BOOK OF ABSTRACTS

RÉSUMÉS

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THE SIGNIFICANCE OF ECG CHANGES DURING ADENOSINE INFUSION AS A STRESS AGENT DURING MYOCARDIAL PERFUSION IMAGING (MPI) FOR PREDICTING CORONARY ARTERY DISEASE (CAD)

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ECG changes are recognized complications of adenosine stress test and their manifestation may range from minor to life threatening changes that urge for stopping the whole procedure. This study will elaborate the significance of these changes in predicting the possibility of CAD.

Methods: This was a retrospective observational registry performed in a single center in the Kingdom of Saudi Arabia. The data were collected from the nuclear medicine database identifying all the reported Gated myocardial perfusion SPECT with adenosine stress tests between January 2013 and January 2014. The adenosine dose was given as a continuous infusion of 140 mcg/kg/min over a 6-minute period. Injection of cardiac radiopharmaceuticals was given at 3 minutes of this 6-minute protocol.

Results: There were 346 patients identified with cardiac nuclear scans in the pre-specified time frame who subjected to adenosine stress scan. 152 of these patients were male accounting for 44% of the total population. Average age at the time of examination was 60.82 ± 11.29 years. Patients were presented with one or more risk factors. Patients with baseline abnormalities, past history of CAD with or without PCI or CABG and previous MI were excluded from the study. Ninety eight patients (28%) were reported as positive for CAD, 40 patients were reported with ischemic ECG changes (12%) during adenosine infusion, 23 patients who have ischemic changes were positive on MPI, while 17 patients who have positive ECG had a negative MPI. Odd Ratio (OR) was 4.16, 95% C.I. was (2.11-8.18). Fisher Exact test was applied and showed a P value of < 0.01. No reported case of asystole, myocardial infarction or complete heart block in this study period.

Conclusion: The development of ischemic changes during adenosine myocardial perfusion imaging (MPI) has been shown to be a predictor of CAD and consequently subsequent cardiac events and worse outcome. Our study showed that the probability of a positive MPI is 4 times higher with a positive ECG ischemic changes during adenosine stress test and consequently these ECG ischemic changes should be taken in consideration in the final report.

DOUGHNUT SIGN OF ANEURYSMAL BONE CYST OF CALCANEUS ON TRIPHASIC BONE SCAN

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Abstract: An aneurysmal bone cyst is an expansile osteolytic lesion with a thin wall, containing blood-filled cystic cavities. It has a classical appearance of doughnut on bone scintigraphy (Doughnut sign). We present a case of a 19 years old lady with 1.5 years history of pain of moderate severity over the left calcaneal region associated with difficulty on walking. On local examination, her left calcaneal region was normal looking with no signs of acute inflammation but she had mild tenderness. A dynamic triphasic bone scan was performed with 518 MBq (14 mCi) of Technetium-99m Methylene Diphosphonate (Tc-99m MDP). Her dynamic images revealed asymmetrical flow over left calcaneal region and a well defined area of enhanced activity over left calcaneus on blood pool images. Delayed images shows photopenic area surrounded by a peripheral rim of increased activity in the left calcaneus; a characteristic doughnut appearance (figure 1 and 2). Delayed image also revealed an
incidental finding of a small shrunken right kidney with an enlarged left kidney (compensatory hypertrophy). An X-ray of left calcaneus (lateral view) revealed radiolucent areas separated by trabeculae giving a soap bubble appearance (figure 3). The findings were classical for aneurysmal bone cyst of calcaneus.

003

EVALUATION OF RADIUM 223 DICHLORIDE ADSORPTION TO UNIT DOSE SYRINGES

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Objectives: This study aimed to examine the following practical considerations; geometric effect between vials and different syringes and the adhesive properties of Ra-223 dichloride on standard syringes over time.

Methods: Xofigo® Radium-223 dichloride (Bayer Inc. /IFE) were drawn into glass vials (Fisher Scientific Co. Ltd), 5 cc syringes (BD syringe), and 10 cc syringes (BD syringe). The samples were assayed, weighed, and compared for geometric effects. Additionally, doses of Xofigo® were drawn into 5cc and 10cc syringes and incubated for 24 hrs, 48 hrs, 72hrs, and 168hrs. After incubation, the syringes were mock-injected and rinsed 3 times. All syringes were assayed and weighed before and after emptying and between rinses. Planar imaging was used to localize the residual activity.

Results: There are only slight differences in assay between Ra-223 dichloride when drawn into vials, 5cc and 10cc syringes. The adherent properties were found to vary less than 10% of desired dose and was incubation-time independent. The first rinse removed most of the residual post-administration activity. Planar imaging showed that most activity was retained in the dead space of the luer lock needle hub and plunger.

Conclusions: Ra-223 Dichloride does not require handling considerations with respect to geometric effect. The adherence of Ra-223 does not require special adaptations for dose salvage due to the initial and time-independent nature of the strength of interaction between radiopharmaceutical and syringe. However, rinsing post-administration will ensure that accurate and precise dose is administered when drawn dose is low. Images showed that initial retention was in the needle hub and plunger but, post rinse activity resides in the needle hub.
004

LU-177 DOTATATE EXTERNAL DOSIMETRY NEW MODEL DOSE MEASUREMENTS THAT REVISED SCHEDULE OF PATIENT RELEASE & RESTRICTION DURATION IN COMPARISON TO PREVIOUS MEASUREMENTS FROM 2013

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Objectives: Compared previous dose rates measurements for Lu-177 Dotatate from 2013 to our new non-cumulative measurements, considering now clearance to proceed both by physical decay and biologic excretion which revised patient release & restriction duration. Our new proposed model combines our experimental results with results from literature.

Methods: 6 patients were administered Lu-177 Dotatate with activity range: 3700 - 5500 MBq. Dose rate was measured post therapy administration at 1.9 m from patient’s with several time points. Measurements where made with a Berthold LB 124 Digital Contamination Monitor. The raw data from our experiment were collected compare to implementation of our model that can be used to predict discharged patients dose to general public or caregivers under various restriction conditions. Finally, we compare our new model with our previous data from 2013.

Results: In 6 patients one hour pre-void & post-void, 5 hour & 20 hour mean dose rate was 5.6 uSv/hr, 4.4 uSv/hr, 2.28 uSv/hr and 1 uSv/hr respectively. Under pre-void condition, we can determine dose reduction factor R value which found to be 0.87. We determined the fraction of radiotherapy product in the patient after voiding by comparing pre- and post-void dose-rate measurements. We found average ratio to be 0.87. Both predicted dose rate & experimental measurements dose rate plot with time data on graph. The dosimetry model show calculation of total dose to caregiver with different scenarios.

Conclusion: In correlation with previous study from 2013, data shows variability and differences compared with our proposed model ranging from 3% to 32%. However, overall we consider 2013, experiment results and our model predictions reasonably close, especially considering we used two different methods to arrive dose. Our intention is to eventually use our new model to guide decisions for Lu-177 Dotatate patient restrictions and release from our institution.

005

QUANTITATIVE EVALUATION OF MYOCARDIAL PERFUSION RESPONSE TO VASODILATION (DIPYRIDAMOLE) COMPARED WITH DOBUTAMINE IN PATIENTS WITH END-STAGE LIVER DISEASE DURING 82RB PET/CT MPI.

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Objectives: The objective of our study was to determine if end-stage liver disease is associated with an attenuated response to vasodilator-stress or dobutamine-stress using $^{82}$Rb-PET MPI with myocardial blood flow quantification.

Materials and Methods: Pre-liver transplant patients who had a normal dipyridamole-stress $^{82}$Rb PET/CT MPI study with no identifiable coronary artery calcium were identified retrospectively (n=27; April/11-Dec/14). Quantitative parameters including left ventricle rest and stress blood flow (mL/min/g myocardium) and stress/rest myocardial flow reserve ratio (MFR) were calculated and correlated with the MELD score (pre-2016). These parameters were compared to a prospectively identified low-risk of liver disease risk control group (n=20; Jun/14-Mar/15; informed consent obtained) and a retrospectively evaluated dobutamine-stress pre-liver transplant $^{82}$Rb PET/CT MPI group (n=16; Nov/15-Sep/16). Statistical evaluation included two-sample independent variable Student t-test, Pearson’s correlation, and linear regression analysis. The methodology was approved by our institutional ethics review board.

Results: The dipyridamole-stress liver disease group had a lower MFR (1.89, 95% CI 1.59-2.19) and a higher rest flow (0.95mL/min/g myocardium, 95% CI 0.86-1.04) than the low risk control group (MFR 2.79, 95% CI 2.37-3.21, p<0.05; rest flow 0.70, 95% CI 0.63-0.77; p<0.05). The dobutamine-stress group had a higher MFR than both other groups (3.99, 95% CI 3.35-4.63; p<0.05). A moderate negative correlation between MELD score and MFR was demonstrated for the dipyridamole-stress liver disease group (r=-0.473, p<0.05).

Conclusion: Dipyridamole demonstrates an attenuated vasodilatory response in end-stage liver disease patients compared to a non-liver disease control group. Dobutamine does not demonstrate this effect and may be the preferred pharmacologic MPI stress agent for end-stage liver disease patients.

NSCLC/PET/CT PARAMETERS

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Aim: To correlate of PET/CT parameters with the clinical outcome in stage 4 NSCLC patients.

Methods: Retrospective analysis of initial staging 18F-PET/CT of 29 stage 4 NSCLC patients for Quantitative parameters; maximum, mean, and peak standardized uptake values (SUV max, SUV mean, and SUV peak) metabolic tumor volume (MTV), total lesion glycolysis (TLG), standardized added metabolic activity (SAM), and normalized standardized added metabolic activity (N SAM) was done for the primary tumor. PET/CT parameters and overall survival was correlated. Biomarkers were measured as continuous variable and dichotomized as High vs. Low by the optimal cut point for OS using maximized log-rank statistics. Each variable was association with OS using Cox proportional hazard model. Association between OS and PET/CT parameter adjusted for age/performance status was calculated by multivariate Cox model.

Results: High level of Quantitative PET parameters is associated with higher risk of death both with continuous and categorical assessment. High tumor SUVmax (Hazard ratio HR = 4.03(1.43-11.29)), SUVpeak (HR=3.24 (1.17-9.03)), log(MTV) (HR = 5.65 (1.84-17.30)), log(TLG) (HR = 4.83 (1.73-13.49)), log(SAM) (HR 2.89 = (1.00-8.35)), significantly correlated with higher risk of a shorter OS (p<0.05).

Conclusion: PET/CT parameters have a role in predicting OS in advanced NSCLC with implication for risk stratification/treatment selection.
IS TRANSIENT LEFT VENTRICULAR ISCHEMIC DILATATION A RELIABLE INDICATOR OF CORONARY ARTERY DISEASE IN THE ABSENCE OF PERFUSION DEFECTS IN STRESS MYOCARDIAL PERFUSION IMAGING?

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Objective: Transient ischemic dilatation (TID) of the left ventricle (LV) in stress myocardial perfusion (SMPI) refers to stress-induced LV enlargement on the post stress scans as compared to the resting imaging. This finding is suggestive of multivessel coronary artery disease (CAD). On several occasions, however, we noted TID in patients whose SMPI demonstrated no perfusion defects and coronary angiography demonstrated no hemodynamically significant coronary stenosis. Our goal was to determine the frequency of this unexpected discordance.

Methods: Over a 5-year interval, the medical records of a total of 17 patients whose SMPI showed TID but no perfusion defects were reviewed. Thirteen of these 17 patients underwent coronary angiography. The remaining 4 patients were excluded from this analysis.

Results: All patients had visually evident TID on SPECT imaging, and the TID ratios ranged from 1.24 to 2.46. Twelve of the 13 patients (92.30%) had no hemodynamically significant coronary arterial occlusion on coronary angiography. Using a Wilson score interval, this proportion is significantly greater than random chance with statistical confidence of 99%. The remaining one patient had an 80% right coronary arterial occlusion.

Conclusion: TID of the LV without perfusion defects and without hemodynamically significant coronary stenosis was found in 12 of 13 patients (92.30%). Perhaps TID is either not very specific for CAD, or is detecting subendocardial ischemia that cannot be detected by coronary angiography. In SMPI, the finding of TID without perfusion defects does not necessarily indicate CAD that is detectable by coronary angiography.

A NOVEL QUANTITATIVE APPROACH TO POSITRON EMISSION TOMOGRAPHY FOR THE EARLY DIAGNOSIS OF ALZHEIMER’S DISEASE

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Positron Emission Tomography (PET) with fluorodeoxyglucose (FDG) radiotracer has been widely used as a brain imaging technique to aid diagnosis of Alzheimer’s disease (AD). To reduce variability associated with subjective FDG-PET readings, we developed a quantitative FDG-PET reading method for early AD diagnosis. We applied scaled subprofile modeling (SSM), a principal component analysis (PCA) technique, and a machine learning approach to the publically available FDG-PET database provided by AD neuroimaging initiative (ADNI). We identified FDG-PET images of 94 patients with AD and 90 normal controls (NL; who did not develop AD in >3 years follow-up period). Twenty subjects from each group were randomly selected (training set) and SSM/PCA was performed to construct AD-related metabolic covariance pattern (ADRP). Optimal threshold for ADRP expression that results in maximum sensitivity × specificity was determined, then prospectively applied to the
remaining AD (n=74) and NL (n=70) to classify them. Following 1,000 repetitions, 1,000 voting machines were constructed. The percentage of voting results was used to determine the group. During voting, patients included in the training set were excluded. This approach classified AD vs. NL with high sensitivity (=0.77) and specificity (=0.87). When applied to patients with late-stage mild cognitive impairment (L-MCI) with >3 years of follow-up period, it accurately classified AD converters (n=33) vs. non-converters (n=75) with low sensitivity (=0.58) and moderate specificity (=0.63). This voting approach was applied to MCI patients scanned with FDG-PET (follow-up period: 10-56 months) in our Health Science Centre from 2010-2012. Good sensitivity (=0.72) and specificity (=0.70) were achieved in predicting patients who converted to AD (n=20) vs. who did not (n=18). In conclusion, we demonstrated a good feasibility of the proposed automated FDG-PET reading method that can be implemented at regional PET centres.

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**009**

**REPRODUCIBILITY OF LOBAR PERFUSION AND VENTILATION QUANTIFICATION USING A SPECT/CT SEGMENTATION SOFTWARE IN LUNG CANCER PATIENTS**

*Karine Provost, Antoine Leblond, Annie Gauthier-Lemire, Edith Filion, Houda Bahig, Martin Lord*

Pre-therapy quantification of perfusion in lung cancer patients using planar Tc99m-MAA perfusion scintigraphy poorly reflects true lobar anatomy. This study evaluates inter- and intraobserver agreement of quantification using a novel semi-automatic SPECT/CT lung segmentation software, and compares results of regional lung contribution obtained with SPECT/CT and planar scintigraphy.

**Methods:** Thirty lung cancer patients underwent ventilation perfusion scintigraphy with Tc99m-MAA and Technegas. Regional lung contribution to perfusion and ventilation was measured on planar scintigraphy and SPECT/CT semi-automatic lung segmentation software by two observers. Interobserver and intraobserver agreement for SPECT/CT software were assessed using intra-class correlation coefficient (ICC), Bland Altman plots, and absolute differences of measurements. Measurements from planar and tridimensional methods were compared using paired sample t-tests, and mean absolute differences.

**Results:** ICC were in the excellent range (above 0.9) for both interobserver and intraobserver agreement using the SPECT/CT software. Bland Altman analyses showed very narrow limits of agreement. Absolute differences were below 2.0% in 96% of both interobserver and intraobserver measurements. There was a statistically significant difference between planar and SPECT/CT methods (P<.001) for quantification of perfusion and ventilation for all right lung lobes, with a maximal mean absolute difference of 20.7% for the right middle lobe. There was no statistically significant difference for quantification of perfusion and ventilation for left lung lobes using both methods, however absolute differences reached 12.0%. Total right and left lung contribution were similar using both methods, with a mean difference of 1.2% for perfusion and 2.0% for ventilation.

**Conclusion:** Quantification of regional lung perfusion and ventilation using a SPECT/CT lung segmentation software is highly reproducible. This tridimensional method yields statistically significant differences in measurements for right lung lobes when compared to planar scintigraphy. We recommend that SPECT/CT based quantification be used for all lung cancer patients undergoing pre-therapy evaluation of regional lung function.
EVALUATING THE RESULTS OF NEW PSYCHIATRIC TREATMENTS: BRAIN SPECT USEFULNESS.

Dan Pavel MD; Steve Best MD

Objectives. Documenting response to novel treatments for complex Neuropsychiatric conditions with comorbidities.

Methods: 3 novel treatments considered: concurrent Transcranial Magnetic Stimulation and ketamine infusion (TMS/ketamine); Hyperbaric Oxygen Therapy (HBOT); perispinal injection of etanercept (PSE). Brain SPECT pre and post: Triple head camera, HMPAO; special software with multiparametric color displays optimized for visual evaluation.

6 patients with disabling Neuropsychiatric conditions unresponsive to previous outside treatments.

(I) 62 y.o. female: suicidal, with Treatment Resistant Depression, grief and effects of prolonged polypharmacy.

(II) 34 y.o. female: regulatory disorder of childhood, 2 concussions, post-traumatic epilepsy, RSD, major incapacitation.

(III) 54 y.o. male: childhood Tourette’s history alcohol abuse, severe depression, fatigue, sleep apnea.

(IV) 55 y.o. female: major depression, panic/agoraphobia, long term back pain, frequent headaches.

(V) 43 y.o. m: bipolar II, anxiety, impulsive behavior, family stressors, inability to hold job.

(VI) 77 y.o. male: 3 years post sudden onset of dementia induced by general anesthesia: major cognitive, physical and emotional impairments.

Results. Patient (I). 5 months post TMS/ketamine, SPECT = marked improvements, in cortical and subcortical structures. Patient (II). After HBOT: multiple areas of improved perfusion. Subsequent follow-up post 4 x PSE injections showed additional major improvements. Patient (III): post TMS/ketamine SPECT at 5 months = several improvements including of his severe frontal underperfusion; and 13 mo later, SPECT = additional significant improvements. Patient (IV): SPECT 14 months post TMS/ketamine, = major bilateral improvement in all affected areas. Patient (V). Post TMS/ketamine, at 5 ½ months SPECT = improvement in all previously under-perfused areas. Patient (VI): Post combined HBOT and PSE, SPECT at 5 months = localized areas of improvement in key locations.

Clinical improvements in all were documented via periodic visits and family members observations.

Conclusions: Baseline brain SPECT contributed to decision and tailoring of treatments. Follow-up SPECT validated the beneficial treatment effect and guided long term treatment strategy.

BODY MASS INDEX AFFECTS CEREBRAL PERFUSION IN MEMORY IMPAIRMENT

Shiva Rahimi-Shahmirzadi, MD, Robert Miletich, MD

Purpose of Study: Obesity is a recognized risk factor for both cardiovascular disease and cerebrovascular disease. More recently a role in cognitive impairment and dementia, including Alzheimer’s disease, has begun to be recognized. We hypothesize that there is a relationship between body mass index (BMI) and cognitive impairment mediated at least in part by cerebrovascular disease.

Method: Approximately 800 patients referred with memory impairment were evaluated with bicisate cerebral perfusion single photon emission computed tomography (SPECT), or CPS. They were classified into ranks of obesity as shown by BMI (kg/m²): < 18.5 underweight, 18.5-24.9 normal, 25-29.9 overweight, 30-34.9 obesity I, 35-39.9 obesity II, >40 obesity III. They were also classified by age (yrs): ≤35, 36-55, ≥56. CPS were analyzed using SPM12, spatially normalizing to the MNI database template, without spatial filtering, proportionally normalizing to the brainstem. All normaliziation results were verified in each subject.
**Results:** With increasing BMI, there is increasing cerebral hypoperfusion. This is present in both grey matter and white matter. The pattern of hypoperfusion is most consistent with small vessel disease (SVD). This pattern is most robust in the younger age groups.

**Conclusion:** The relation between BMI and cognitive impairment appears to be mediated in major part through cerebrovascular disease, specifically SVD. The age effect on this relationship may be related to interactions with other factors. These findings support a role of vascular disease in dementia and even Alzheimer’s disease.

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**012**

RESTING WALL MOTION STUDIES USING A CARDIAC SOLID STATE CAMERA: EFFECTS OF DOSE REDUCTION AND SHORTER ACQUISITION TIMES


**OBJECTIVES:** In this study, we evaluated how simulated dose reduction and acquisition time truncation affect measures of ejection fraction.

**METHODS:** 19 patients (14 male, mean BMI 30) underwent 99mTc ultratag (900 MBq) resting gated blood pool imaging on a General Electric 530c using list mode acquisition (15M counts, 812 mins acquisition time). Dose reduction and time truncation were simulated by reducing total counts in list mode data. To simulate dose reduction: List mode data was resampled by selecting random subsets of counts from the entire list. In this way, we simulated dose reduction at levels corresponding to 80%, 60%, 50%, 40%, 30%, and 20% of total activity. To simulate time truncation: list mode data was truncated at time points corresponding to the first 80%, 60%, 50%, 40%, 30%, and 20% of total acquisition time. Original list mode data (non resampled, non truncated) was considered gold standard. All list mode data was reconstructed, and planar acquisitions were simulated by reprojection. Ejection fraction was then measured for each level of dose reduction or time truncation using three algorithms available on an Xeleris 3.1 workstation: reprojected planar (RP), QBS count based (CN), and volume based (VL).

**RESULTS:** Dose reduction: Bias in ejection fraction measurement for simulated dose reduction fluctuated randomly for RP, CN and VL, but remained less than +/-2% at all levels of dose reduction. Time truncation: Bias in ejection fraction measurement for RP, CN and VL increased with simulated time reduction. Bias was highest at 20% acquisition time: +4.2% for RP, +4.7% for CN, and +5.7% for VL.

**CONCLUSIONS:** Substantial opportunity exists to reduce dose and shorten acquisition time on dedicated solid state cameras. Simulating reduced time or dose introduces minor biases in ejection fraction measurements. However, there is excellent correlation between these biased measurements and corresponding full count density measurements.

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**013**

PEDIATRIC BONE MINERAL DENSITY IN NEWFOUNDLAND AND LABRADOR

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**Objectives:** To establish normative bone mineral density (BMD) data for the pediatric population of Newfoundland and Labrador (NL) and to compare this BMD data with the GE Lunar pediatric reference values, and to explore factors associated with BMD.

**Methods:** Population-based observational study involving healthy children aged 8-18 years from St. John’s, NL. A total of 157 females and 135 males participated in the study. BMD measurements were obtained at the femoral neck and lumbar spine (g/cm²) using dual x-ray absorptiometry (GE Lunar DEXA). Comparison was made
to GE Lunar reference data. Lifestyle variables were collected via self-administered questionnaires. All analyses were performed sex-stratified, using linear regression models.

**Results:** In girls, significantly higher BMD values than the Lunar pediatric reference were seen in the lumbar spine at age 8, 9, 10 and 12 (10.8%, 8.0%, 7.5%, and 9.1%, respectively); significantly lower values than the Lunar reference were seen in the femoral neck in girls age 11 (-7.7%). In boys, significantly higher values than the Lunar pediatric reference were seen in the lumbar spine in males age 9 and 17 (6.9% and 9.5%, respectively), and in the femoral neck in males age 17 (14.4%). In girls, height and weight were positively associated with BMD at the femoral neck and lumbar spine. In boys, weight was positively associated with BMD at the femoral neck and lumbar spine. Other factors including age, BMI, ethnicity, sexual maturation, smoking, alcohol use, and regular physical activity did not yield statistically significant effects on BMD.

**Conclusions:** Results show that BMD values in the pediatric population of NL are similar or higher than the age-matched GE Lunar reference value (with the exception of the femoral neck in girls age 11). Height and weight were positively associated with BMD in girls, and weight was positively associated with BMD in boys.

**014**

**DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS (DISH); A NEW-CLEAR IMAGE ON Tc-99m MDP BONE SCAN.**

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**Background:** Diffuse idiopathic skeletal hyperostosis (DISH) is a common non-inflammatory and benign disorder in an elderly with male gender preponderance. Usually it remains asymptomatic and appears in radiographic investigation for some other pathology evaluation. Here, we are presenting a case of DISH that was observed on Tc-99m MDP bone scintigraphy in patient who was advised bone scan for metastatic workup for unknown primary malignant site.

**Case History:** A 74 year old hypertensive and osteoarthritic elderly male came with the history of lower backache for few months with no history of trauma and past history of enthesitis left knee one year back (treated with local corticosteroid injections). His lower backache radiated to both hip regions and got worse within a month, made him chair/bed bound. His recent laboratory tests were within normal limits. His x-ray lumbosacral spine and hip showed arthritic changes. On subsequent MRI lumber and sacral spine showed multilevel disc dessication in lower dorsal and lumbar spine, mild scoliosis in dorso-lumbar spine convex to left side, old partial compression and anterior wedging of D12 vertebral body, multilevel facetal arthropathy in lumbar spine, altered intensity signal return noted from S1-S2 vertebral bodies and from sacral ala bilaterally which appear hypointense on T1 and hyper-intense on T2 FAT SAT images. Later findings were suspicious of metastatic infiltration and bone scan was suggested for complete skeletal survey. As there was no primary malignancy diagnosed, three phases skeletal scintigraphy with Tc-99m MDP (16mCi) was performed, acquiring dynamic images of pelvis (local pain site) immediately followed by delayed whole body skeletal images in anterior and posterior projection. Initial blood flow and blood pool images show relatively increase tracer uptake over left hip region. Delayed images showed an area of abnormally increase tracer uptake near left sacroiliac joint region extending to sacrum, consistent with bone metastases. Degenerative arthritic changes were found on bilateral shoulder, elbow and knee joints. Other than this, a non-specific pattern of non-homogenous increased tracer uptake over right antero-lateral aspect of multiple (more than four) dorsal and lumbar vertebral bodies was observed, giving an impression of diffuse idiopathic skeletal hyperostosis (DISH). In the past, bone scan has proved many times that it has vital role in early detection of bone changes at cellular level. So, the detail MRI correlation was advised of complete dorsal spine for DISH conformation and patient was being refered to oncologist by his physician for further evaluation and management of the metastatic lesion.
UNUSUAL NONMETASTATIC IODINE-131 UPTAKE IN THYROID CANCER PATIENTS, CLARIFIED BY SPECT-CT
Tan-Trao Phi, Steven Burrell

Objectives: To illustrate the utility of SPECT-CT in the localization and characterization of unusual iodine-131 (I-131) uptake in thyroid cancer patients.

Methods: We collected a case series of thyroid cancer patients, who underwent I-131 thyroid treatment, and had subsequent follow-up I-131 whole-body scanning, which demonstrated unexpected uptake. SPECT-CT was performed to help improve anatomical localization and uptake characterization, with multimodality imaging cross-correlation as needed, for further evaluation.

Results: SPECT-CT helped localize unexpected I-131 uptake in post-ablation whole-body scanning, and in correlation with other imaging established the etiology of the uptake, or at least the probable benign nature. While it is well known that benign entities can take up I-131, the published lists of such entities is very diverse and increasing in number. We present previously unreported etiologies (hip joint, brain surgery clips, epididymal cyst) and under-recognized etiologies such as pulmonary aspiration, along with a comprehensive summary from the literature.

Conclusion: SPECT-CT hybrid imaging is an important adjunct in the localization and characterization of unexpected radio-iodine uptake in thyroid cancer patients. Physicians interpreting I-131 scans should be familiar with the wide spectrum of benign uptake and should have a high index of suspicion for a benign etiology when encountering unusual findings, particularly if the serum thyroglobulin is not elevated.

PEPTIDE RECEPTOR RADIONUCLIDE THERAPY IN PATIENTS WITH DIFFERENTIATED THYROID CARCINOMA WHO BECAME RESISTANT TO 131I THERAPY
Ljiljana Mijatovic Teodorovic

Objective: The aim of the paper is to evaluate the efficiency of the peptide receptor radionuclide therapy (PRRT) in patients with differentiated thyroid carcinoma (DTC) who do not show 131I uptake on the whole body scintigraphy (WBS) and who had high serum thyroglobulin levels.

Methods: We treated the total of 832 patients with DTC (749 papillary (PTC), 73 follicular (FTC) and 10 Hurttle cell carcinoma (HCTC)) by 131I. In 7 out of 832 patients (5 PTC, 1 FTCi and 1 HCTC), who do not show 131I uptake
on the whole body scintigraphy (WBS) and who had high serum thyroglobulin levels, octreoscan was performed, after iv administration of 740 MBq $^{99m}$Tc-tectrotyde. In order to reduce the radiation dose to the kidneys and the bladder, we hydrated patients well before administration of diagnostic dose of $^{99m}$Tc-tectrotyde. All of 7 patients had positive octreoscan. All of them were treated by 11-16.5 GBq of $^{177}$Lu DOTATE or by $^{177}$Lu DOTATE and $^{90}$Y-DOTATOC. Response to the therapy was evaluated by $^{177}$Lu-DOTATATE whole body scintigraphy, as well as by decrease in serum thyroglobulin level.

Results: After the last treatment with $^{177}$Lu DOTATE or $^{177}$Lu DOTATE and $^{90}$Y-DOTATOC 4 of 5 patients with PTC had decrease in serum thyroglobulin level. Two of them had stable disease, 1 had minor remission, and one had partial remission. A patient with HCTC had partial remission and decrease in serum thyroglobulin level, while a patient with FTC had progressive disease.

Conclusion: PRRT with $^{177}$Lu DOTATE or $^{177}$Lu DOTATE and $^{90}$Y-DOTATOC in DTC patients with increased thyroglobulin levels and without $^{131}$I uptake, could be good therapeutic option if octreoscan was positive.

017

PERSONALIZED $^{177}$LU-OCTREOTATE PEPTIDE RECEPTOR RADIONUCLIDE THERAPY OF NEUROENDOCRINE TUMORS: INITIAL DOSIMETRY AND SAFETY RESULTS OF THE P-PRRT TRIAL

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Objectives: $^{177}$Lu-octreotide PRRT is commonly administered at fixed injected activity (IA) per cycle despite highly variable absorbed doses to critical organs and submaximal treatment of most patients. With the aim to maximize tumor irradiation without increasing toxicity, we are prospectively evaluating a novel personalized PRRT (P-PRRT) approach in which renal absorbed dose is standardized. Here we report on initial dosimetry and short-term safety results of the ongoing P-PRRT trial (NCT02754297).

Methods: From April to December 2016, 27 patients underwent 55 personalized $^{177}$Lu-octreotide cycles (48 induction and 7 consolidation/maintenance cycles) followed by quantitative SPECT dosimetry in all but two cycles. The renal absorbed dose per IA (Gy/GBq) was predicted by BSA and GFR for the first cycle, and by measured renal Gy/GBq for subsequent cycles. IA was personalized to deliver 23 Gy to the kidney over a 4-cycle induction course, or 6 Gy during consolidation/maintenance cycles offered to responders. Prescribed renal absorbed dose (thus IA) was reduced by 25% or 50%, respectively, in cases of baseline grade 2 or 3 cytopenias or renal dysfunction (using CTCAE definitions). Increase in IA at any subsequent cycle was limited to 50% above the highest IA ever administered to the patient. Using actual Gy/GBq data, we extrapolated absorbed doses for fixed IA of 7.4 GBq/cycle (25% or 50% reductions applied as above). Data is reported as median (interquartile range) and comparisons were made using Wilcoxon test. Acute (<72 hr.) and subacute (<8 wk.) side effects were recorded. Blood counts, renal and hepatic biochemistry were performed at 2, 4 and 6 weeks after each cycle.

Results: Per-cycle personalized IA was 8.6 (6.2 – 10.5) GBq and was significantly higher than fixed IA of 7.4 (5.6 – 7.4) GBq ($P<0.0001$). P-PRRT resulted in per-cycle absorbed doses of 5.0 (3.9 – 6.1) Gy to the kidney and a maximum of 32.1 (15.4 – 58.2) Gy to the tumor, which were significantly higher than those extrapolated for a fixed-IA regime, of 4.3 (2.4 – 5.1) Gy and 24.6 (13.5 – 45.6) Gy, respectively ($P<0.0001$). P-PRRT allowed a median 1.26 (1.03 – 1.50) fold, and up to a 3.54-fold increase in IA and absorbed doses compared to the fixed-IA regime. Renal Gy/GBq was highly variable between patients, ranging from 0.21 to 4.25 Gy/GBq, but P-PRRT limited the highest per-cycle renal absorbed dose to 9.0 Gy, vs. 23.6 Gy in the fixed-IA regime. Commonest acute side effects were nausea, vomiting and abdominal discomfort/pain in 18.2%, 5.5% and 5.5% of 55 cycles, or in 22.2%, 7.4%
and 7.4% of 27 patients, respectively. Fatigue was reported as a subacute side effect following 15.2% of 33 cycles, or in 22.7% of 22 patients. Grade 3 or 4 subacute toxicity occurred as lymphocytopenia, altered liver function tests, anemia, leucopenia and thrombocytopenia in 24.4%, 4.4%, 2.2% and 2.2% of 45 cycles, or in 30.8%, 7.7%, 3.8%, 3.8% and 3.8% of 26 patients, respectively. Of these events, grade 4 toxicity accounted for only three (6.7%) episodes of pronounced lymphocytopenia in two (7.7%) patients, without clinical consequences. No renal toxicity was observed during the study period.

Conclusion: $^{177}$Lu-octreotate P-PRRT allowed a significant increase of IA per cycle over typical fixed IA in the majority of patients, without exceeding the conservative threshold of 23 Gy to the kidney over a 4-cycle induction course. Maximized tumor irradiation in these patients is expected to translate into improved therapeutic efficacy. P-PRRT appears well tolerated, with a favorable side effect and subacute toxicity profile, which is comparable to that reported for fixed-IA PRRT. Furthermore, severe chronic renal toxicity may potentially be avoided in the few patients receiving extremely high Gy/GBq to the kidney, as compared as if they would be treated with fixed-IA PRRT.

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criteria (Deauville or IHP criteria). Our main objective was to prove the predictive value of an early PET (after 1 R-CHOP cycle) compared with the outcome at the end of R-CHOP treatment.

Eighty-two patients were included in our study, mainly recruited from 2006 to 2012. The cohort was composed of pure CD20+ DLBCL, with exclusion of transformed indolent lymphomas. All patients were exclusively treated with R-CHOP chemotherapy. A baseline PET before beginning R-CHOP therapy was performed, followed by subsequent PET studies after 1 cycle, 4 cycles and 3 months after the end of treatment. Data was analyzed for progression free survival and overall survival with follow-up spanning up to 11 years. Quantitative analysis of metabolic activity was performed with SUVmax, total lesion glycolysis (TLG) and metabolic volume for the main lesion as well as the total tumor burden, using MIM Software’s PET edge detection tools. The data was also analyzed using a ratio with liver SUVmean. Furthermore, the quantitative values extracted for each study were compared with Deauville criteria, as samples of mediastinal and liver SUVmean were extracted simultaneously.

Our analysis supports that early interim PET for DLBCL after 1 R-CHOP cycle can predict the outcome at the end of R-CHOP chemotherapy. Its prognostic value can allow most appropriate treatment with faster escalation of chemotherapy regimens, avoiding unnecessary costs related to inefficient subsequent R-CHOP cycles when resistance is quickly established. The patient could potentially improve long-term survival.

019

LUNG SCINTIGRAPHY FOR ASSESSMENT OF PE IN PREGNANCY

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Objectives: To assess the diagnostic accuracy measures of lung perfusion-only scintigraphy in a large group of pregnant patients suspected of having pulmonary embolism.

Method: This study was a retrospective study of a cohort of pregnant patients suspected of having PE, who underwent V/Q scan at The Ottawa Hospital between 2004 and 2015. The perfusion-only images were re-read using PISAPED criteria for image interpretation. Then the results were compared against the initial V/Q scan reports made by nuclear medicine specialists. The 90-day clinical follow-up was reviewed for the final clinical diagnosis of PE. Finally, diagnostic accuracy measures were calculated.

Results: A total of 362 patients were included. Mean maternal age at the time of lung V/Q scan was 30.3 years-old (SD=5.8) ranging from 16 to 51 years-old. From a total of 362 lung perfusion scans, 316/362 (87.3%) scans were interpreted as normal/near normal, 17/362 (4.7%) scans were interpreted as high probability and 29/362 (8.0%) scans were interpreted as non-diagnostic. Final clinical diagnosis of PE was established in 15 patients after the lung scan. None of the patients with normal/near normal perfusion-only scans were diagnosed with PE in the 90-day clinical follow-up; a negative predictive value (NPV) of 100%. The sensitivity and specificity of perfusion-only imaging after including the non-diagnostic studies were 100% (100% to 100%) and 99.1% (88.1% to 94.1%) respectively, with a NPV of 100% (100% to 100%) and a PPV of 32.6% (19.1% to 46.2%). As expected, there was 100% agreement between perfusion-only and ventilation/perfusion scans when the results were normal/near normal.

Conclusion: The results show that perfusion-only imaging has a very high NPV for PE in pregnant population and therefore can exclude PE with a very high degree of accuracy without the need to perform ventilation scans.
020

USING A DEEP NEURAL NETWORK MACHINE LEARNING ALGORITHM TO PREDICT LUNG CANCER RECURRENCE POST STEREOTACTIC BODY RADIOTHERAPY (SBRT)

Objectives: To predict the lung cancer recurrence within 2-years post stereotactic body radiotherapy.

Methods Used: 283 patients were selected from a database of 693 biopsy-proven lung cancer patients who were treated with SBRT between 2003 and 2015. PET/CT imaging and clinical characteristics that predicted lung cancer recurrence within 2 years were assessed using random forest feature selection. Any missing clinical data was imputed via multiple imputation using chained equations. The patients were split into a training dataset using 211 patients, and a testing data set of 65 patients. A neural network algorithm was trained on the 23 strongest predictors for lung cancer recurrence using a sigmoid prediction function and back propagation. This trained neural network was then used to predict the patient-specific lung cancer recurrence in the remaining 72 patients. Accuracy was assessed using a confusion matrix.

Results obtained: The neural network obtained an accuracy of 72% (CI=59-81%) in predicting recurrence of lung cancer within 2 years post-SBRT on a per-patient basis.

Conclusions: Machine learning holds promise as a way to predict patient-specific outcomes. Further research on the ideal predictors and larger datasets are required to improve model accuracy.

Eric Lepp Clinical Vignettes

EL-001

THE ROLE OF PET CT IN DETECTING SPINAL OSTEOMYELITIS IN A LYMPHOMA PATIENT (CASE STUDY)

Olfat Kamel Hasan, Cigdem Akincioglu, David Laidley

A 65-year-old female patient presented with acute kidney injury and bilateral ureteric obstruction. CT at the time demonstrated large retroperitoneal mass extending along T12-L5, mediastinal, axillary and inguinal lymphadenopathy. Right inguinal lymph node biopsy revealed follicular lymphoma grade 3A (stage IIIB). She was treated by 6 cycles of R-CHOP. Interim CT scan demonstrated good partial anatomic response.

A post therapy PET-CT scan demonstrated focal non homogenous uptake localized to L3-L4 disc space, extending to involve the adjacent end-plates and the retroperitoneal soft tissue mass anteriorly with new end-plate destruction. The rest of the mass and lymphadenopathy were not hypermetabolic and showed further reduction in size. There was a hypermetabolic focus in the left arm as well, correlating with a skin ulcer. Based on these findings, the diagnosis of discitis/spinal osteomyelitis was strongly suspected.

The referring oncologist was informed on the same day and an urgent clinical assessment and non-enhanced MRI were arranged. All results were concordant with the PET diagnosis. The patient was treated with IV antibiotics for 6 weeks, had a complicated course of recovery. Eventually, she responded very well with remarkable improvement.

The PET findings played an important role in diagnosing the significant complication of spinal osteomyelitis with the possible source in the left arm, initiating a sequence of clinical tests leading to proper management. Although there was no baseline PET study, we were able to combine all the available data to reach the right diagnosis. This included proper interpretation of the pathological type of lymphoma, prior interim CT findings, and the clinical course. In addition to the added value of hybrid imaging.

In conclusion, it’s well known that PET plays a vital role in lymphoma, not only for staging and response to therapy assessment, but also in discovering unexpected serious complications.
LE RÔLE DU TEP CT DANS LA DÉTECTION DE L'OSTÉOMYÉLITE SPINALE CHEZ UN PATIENT ATTEINT D'UN LYMPHOME (ÉTUDE DE CAS)
Olfat Kamel Hasan, Cigdem Akincioglu, David Laidley

Une patiente de 65 ans qui s’est présentée avec une lésion rénale aiguë et une obstruction urétérale bilatérale. CT a démontré une grande masse rétropéritonéale s’étendant le long de T12-L5 en plus de lymphadénopathie médiastinale, axillaire et inguinale. Une biopsie ganglionnaire inguinale droite a démontré la présence d'un lymphome folliculaire de grade 3A (stade IIIB). Elle a été traitée par 6 cycles de R-CHOP. La TDM provisoire a démontré une bonne réaction anatomique partielle.

Un TEP-CT scan post-thérapeutique a démontré une absorption focale non homogène localisée à l'espace disque L3-L4, s’étendant pour impliquer les plaques adjacentes et la masse rétropéritonéale des tissus avec une nouvelle destruction de la plaque finale. Le reste de la masse et la lymphadénopathie n’étaient pas hypermétaboliques et ont montrés une réduction supplémentaire de leur mesure. Il y avait également une focus hypermétabolique dans le bras gauche, en corrélation avec un ulcère cutané. A partir de ces résultats, le diagnostic de l'arthite discale / spinal a été fortement suspecté.

L’oncologue référant a été informé le même jour et une évaluation clinique urgente et une IRM non renforcée ont été organisées. Tous les résultats étaient concordants avec le diagnostic de TEP. La patiente a été traitée avec des antibiotiques Intraveineuse pendant 6 semaines, a eu un cours compliqué de récupération. Cependant, elle a finalement répondu très bien avec une amélioration remarquable.

Les résultats du TEP ont joué un rôle important dans le diagnostic de la complication importante de l'ostéomyélitie spinale avec la source possible dans le bras gauche, initiant une séquence d’essais cliniques conduisant à une bonne prise en charge. Bien qu'il n'y ait pas eu d'étude TEP de référence, nous avons pu combiner toutes les données disponibles en plus de l'imagerie hybride pour atteindre le bon diagnostic. Cela comprenait une interprétation correcte du type pathologique du lymphome, des résultats provisoires antérieurs de la tomodensitométrie et le cours clinique.

En conclusion, il est bien connu que le TEP joue un rôle vital dans le lymphome, non seulement pour la mise en scène et la réponse à l'évaluation thérapeutique, mais aussi pour découvrir des complications graves inattendues.
Clinical History: Forty-six-year-old gentleman on amiodarone for the past 2 years for persistent atrial fibrillation/flutter. Found to be hyperthyroid biochemically. Amiodarone was then discontinued 14 days prior to requested hyperthyroid work-up. This included a Nuclear Medicine thyroid scan and thyroid ultrasound for assessment of amiodarone-induced thyrotoxicosis (AIT).

Background Information: Type I AIT represents a hypermetabolic gland secondary to excess iodide load from orally ingested amiodarone (75mg of iodide per standard 200mg/day amiodarone dose). On the other hand, Type II AIT represents a destructive thyroiditis, with release of preformed thyroid hormones. Differentiating between these two entities is important as therapeutic management differs. In Type I AIT, treatment consists of tapazole, a thyroperoxidase enzyme inhibitor which prevents oxidation of iodide within the thyroid. In Type II AIT, steroids are used for treatment to decrease active inflammation.

Physical and Laboratory Findings: No thyroid nodules were palpable. Pertinent biochemical markers included TSH <0.03, free T4 >155.0, free T3 >30.0, and negative thyroid antibodies.

Tentative Diagnosis: Amiodarone-induced thyrotoxicosis Type I vs. Type II vs. mixed type.

Diagnostic Investigation: Thyroid ultrasound demonstrated a diffusely bulky and heterogeneous gland, non-specific and unhelpful in diagnosis. 99mTc-pertechnetate scan (370 MBq, anterior pinhole/planar images of the thyroid at 5 min) demonstrated a low-uptake pattern. This was initially suspected to represent Type II AIT; however, given the recent exogenous iodine load from amiodarone, specificity is decreased.

Given this concern, and after a literature review, further assessment with 99mTc-sestamibi (1110 MBq, anterior pinhole/planar images of the thyroid at 2, 10, 15, and 60 min) was performed. Rapid diffuse uptake throughout the thyroid was in keeping with a hypermetabolic gland, which suggested Type I over Type II AIT and allowed specific therapeutic intervention.


"Take Home" Message: Approximately 15-20% of patients taking amiodarone will develop AIT. Differentiating between Type I and II is important for clinical/therapeutic management. A 99mTc-sestaMIBI thyroid scan can be used to differentiate these two entities.

Figure. Comparison of anterior pinhole images of 99mTc-pertechnetate (left) and 99mTc-sestaMIBI (right) thyroid scans in a 46-year-old male with hyperthyroidism secondary to amiodarone therapy. Low-uptake pattern on 99mTc-pertechnetate scan with rapid diffuse uptake on 99mTc-sestaMIBI scan are diagnostic of Type I amiodarone-induced thyrotoxicosis.
EL-003

**18F-MFES: A MIGHTY IMPROVED ESTROGEN-RECEPTOR PET TRACER**

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With the arrival of molecular tracers, their use as a surrogate to biopsies—especially in risky locations—can be highly valuable. Our research center developed 18F-MFES, an improved version of 18F-FES, described in the 1980s.

During a rotation in CHAUR, an accredited hospital affiliated with Sherbrooke University, I was responsible for the imagery assessment of a 64-year-old female patient. She presented with a rapidly progressive breast lesion (1). The biopsy revealed an infiltrating ductal carcinoma (IDC) grade 1/3 with strong expression of hormonal receptors and HER2 negative.

A Tc99m-MDP bone scan, performed for severe neck pain, showed a highly suspicious uptake in the lower cervical spine (2). SPECT/CT (3) revealed an underlying osteolytic lesion. Thereafter, an 18F-FDG PET/CT (4) highlighted the primary tumor and a unique hypermetabolic bone lesion on the left side of C7, in intimate contact with the vertebral artery. The bone lesion’s SUVmax value was comparable to the breast cancer’s activity.

The best next step was unclear for the attending staff since a percutaneous or open biopsy was at high risk of vascular trauma of the left vertebral artery. Radiation therapy was considered without pathological confirmation, but with persistently high risk for the vessel. I therefore suggested pursuing the investigation with 18F-MFES, a tracer whose value was already proven locally at CHUS, but little known by the other provincial nuclear medicine departments.

The patient was transferred to Sherbrooke and benefitted from a 18F-MFES PET/CT (5). The bone lesion strongly expressed estrogen receptors (6). Additionally, two previously unsuspected metastases were discovered in a rib and axillary lymph node (7, 8).

The primary interest of this case is to underline the impact of molecular imaging as a powerful tool in unclear cases with high risk of interventional complications. Indeed, this patient benefitted from appropriate therapy while avoiding unnecessary risks.

Image 1 (Mammographies)
Image 2 (planar bone scan)

Image 3 (SPECT-CT)
PROSTATE CANCER IN THE ERA OF MOLECULAR IMAGING
Guillaume Chaussé

A 71-year-old gentleman diagnosed with high risk prostate cancer underwent robotic prostatectomy in the USA in 2011 followed by salvage radiotherapy at the prostatic bed and hormone therapy. In 2015 he was found to have increased Prostate Specific Antigen (PSA) level: CT chest-abdomen-pelvis failed to show a recurrence site; A T3 lesion was found on whole body 99mTc-MDP bone scan as well as a focus of uptake at the left seventh costochondral junction (CCj), both subsequently demonstrated on NaF PET scanning. Due to its anatomical location and appearance, the CCj uptake was considered of post-traumatic etiology. However, biochemical progression despite resumed androgen deprivation therapy (ADT) prompted the need for further imaging: trivial finding of uptake at the 7th CCj on 11C-Acetate PET (performed in the US) was only found retrospectively.

Persistence of uptake on a 2016 bone scan raised concerns. Confirmatory imaging was performed using 68Ga-Prostate Specific Membrane Antigen (PSMA) scan which showed activity at the left 7th CCj, confirming the atypical location of a metastatic deposit from prostate cancer. To further confirm the specificity of 68Ga-PSMA and absence of accumulation in traumatic bone lesions, a recent traumatic fracture at the left humerus demonstrated intense uptake on a repeat bone scan performed two days after the PSMA scan which had shown no significant humeral uptake.

This case illustrates the great potential of multimodality/multitracer imaging as well as the outstanding specificity of PSMA compounds for prostate cancer. It also casts light on the future of molecular imaging in Canada.
Figure 3. There is no abnormal uptake on planar 99mTc-MDP scanning in 2013.

Figure 4. On the left, the left 7th costochondral junction displays a new focus of mild uptake on planar 99mTc-MDP scanning in 2015. It is reported as a “common site for post-traumatic etiology”. On the right, a static anterior view of the NaF PET MIP image clearly outlines the presence of bone activity at the left 7th costochondral junction, again commented on as “likely post-traumatic”. A T3 vertebral body lesion is also noted on both studies.

Figure 5. In the context of slowing rising PSA levels, a 11C-Acetate PET/CT scan is performed, redemonstrating the T3 lesion. Side: Anterior view of the MIP image. Above: axial views at the T3 lytic lesion (red arrows)
Figure 6. After meticulous retrospective review of the 11C-Acetate scan, an area of faint uptake is found at the left 7th CCj (red arrows).

Figure 7. In 2016, the patient presented in the context of a recent fall with a left humeral fracture. Without previous studies, the left 7th CCj uptake could have easily been explained by the trauma. However, persistence of uptake in the exact same location raised suspicion for an alternative etiology. This finding prompted the need for advanced molecular imaging.

Figure 8. MIP images, Left: Unequivocal 68Ga-PSMA uptake at the left 7th CCj and T3 vertebral body, confirming the two sites of metastatic disease. Courtesy of Dr Stephan Probst, Jewish General Hospital. Middle: 11C-Acetate mild uptake to the T3 lesion and no definitive uptake at the 7th CCj. Right: 18F-NaF shows high sensitivity for both lesions. Due to anatomical location, this study could not confirm metastatic deposit at the focus of the 7th CCj because of poor specificity.
Objective: Identify mimickers of osteoblastic metastases on contrast enhanced CT.

Abstract: Detection of bone metastases is crucial for accurate staging and treatment planning. The aim of imaging is to localize the involved bones and to predict the potential for pathological fracture and subsequently spinal cord compression, if the lesion is spinal (1). Skeletal manifestations of lymphoma in the spine are commonly occurred as a result of direct invasion from adjacent lymph node. The bone changes are usually depicted during the course of the disease rather than at the initial presentation (2). We are presenting two patients with treated lymphoma that were found to have new osteoblastic lesions on routine follow up contrast enhanced CT (CECT). Contrast enhancement of the vertebral...
body marrow secondary to collateral venous flow through the vertebral venous plexus mimicked osteoblastic metastases.

**Case reports:** A 54 year old male with Hodgkin lymphoma, nodular sclerosis subtype, status post 6 cycles of chemotherapy completed in November 2013 and has remained in remission since. On routine follow up with CECT of the neck, several new osteoblastic lesions were demonstrated in the cervical and thoracic vertebral bodies, these were worrisome for metastases.

A 22 year old male with diffuse large B-cell non-Hodgkin lymphoma, status post 6 cycles of chemotherapy completed in December 2014 and has remained in remission since. On routine follow up with CECT of the chest, a new osteoblastic lesion was demonstrated in the T5 vertebral body.

**Discussion:** 16% patients of lymphoma eventually have bone involvement (3). Osseous metastases in lymphoma occurs secondary to direct invasion from adjacent lymph node causing focal osteoblastic lesion which is commonly seen in the spine (2). Multiple osseous metastases are more common than a solitary metastasis. Most metastases tend to be osteolytic; however, osteoblastic and mixed metastases may also be encountered (2). An ivory vertebra, diffuse homogenous increase in the vertebral body density, has also been reported (2). A 54 year old male with nodular sclerosis Hodgkin lymphoma had a routine follow up with CECT of the neck. CECT of the neck demonstrated several new osteoblastic lesions in C3, C4, C5, C7, T1, T2 and T3 vertebral bodies, these were worrisome for metastases. A whole body SPECT bone scan was performed to evaluate osseous disease extent. There was no abnormal uptake within the cervical and thoracic spine to correlate to the previously described osteoblastic lesions. A PET/CT was performed to further evaluate disease extension. There was no abnormal focal FDG uptake within the cervical and thoracic spine and no osteoblastic lesions on the CT portion of the examination.

The patient has a known history of left innominate and left subclavian veins occlusive thrombosis, in addition the left internal jugular and left axillary veins had partially occlusive thrombosis, these were documented on vascular ultrasound in 2013. The most recent follow up CECT of the neck demonstrated at least partial occlusion of the proximal left subclavian vein with numerous collaterals visualized in the left shoulder and upper back region. The previously questioned osteoblastic lesions were merely enhancement of the vertebral body marrow secondary to the collateral formation and venous flow through the vertebral venous plexus in the cervical and thoracic spine.

Enhanced CT scan of the neck showing several osteoblastic lesions in C3, C4, C5, C7, T1, T2 and T3.
Whole body SPECT bone scan does not display any abnormal uptake corresponding to the previously described osteoblastic lesions.

PET scan does not show any abnormal focal FDG uptake within the cervical and thoracic spine.

Fused PET/CT scan does not show any abnormal focal FDG uptake within the cervical and thoracic spine.
A 22 year old male with diffuse large B-cell non-Hodgkin lymphoma had a routine CECT of the chest. CECT of the chest demonstrated a new osteoblastic lesion in the T5 vertebral body. A whole body SPECT bone scan was performed to evaluate disease extent. There was no abnormal uptake in the T5 vertebral body to correlate to the previously described osteoblastic lesion. Additional SPCET/CT of the thoracic spine was performed. There was no osteoblastic lesion on the CT portion of the examination.

The patient had a history of chronic occlusion of bilateral brachiocephalic and left subclavian veins as demonstrated on the CECT of the chest. Once again the questioned osteoblastic lesion in the T5 vertebral body was merely enhancement of the T5 vertebral body marrow secondary to collateral formation and venous flow through the vertebral venous plexus.

CT portion of the PET/CT scan does not show any abnormal focal FDG uptake within the cervical and thoracic spine.

Enhanced CT scan of the chest showing an osteoblastic lesion in T5.
Conclusion: In the presence of chronic venous occlusion within the subclavian veins, collateral venous flow within the vertebral body venous plexus may be demonstrated and that could mimic the appearance of an osteoblastic metastasis. Therefore, vertebral venous plexus enhancement should be considered as a mimicker of osteoblastic lesions on CECT in the setting of subclavian venous occlusion.

F18-FDG PET/CT APPEARANCE OF A VASCULAR MALFORMATION MIMICKING MALIGNANCY
Karine Provost

We present the case of a 13-year-old boy who sought medical care due to abdominal pain. Initial imaging with ultrasound, CT and MRI revealed a large soft-tissue mass in the left lower quadrant, with iliac crest invasion. MRI characteristics were suggestive of sarcomatous tumor, such as Ewing’s sarcoma or rhabdomyosarcoma. F18-FDG PET/CT study revealed homogeneous, low uptake in the mass, SUVmax 1.5, which was atypical for aggressive tumor, but a low grade, well-differentiated tumor could not be excluded. Due to high clinical suspicion of malignancy, patient underwent biopsy of the lesion, which revealed benign capillary lymphatic malformation. The patient was subsequently treated with embolization.

Vascular and lymphatic malformations may present as a large, heterogeneous soft tissue mass, which can occasionally mimic malignancy, both clinically and radiologically. Slow-flow vascular anomalies, such as venous, lymphatic, capillary or mixed malformations, may not display typical enhancement pattern on CT or MRI, making the diagnosis more challenging.

Vascular malformations, although present at birth, usually grow during childhood and may become symptomatic during puberty, as in this patient, due to hormonal growth stimulation. Vascular malformations may show infiltrative pattern and invasion of adjacent tissues and even bone, although this has been described mostly for venous malformation or in association with syndromes such as Gorham-Stout disease. Only a few case reports have described F18-FDG PET/CT appearance of hemangioma and vascular malformation. Uptake of F18-FDG is typically only mild, similar to blood pool activity.

Vascular malformations should be considered in the differential diagnosis of atypical lesions presenting infiltrative or aggressive features, with discordantly low FDG uptake.

Figure 1. (A,B) Selected axial images from fused and unfused F18-FDG PET/CT study showing homogenous, low grade FDG uptake in left lower quadrant mass with focal left iliac bone invasion. (C) Maximal Intensity Projection image of whole-body F18-FDG PET/CT shows uptake in the mass is similar to physiologic hepatic activity. Biodistribution is otherwise normal.
EL-007

LYMPHOSCINTIGRAPHY IN PLASTIC BRONCHITIS

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The utility and elegance of lymphoscintigraphy is demonstrated in the setting of plastic bronchitis. A 61 year old male presented with repeated hospitalizations for respiratory failure from a known respiratory bronchiolitis interstitial lung disease (RB-ILD). Since 2013, he had undergone 15 bronchoscopies (with and without lavages and mucosal biopsies) in addition to wedge biopsies of the right upper and lower lobes. Pathology demonstrated patchy areas of acute inflammation and a background of emphysema and RB-ILD. On bronchoscopy in June 2016, the pulmonologist noted thick, white mucoid secretions in the airways, particularly in the right lower lobe, as well as a suspected chylous leak into the bronchus intermedius. A conventional lymphangiogram was attempted but technically unsuccessful. Consequently, lymphoscintigraphy with ⁹⁹m technetium-labelled antimony trisulfide colloid was performed. The webbed spaces of both lower extremities were injected, and dynamic, delayed and SPECT-CT images revealed accumulation of colloid in the tracheobronchial tree as well as the right middle and lower lobes corresponding to the ground glass change on CT, consistent with the clinically suspected chylous leak.

Although rare, plastic bronchitis is likely more common than reported as many clinicians are unfamiliar with the disease and may fail to recognize milder forms of the syndrome. The classic feature is expectoration of branching casts, not to be confused with mucous plugs. Lymphatic imaging in this condition has been performed with conventional lymphangiography, dynamic contrast enhanced MR lymphangiography and only rarely, using the least invasive method of lymphoscintigraphy. Given its simplicity and relatively non-invasive nature, lymphoscintigraphy may become a preferred imaging modality in plastic bronchitis, since in its “true” form (as in this case) it is treatable with selective lymphatic vessel ablation.

EL-008

METASTATIC PROSTATE CANCER IN HILAR LYMPH NODE – BEWARE THE HIDDEN CANCER

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A 76 years old gentleman with a history of prostatectomy 10 years prior, had a chest radiograph for persistent cough which showed a right upper lobe (RUL) opacity and contrast enhanced computed tomography (CT) scan of the thorax and abdomen revealed a 2.2 cm mass in the RUL with no mediastinal or hilar lymphadenopathy and no metastasis. Hybrid Positron emission tomography and CT scan (PET/CT) was subsequently carried out for lung cancer staging.
The PET/CT scan showed high FDG activity (SUVmax 5.9) in the RUL mass. Intermediate (SUVmax 2.5) activity was seen in a right hilar lymph node, thought to be reactive but metastasis could not be excluded and staging was T1b N0/1 M0.

Right upper lobectomy and resection of his right para-tracheal, right hilar and subcarinal lymph nodes was deemed the most suitable treatment option and the resected tissues were sent for histological analysis. The RUL tumour was confirmed as keratinising squamous cell carcinoma and the hilar node was adenocarcinoma with positive immunohistochemistry for prostate specific antigen and prostatic acid phosphatase, consistent with metastatic prostate cancer.
His serum PSA was 0.9 µg/L (normal range <5.0) and the urology MDT chose the “watch and wait” management strategy with repeat PSA measurement in 6 months.

Biochemical recurrence post-prostatectomy, is PSA greater than or equal to 0.2 ng/mL with a confirmatory second increase (Jadvar, 2016) and imaging (contrast enhanced CT, bone scintigram and/or pelvic MRI) is used to detect sites of recurrence. While there is no clear consensus on the role of FDG in prostate cancer management, studies have shown it is sensitive and specific for detection of recurrence, post-prostatectomy. In this case, our PET/CT scan report inadvertently led to the detection of prostate cancer disease recurrence.

**Conclusion:** FDG PET can be a useful tool in detecting recurrent prostate cancer post-prostatectomy.