one of the report pages would need to be re-generated because of severely deficient registration, inadequate for clinical reading.

Ergebnisse/Results: The time needed by the technologist to completely process a rest/stress examination starting from the transaxial images was 123±95 seconds with the standard workflow, 59±7 seconds with the workflow based on the automatic registration. According to both reading physicians, the report pages generated using the workflow with the automatic registration showed a superior alignment in 56% of the cases, equivalent in 43% of the cases and inferior in 1% of the cases. Re-generation of the report page due to relevant misalignment during QC was required much more often when processed manually as compared to the automated approach (26% versus 2%).

Schlussfolgerungen/Conclusions: Automatic registration of rest/stress datasets prior to further processing allows a faster report generation and provides a better spatial matching between the datasets, increasing the confidence of the reading physician.

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V58 A Mass Conservation Based Optical Flow Method for Cardiac Motion Correction in 3D PET Data

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Ziel/Aim: Motion artifacts due to cardiac motion are well known. These artifacts may lead to quantification errors in PET imaging. Using cardiac gating reduces the motion artifacts but increases the noise level due to lesser amount of information per gate. Therefore to use a motion correction scheme to utilize all PET information whereas avoiding the motion artifacts is advisable. In this study a new method of cardiac motion correction on 3D-PET data is presented which is based on mass conserving optical flow.

Methodik/Methods: The law of mass conservation holds true for cardiac PET images as the total activity in the heart muscle remains constant during the cardiac cycle (for data pre-corrected for radioactive decay). Adding a smoothing term to the law of mass conservation to solve the under-determined system of linear equations leads to an optical flow functional. The minimization of this functional was achieved by using the corresponding Euler-Lagrange equations. The thus estimated optical flow vectors can then be used to deform the PET data to correct it for cardiac motion.

Ergebnisse/Results: Three criteria, 1) the correlation coefficient between the images from different phases, 2) the myocardial thickness in the left ventricle and 3) the mean blood pool activity in the left ventricle, were used to assess the quality of the proposed method. One NCAT software phantom and 14 patient datasets were included in the study. The correlation coefficient between the images from the diastolic and all other cardiac phases was increased from 0.83 to 0.998 on average after motion correction. The myocardial thickness increases from the diastolic to the systolic phase. It can be estimated on cardiac

images by taking the FWHM of the profile curves through the heart muscle. After motion correction the myocardial thickness was found to be corrected to within 0.1mm of the target phase for all image volumes. Similarly, activity in the blood pool in the left ventricle varies due to partial volume effects induced by cardiac motion. This variation is reduced after motion correction. The standard deviation in the mean blood pool activity, measured in a 100 voxel large region of interest, among different cardiac phases was reduced from 410 to 27.
Schlussfolgerungen/Conclusions: A new method of cardiac motion correction was presented, which is based on mass conserving optical flow. The method accurately corrected the cardiac motion on all datasets as measured with three different criteria.

V59 Fully automated sentinel-lymph-node detection software for breast- and prostate-cancer patients using SPECT/CT-studies

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Ziel/Aim: In nuclear medicine sentinel-lymph-node (SLN) examinations are standard procedures. The common way of interpretation is the visual analysis of the images by nuclear medicine specialists. The SPECT/CT-data analysis depends solely on the examiner's experience and is very time-consuming. Therefore our goal was to design a fully automated post-processing-method which detects, classifies and quantifies SLN on SPECT/CT-studies. The clinical investigation of the method was performed on data, taken from breast- and prostate-cancer patients. Results show that the method successfully fulfilled its requirements on both patient groups.
Methodik/Methods: We collected 72 reconstructed SPECT/CT-datasets of each entity. The SPECT/CT-data were acquired 0.5-2 hours after injection of 30-150 MBq of Tc-99m-Nanocolloid, by using a SPECT/CT-camera-system (Symbia T, Siemens). The method was performed in InterView software manufactured by Mediso and physicians and scientists of the department for nuclearmedicine Kiel. Two masks were automatically segmented from the CT representing the region of the body and the bones. Based on the body mask a threshold for the background noise level was determined in the SPECT. All values being less than the noise threshold were deleted from the SPECT. In order to merge separate hot spots of the injection into one region, another threshold value was determined and applied automatically. The rest of the detected hot spots in the SPECT were quantified by calculating their volume/mean/std.dev/min/max. Two indices were calculated for every individual hot spot: weighted probability (mean*(std.dev/volume)) and bone ratio (volume laid on bone regions / total volume). Separator functions were calculated on the 2D feature space of the above indices to automatically classify the SPECT hot spots as true and false lymph-nodes. The determination of the separator functions was based on trials given by two experienced nuclear medicine specialists independently. The implementation and the validation of the method were performed in InterView Fusion software manufactured by Mediso. The result of the automated method was compared to corresponding previous reports.
Ergebnisse/Results: 98.3% and 99.5% of previously reported lymph nodes were determined automatically for the studies of prostate- and breast-cancer patients respectively by using the InterView Fusion software. The whole post-processing-method took an average time of 2 minutes for a patient's SPECT/CT-dataset to gain all marked lymph-nodes and their quantitative values.
Schlussfolgerungen/Conclusions: The fully automated SLN detection and quantification algorithm can be applied on SPECT/CT-data of prostate- and breast-cancer patients. The clinical validation of the method indicates that it is a fast and accurate tool for SLN detection. Therefore it can support physicians in daily routine sustainably.

V60 Evaluation of partial volume correction methods and T1-MR segmentation algorithms for dopaminergic PET studies.

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Ziel/Aim: To improve and evaluate quantitative [18F]FDOPA PET assessment by means of different partial volume correction (PVC) algorithms based on automatic and manual parcellation methods. Most PVC algorithms require anatomical information derived from magnetic resonance (MR) data and thus, are sensitive to the performance of MR segmentation.
Methodik/Methods: Dynamic [18F]FDOPA PET was simulated using SORTEO PET simulator (2) and Zubal brain phantom(3). The last 6 frames were averaged and coregistered to the Zubal MR image. FSL and SPM5 segmentation was performed on the T1-MR brain phantom. Additionally a mask for Nucleus Caudatus (NC) and Putamen (PUT) and an atlas for subcortical tissues were created by manual parcellation and by FIRST (FMRIB's integrated Registration and segmentation Tool), respectively. SPM5 segmentation results were adjusted respectively by the mask, the atlas and the phantom labels. Finally the original and adjusted segmentation images were passed to the six PVC algorithms (PMOD 3.0 and PVELab (1)). Phantom labels were utilized to extract values from NC and PUT before and after correction.
Ergebnisse/Results: Both FSL and SPM5 exhibit a good segmentation in NC, but a poor result in PUT, for which approximately 76% and 50% PUT voxel were misclassified, respectively. Mask (25%) or atlas (16%) adjustment within SPM5 improves this misclassification. High DICE coefficients indicate a good agreement between manual and automatic parcellation were observed: 0.85±0.05, 0.86±0.05 for left/right NC and 0.85±0.05, 0.89±0.02 for left/right PUT. The best recovery coefficient (RC) for both structures with the adjusted segmentation was obtained from Müller-Gärtner (MG) (NC=0.87±0.01, PUT=0.84±0.01), modified MG (NC=0.88±0.01, PUT=0.85±0.01) and Rousset (NC=1.08±0.02, PUT=1.02±0.07) compared to the non corrected RC (NC=0.70, PUT=0.75). The absolute mean difference of these values to the RC derived from the phantom labels adjusted segmentation was less than 10 %.
Schlussfolgerungen/Conclusions: For PVC of dopaminergic PET studies, adjustment of MR segments is necessary. With the atlas formed by FIRST, this adjustment could be fully automatic. The dedicated software: PVELab, offers multiple PVC facilities, some of them (e.g. MG and modified MG) are robust to potential segmentation errors and have ability to provide sufficient recovery for NC and PUT with help of MR segment adjustment.
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V61 Evaluation of treatment response of cilengitide in an experimental model of breast cancer bone metastasis using dynamic PET with FDG

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Ziel/Aim: Cilengitide (EMD 121974) is a cyclic arginine-glycine-aspartic acid containing peptide that binds to αvβ3 and αvβ5 with nanomolar affinity. In cell adhesion assays, it inhibited both αvβ3 and αvβ5 mediated cell adhesion with IC_{50} values in the low micromolar range and inhibited angiogenesis in the chick chorioallantoic membrane assay and rabbit cornea assay [1]. In experimental breast cancer bone metastases, cilengitide was shown to reduce the size of osteolytic lesions and the corresponding soft tissue tumors [2].Metabolic imaging with PET is an established method in addition to anatomic imaging methods in patients with several tumor types, including metastatic breast cancer. Several studies have been performed to assess the impact of transporters