Methods: Total RNA was extracted from 12 consecutive N1 and 11 consecutive N0 papillary thyroid carcinoma samples that were shock-frozen in isopentane and stored at -80°C for a median of 11 years (range: 1-16 years). Furthermore, total RNA was isolated from 12 age- and gender-matched normal thyroids. RNA integrity was assessed by electrophoresis using the RNA Integrity Number (RIN) algorithm. The Affymetrix U133 2.0 full human genome GeneChip was used for hybridization with total RNA. GeneOntology was explored using the NIH Database for Annotation, Visualisation and Integrated Discovery (DAVID V2.1), significance was obtained by Fisher's exact test.
Results: The median RNA yield was 1.9µg/mg tissue with an 8.6 (7.3-9.8) median RIN. Metastatic papillary thyroid carcinoma revealed activation of 2770 genes (1216 annotated) and deactivation of 2210 genes (941 annotated) as compared to non-metastatic papillary thyroid cancer. Most significant gene classes upregulated comprised cell adhesion (n=113, p<0.0001), cell-cell-adhesion (n=34, p<0.0001), cell motility (n=28, p=0.0049), cell-matrix-adhesion (n=13, p=0.0096) and cell migration (n=11, p<0.0451). Stringent filtering revealed a set of 42 genes upregulated solitary in metastatic papillary thyroid cancer, including SPUVE and LRP4, which have been previously reported as generally overexpressed in papillary thyroid cancer. Filtering also revealed a set of 32 genes downregulated in metastatic papillary thyroid cancer.
Conclusions: Our results reveal gene sets involveld in progression of papillary thyroid carcinoma. Among these genes, SPUVE, a serine protease, and LRP4, a regulator of extracellular matrix-metalloproteinases, are significantly upregulated in metastatic papillary thyroid cancer and can possibly be employed as diagnostic clinical markers.

14.1

Are low dose CT used for pediatric PET-CT imaging adequate for diagnosis? An image noise-based analysis

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Background: PET and PET-CT are being successfully used in pediatric oncology in children with Hodgkin and non-Hodgkin lymphomas and seem promising for monitoring treatment response in children with osteosarcomas and rhabdomyosarcomas, Ewing's sarcoma, neuroblastoma. Optimizing multislice spiral CT for pediatric CT examination allows significant dose reduction and is currently performed in many institutions. However, this issue has not been fully characterized in relation to PET-CT protocols. We wanted to determine the lowest dose that can be applied in pediatric PET-CT in order to safely set the tube current modulation parameters.
Material and Methods: Using a variety of phantoms, CT images were acquired on both a PET-CT (Discovery LS, 4-slice system) and a dedicated CT unit (GE Lightspeed 8-slice systems) using two different protocols: (1) a diagnostic acquisition CTDIvol of 9 to 14 mGy for a weight range of 5 to 15 kg, and (2) attenuation correction CT images using a CTDIvol of 6 mGy. The image quality was assessed by means of a mathematical model (i.e. non-prewhitening matched filter) confirmed by images of a CT contrast-detail phantom.
Results: When reducing the CTDI from 14 mGy to 6 mGy, image noise increased from 6 to 19 HU. The large CTDI used in a diagnostic acquisition allowed detecting target sizes as small as 2 mm whereas the CTDI used in attenuation correction images only allowed detection of size of 3 to 6 mm (contrast of the target: 10 HU).
Conclusion: In patients where the detection of small low contrast structure is not required, follow-up can be performed using CTDI values comparable to the one used for attenuation correction and image fusion in PET/CT. Using optimal CT technique in children allows to significantly reduce radiation exposure by adjusting CT parameters to the clinical question. The dose reduction can be performed without decreasing image quality when high-contrast organs are considered.

14.2

Characterisation of sources of artefact when using CT-based attenuation correction in PET

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Purpose: Quantitative image reconstruction in PET requires an accurate attenuation map of the object under study for the purpose of attenuation correction. The purpose of this work is to quantitatively measure the impact of scattered radiation and contrast medium on the accuracy of CT-based attenuation correction (CTAC).
Methods: Our recently developed MCNP4C-based Monte Carlo x-ray CT simulator for modelling both fan- and cone-beam CT scanners and the Eidolon dedicated 3D PET Monte Carlo simulator were used to generate realigned PET/CT data sets. The impact of x-ray scatter on the accuracy of CTAC was investigated through simulation of a uniform cylindrical water phantom for both a commercial multislice and prototype flat panel detector-based cone-beam CT scanners. The influence of contrast medium was studied by simulation of a cylindrical phantom containing different concentrations of contrast medium. Moreover, an experimental study using an anthropomorphic striatal phantom was conducted for quantitative evaluation of errors arising from the presence of contrast medium by calculating the apparent recovery coefficient (ARC) in presence of different concentrations of contrast medium.
Results: The analysis of attenuation correction factors (ACFs) for simulated cylindrical water phantom in both fan- and cone-beam CT scanners showed that the contamination of CT data with scattered radiation in the absence of scatter removal underestimates the true ACFs, namely by 7.3% and 28.2% in the centre for both geometries, respectively. The ARC was 190.7% for a cylindrical volume of interest located in the main chamber of the striatal phantom containing contrast medium corresponding to 2000 Hounsfield units.
Conclusions: Without x-ray scatter compensation, the visual artefacts and quantitative errors in flat panel detector-based cone-beam geometry are substantial and propagate cupping artefacts to PET images during CTAC. Likewise, contrast-enhanced CT images may create considerable artefacts during CTAC in regions containing high concentrations of contrast medium.

14.3

PET comparison on the basis of the new acceptance testing procedure proposed by the Federal Office of Public Health (BAG–OFSP)

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Purpose: To characterize two PET systems, in terms of image quality and quantitative aspects, using the draft of the PET acceptance testing procedure proposed by the Public Health Authority (OFSP), which is based on the NEMA 1994 and 2001 standards. Our second aim was to assess the feasibility of the NEMA procedures, or if alternative methods need to be developed.
Material and Methods: One PET/CT in Genolier (Philips Gemini) and one PET/CT in Lausanne (GE Discovery LS) have been in-