Abstracts of Original Contributions
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RAPID FIRE ePOSTERS

Thursday, September 12, 2019 6:30 p.m.-7:30 p.m.

100-01

APPROPRIATENESS OF INPATIENT STRESS TESTING: IMPLICATIONS FOR DEVELOPMENT OF FUTURE CLINICAL DECISION SUPPORT MECHANISMS AND CRITERIA

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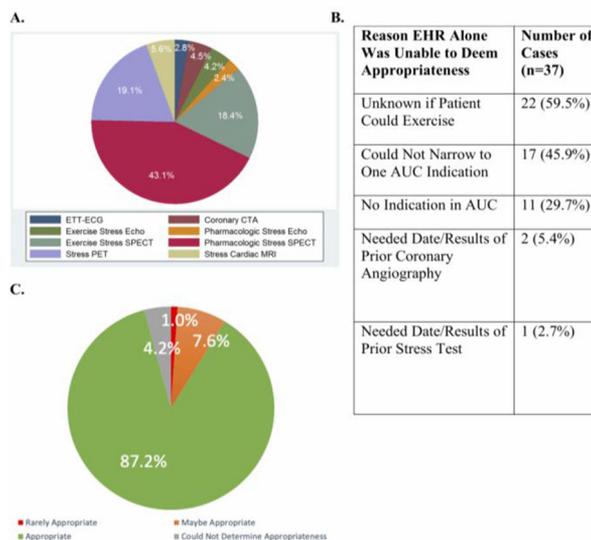
Background: The Protecting Access to Medicare Act of 2014 (PAMA) will require consultation of apprpriate use criteria (AUC) through a clinical decision support mechansm (CDSM) for advanced imaging. Our aim was to evaluate how to enhance future CDSM for inpatient testing.

Methods: We prospectively collected data on all consecutive inpatient stress tests and coronary computed tomography angiograhpy (CTA) studies for medical inpatients at Brigham and Women's Hospital from 11/2014 to 5/2015 (n = 288), including patient history, presentation, and ability to exercise. Appropriateness of each study was determined independently by two physicians retrospectively using the 2013 Multimodality AUC.

Results: The median age of the study population was 66 (interquartile range 56, 75), 41% were female, and 53% had a history of coronary artery disease. Nuclear myocardial perfusion imaging was the most common test ordered (81%). Review of the electronic health record (EHR) alone was insufficient to deem appropriateness for 13% of cases. The most common reason was inability to determine if the patient could exercise (60%). After reviewing the EHR and pilot CDSM data together, 87% of cases were deemed appropriate. Appropriateness could not be determined for 4% of cases. The most common reason was there was no AUC indication matching the exam (83%). Such cases included coronary CTA prior to cardiac surgery (20%) and evaluation post-spontaneous coronary artery dissection (SCAD) (20%).

Conclusions: Few stress tests or coronary CTAs in a medical inpatient cohort were deemed maybe/rarely appropriate, but appropriateness could not be determined by the EHR alone for 13% of cases. In preparing for PAMA, it will be important for future CDSM to obtain information on the patient's ability to exercise and for future AUC to include additional indications that are not currently addressed.

Figure. Summary of Study Orders and Appropriateness Assessment. **A.** Study Type Frequency – All Patients. **B.** All Reasons the Electronic Health Record Alone was Unable to Deem Appropriateness. **C.** Appropriateness of Studies Ordered Using Data from Both the Electronic Health Record and Pilot Clinical Decision Support Mechanism.

Reason EHR Alone Was Unable to Deem Appropriateness	Number of Cases (n=37)
Unknown if Patient Could Exercise	22 (59.5%)
Could Not Narrow to One AUC Indication	17 (45.9%)
No Indication in AUC	11 (29.7%)
Needed Date/Results of Prior Coronary Angiography	2 (5.4%)
Needed Date/Results of Prior Stress Test	1 (2.7%)

100-02

COMPARISON OF SYMPATHETIC INNERVATION STATUS BETWEEN HFREF AND HFRECEF: A PILOT CROSS-SECTIONAL STUDY

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Introduction: Recent introduction of novel medical treatment for dilated cardiomyopathy (DCM) led to a substantial rate of functional recovery. We assessed whether myocardial sympathetic innervation status is different between patients with (heart failure with recovered ejection

fraction, HFrecEF) and without (heart failure with reduced ejection fraction, HFrEF).

Methods: Fifteen patients with DCM with available echocardiography at initial presentation and 6-month follow-up underwent I-123 meta-iodobenzylguanidine (MIBG) planar scan and SPECT/CT. All the enrolled patients had LVEF < 45% at the initial presentation. According to the results of 6-month follow-up echocardiography, they were classified to either HFrEF or HFrecEF: HFrEF was defined as sustained reduction in left ventricular ejection fraction (LVEF) (< 45%) despite medical treatment while HFrecEF was defined as recovered LVEF >=45% after medical treatment. Cardiac MIBG uptake was quantified by calculating heart-to-mediastinum ratio (HMR) at early (15 min) and late (4 h) time points. HMR was calculated using both planar and SPECT/CT images. Washout rate was also quantified both for planar and SPECT/CT images. Cardiac MIBG uptake was compared between HFrEF and HFrecEF.

Results: Six patients were classified as HFrecEF while 9 were classified as HFrEF. Initial LVEF was similar between the two groups. Patients with HFrecEF showed significantly higher early HMR (planar), late HMR (planar), and late HMR (SPECT/CT). However, there was no significant difference in washout rate between the two groups, regardless of background activity correction or imaging methods. Optimal cutoffs were 1.65 (AUC 0.870) for early HMR (planar), 1.67 for late HMR (planar), and 3.92 for late HMR (SPECT/CT), respectively, for differentiating HFrecEF from HFrEF.

Conclusions: HFrecEF showed more preserved cardiac sympathetic innervation as compared to HFrEF.
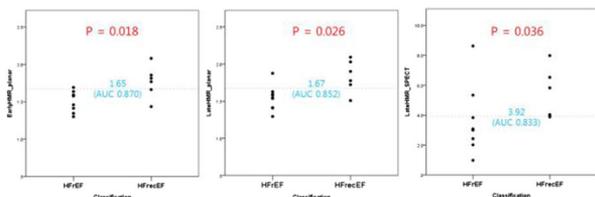
100-03

99MTECHNETIUM PYROPHOSPHATE SPECT IMPROVES DIAGNOSTIC CERTAINTY OF TRANSTHYRETIN CARDIAC AMYLOIDOSIS: A MULTICENTER EXPERIENCE FROM UNDERSERVED POPULATIONS

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Introduction: Myocardial uptake of technetium pyrophosphate (PYP) is a characteristic finding among patients with transthyretin cardiac amyloidosis (ATTR). Perugini score and determination of heart-to-contralateral lung (H/CL) ratio form the basis of diagnosing ATTR on planar PYP imaging. Whether a positive planar PYP study translates to tomographic evidence of PYP uptake is not known.

Methods: Imaging data of patients referred for cardiac PYP imaging at two inner city hospitals were evaluated. ATTR was said to be present if the Perugini score was ≥ 2 or if the H/CL ratio was ≥ 1.5 at one hour on planar imaging, along with an absence of immunologic evidence of abnormal light chains. As part of our diagnostic imaging protocol, SPECT was performed on all patients after planar acquisition. The ability to visualize standard myocardial segments after reconstruction of SPECT data was considered as evidence of myocardial uptake.

Results: A total of 27 patients (table) were referred for PYP imaging of which 26 (96.3%) were positive for ATTR on planar imaging (mean age 81 years, male 63%). 26 patients had a Perugini score ≥ 2, while 15 patients (56%) had a H/CL ratio ≥ 1.5. Myocardial uptake on SPECT was noted in all 27 patients, and the diagnosis of ATTR in one patient with discordant planar (Perugini score = 1) and SPECT data was confirmed on cardiac MRI.

Conclusions: Our initial experience from two inner city tertiary care centers suggests that H/CL ratio does not meet the diagnostic cutoff for ATTR in a substantial proportion of patient with a Perugini score ≥ 2, on planar PYP imaging. SPECT adds diagnostic certainty in patients with a Perugini score < 2, and should be routinely performed in all patients referred for PYP imaging.

Table 1	
	ALL PATIENTS N= 27
Positive 99mTc-PYP	27
Perugini score ≥ 2	2.81 ± 0.48
Perugini score	
Grade I	1 (3.7%)
Grade II	3 (11.1%)
Grade III	23 (85.2%)
HC/L ratio	
>1.5	16 (59.2%)
1-1.5	11 (40.8%)
< 1	0
Mean age (years)	81
Male	17 (63%)
African American	11 (41%)
BSA (kg/m²)	1.86 ± 0.25
Low voltage EKG	12 (44.4%)
Mean LVEF	49%
LV Mass	289

BSA indicates Body Surface Area; 99mTc-PYP (99mTechnetium pyrophosphate), LV (left ventricle), LVEF (left ventricular ejection fraction)

100-04

EVALUATION OF QUANTITATIVE CMR PERFUSION IMAGING BY COMPARISON WITH SIMULTANEOUS 15O-WATER-PET

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Introduction: The aim of the present study was to compare the quantitative accuracy of cardiac perfusion measurements using dynamic contrast-enhanced (DCE-) MRI with simultaneous 15O-water PET as reference.

Methods: 15 patients underwent simultaneous DCE MRI and 15O-water PET scans at rest and adenosine-induced stress on an integrated time-of-flight capable PET-MR scanner. For both methods, MBF was estimated using a single tissue compartment model. The relationship between MRI- and PET-based global and regional MBF values were assessed using correlation and Bland–Altman analysis.

Results: Three subjects were excluded due to technical problems. Global mean (± SD) MBF values at rest and stress were 0.97 ± 0.27 and 3.19 ± 0.70 mL/g/min for MRI and 1.02 ± 0.28 and 3.13 ± 1.16 mL/g/min for PET (p = 0.66 and p = 0.81). The correlations between global

and regional MRI- and PET-based MBF values were fair to good ($r = 0.86$ and $r = 0.75$). The biases were negligable for both global and regional MBF comparisons (0.01 and 0.00 mL/min/g for both). Limits of agreement were wide for both global and regional MBF, with larger variability for high MBF-values. Specifically, limits of agreement where three times as high as previously found for test–retest studies using ^{15}O-water PET.

Conclusions: The correlation between simultaneous MBF measurements with DCE MRI and ^{15}O-water PET measured in an integrated PET-MRI was fair but the agreement was only moderate indicating that MRI-based quantitative MBF measurement is not ready for clinical introduction.

100-05

HEART SCORE DOES NOT PREDICT AN ABNORMAL MYOCARDIAL PERFUSION SPECT AMONG PATIENTS PRESENTING TO THE EMERGENCY DEPARTMENT WITH CHEST PAIN

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Background: HEART Score (HS) is used in the emergency department (ED) to risk stratify patients with chest pain and to guide evaluation for coronary artery disease (CAD). It is not known whether this risk stratification tool predicts an abnormal myocardial perfusion SPECT (MPS) among these patients.

Methods: Patients presenting to the ED with chest pain and who underwent a stress MPS, over a 6-month period, were identified. HS is routinely reported by our ED providers and is recorded in the electronic medical records (low < 4 or high $\geq$ 4). An abnormal MPS was defined by either a summed stress score $\geq$ 4 or a summed difference score $\geq$ 2.

Results: A total of 327 presenting to the ED with chest pain underwent a MPS during the study period (mean age = 59 years; 40% males). Distribution of HS and clinically significant variables is provided in the table. An abnormal MPS was present in 49% of the patients and HS was not an independent predictor of an abnormal MPS (OR, 95% CI: 0.95, 0.64-1.40; p = 0.81) on multivariable regression analysis, after adjusting for clinically significant variables.

Conclusions: MPS is abnormal in a substantial proportion of patients tested for CAD after presenting to the ED with chest pain. However, HS was not predictive of an abnormal MPS, and should not be routinely used to guide disposition or testing for CAD.

Parameters	Low HS (1-3) (n=102)	High HS (> or = 4) (n=225)	P value
Age	51.43 ± 10.76	62.56 ± 12.28	<0.0001*
Male, %	49.02	35.56	0.02*
Diabetes, %	16.67	28.89	0.02*
Hypertension, %	44.12	78.22	<0.0001*
Hyperlipidemia, %	18.63	57.33	<0.0001*
Current smoking, %	24.51	27.56	0.73
Chest Pain suspicious for angina, %	59.80	87.11	<0.0001*
Troponin, ng/ml	0.02 ± 0.03	0.85 ± 10.21	0.002*
Pharmacological stress, %	36.27	55.16	0.002*
Positive Stress ECG, %	8.82	4.50	0.13
SSS	3.8 ± 4.99	5.53 ± 6.87	0.04*
SDS	1.56 ± 2.47	1.82 ±2.65	0.56

* significant at p < 0.05, HS = HEART score, SSS = summed stress score, SDS = summed difference score

100-06

UTILIZATION OF CORONARY CT ANGIOGRAPHY TEMPLATES FOR THE 4D VISUALIZATION OF MPI-DERIVED LV MYOCARDIAL THICKENING

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Introduction: LV myocardial (myo) thickening (WT) is an important prognostic variable routinely assessed with myocardial perfusion imaging (MPI). Visualization techniques range from polar maps to 3D models of the MPI-derived simplistic LV anatomy. The goal of this work is to develop a methodology for the enhanced portrayal of WT by applying the thickening data to an anatomical template obtained from coronary CT Angiography (CCTA) that will look more familiar to cardiologists and referring physicians.

Methods: Ten PET studies were selected from our database of MPI. Three templates of heart anatomy were identified from our CCTAs database on the basis of LV volume to identify small, medium and large hearts; they were modified to match the assumption of 1 cm-thick myocardium at end diastole and each case was associated with one of them. LV myo profiles were identified on gated acquisitions and 3D triangulated surfaces reconstructed accordingly. WT^{PET} was computed by means of standard quantification methodologies from PET data and a Thin Plate Splines (TPS) technique used to analytically represent the changes in WT from one cardiac gate to the next for endo/epicardial borders. The TPS were applied to modify the template endo/epicardial surfaces constraining it to move according to the PET-derived thickening data. In Fig 1. A, the template systolic (S) and diastolic (D) models are displayed with corresponding PET thickening. Validation consisted of subdividing in 17 segments the template myo borders, the myo S and D thickness (MT_S, MT_D) and the template thickening (WT^{TEMP}) defined as (MT_S – MT_D)/MT_D computed. WT^{TEMP} averages were calculated for each segment and compared to WT^{PET}.

Results: WT^{TEMP} and WT^{PET} were computed at rest and stress for all cases; Pearson's correlation coefficients between WT^{TEMP} and WT^{PET} were calculated on the grouped 17 segments (n = 170): at stress R = 0.82, SEE = 0.15; at rest R = 0.79, SEE = 0.12 (Fig 1B).

Conclusions: The computed WT^{TEMP} matches WT^{PET} and guarantees satisfactory correlation coefficients. A validation with direct anatomical WT assessment is in order.
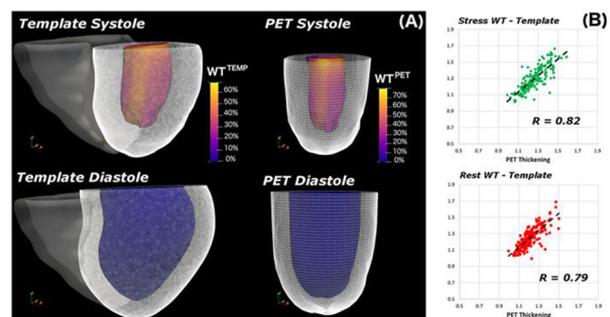
ePOSTER SESSION I: PET MYOCARDIAL BLOOD FLOW

**Thursday, September 12, 2019 6:30 p.m.-7:30 p.m.**

101-01

EVALUATION OF MYOCARDIAL EXTRACTION FRACTION WITH VARIABLE PHARMACOLOGICAL VASODILATION FOR A NOVEL PET MYOCARDIAL PERFUSION TRACER, ^{18}F-RHO6G

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Introduction: Non-invasive quantitative assessment of myocardial blood flow (MBF) with PET is a reliable method for detection of coronary artery disease (CAD). The sensitivity for detection of CAD is dependent of the first-pass myocardial extraction fraction (FPMEF) of a MBF radiotracer, which can be affected by flow. We evaluated the flow dependence of the FPEF of a new MBF radiotracer, an ^{18}F-labeled rhodamine dye (^{18}F-Rho6G) with favorable myocardial imaging characteristics.

Methods: ^{18}F-Rho6G was produced as previously described[1] with high-specific activity (range 75-1480 MBq/nmol) and radiochemical purity (> 99%). We determined the in vivo FPMEF of ^{18}F-Rho6G in swine (n = 4) by intracoronary co-injection of ^{18}F-Rho6G and the non-extractable reference radiotracer, ^{125}I-albumin, via a coronary guide catheter placed in the proximal left anterior descending (LAD) artery, and concurrent withdraw of serial blood samples from a coronary sinus catheter. LAD flow was measured with a coronary Doppler flow probe placed distal to the guide catheter. LAD flow and extraction fraction were measured under 3 conditions: rest, under maximum coronary vasodilation with adenosine (280 µg/kg/min, i.v.), and with phenylephrine (5 ug/kg/min, i.v.) plus adenosine (280 ug/kg/min, i.v.). To determine the FPMEF, the area under the activity curves for both tracers was calculated correcting for the ratio of injected activity, and counting efficiency of each isotope in the gamma counter.

Results: The FPMEF of ^{18}F-Rho6G was very high (> 78%) with minimal flow dependence, although FPMEF was not significantly different during each condition (Rest: 85.0 ± 5.2%, Adenosine: 85.3 ± 5.7%, Phenylephrine + Adenosine 81.0 ± 2.0%) despite a two to three-fold increase in LAD flow. There was a negative correlation between LAD flow and FPMEF with an R^2 of 0.3576 and a Pearson correlation of − 0.60 (Fig 1).**Conclusions:** ^{18}F-Rho6G is a highly promising ^{18}F-labeled myocardial perfusion tracer with a high first pass extraction fraction that is relatively consistent under clinically relevant pharmacological vasodilation.
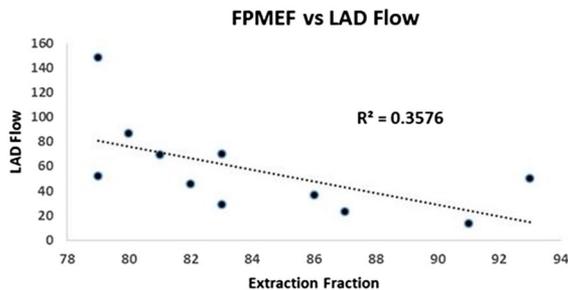
Figure 1: Correlation between LAD flow measured with an LAD coronary flow probe and first-pass myocardial extraction fraction (PFMEF) for ^{18}F-Rho6G. The correlation between LAD flow and FPMEF were measured under rest, adenosine stress (280 ug/kg/min), and adenosine (280 ug/kg/min) + phenylephrine (5 ug/kg/min).

101-02

DIFFERENTIAL ASSOCIATION OF DIABETES MELLITUS AND IMPAIRED [82]RB PET HYPEREMIC MYOCARDIAL BLOOD FLOW ACROSS THE SPECTRUM OF EPICARDIAL CORONARY DISEASE

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Background: Absolute myocardial blood flow (MBF) measurements provide incremental diagnostic value over relative perfusion imaging using cardiac positron emission tomography. Diabetes mellitus (DM) affects the macro- and microvasculature, leading to impairment in peak hyperemic MBF during pharmacologic vasodilation. We sought to quantify the association between DM and hyperemic MBF across the spectrum of epicardial coronary artery disease (CAD).

Methods: Data from 222 patients with known or suspected CAD (63.7 ± 10.7 years, 66 females, 85 with DM) who had dipyridamole stress [82]Rb PET and invasive coronary angiography within 6 months were included. Global hyperemic MBF was calculated using FlowQuant. Extent and severity of Epicardial disease was quantified using stenosis-weighted SYNTAX scores (SWSS), which accounts for sequential epicardial stenosis. Multivariable linear regression was used to predict hyperemic MBF based on clinical risk factors and PET imaging results across a spectrum of epicardial disease.

Results: Significant predictors of Hyperemic MBF included age (− 5.8% per decade), body mass index (− 0.6% per unit), family history of CAD (− 8.1%), stress left ventricular ejection fraction (+ 1.3%), and stress rate pressure product (RPP) (+ 4.1% per thousand). These were all independent of the combined extent and severity of epicardial disease. There was also a significant interaction of DM with SWSS to further decrease hyperemic MBF.

Conclusion: In the presence of significant obstructive epicardial disease, hyperemic MBF decreases more rapidly in patients with DM compared to those without. Patient demographics, risk factors, and stress PET functional parameters should be considered in the clinical interpretation of hyperemic MBF.
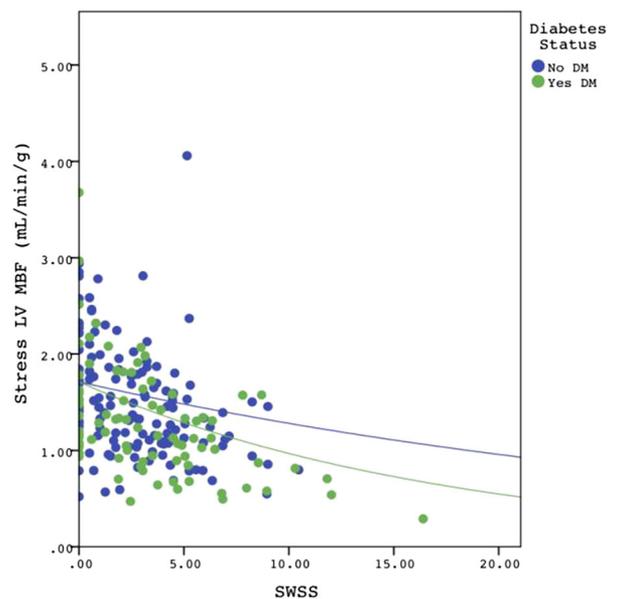
101-03

MYOCARDIAL FLOW RESERVE FROM RUBIDIUM-82 POSITRON EMISSION TOMOGRAPHY CORRELATES WITH CORONARY ARTERY LESION CHARACTERISTICS AND PREDICTS SEVERITY OF CORONARY ARTERY OBSTRUCTION

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Introduction: Global myocardial flow reserve (MFR) from rubidium-82 PET provides incremental prognostic value for the prediction of mortality. However, it is unknown if reductions in regional myocardial blood flow (MBF) correlate with angiographically defined coronary artery disease (CAD) lesion severity and could therefore be used to guide revascularization decision-making. We compared per vessel MFR to CAD lesion characteristics measured by quantitative coronary analysis (QCA) in patients with angiographically-significant CAD.

Methods: Cardiac dynamic 3D Rb-82 PET/CT and coronary angiographic data were compared from 11 subjects presenting with acute chest pain referred for coronary angiography following abnormal PET studies (perfusion, MFR or both). Resting and regadenoson-stress MBF and MFR were derived for each coronary artery. Coronary angiography lesion characteristics were quantitatively assessed (obstruction, segment diameter and length) by QCA using QAngio XA (Version 7.3, Medis Medical Imaging System BV, Leiden, the Netherlands). Correlation of QCA derived measurements with MFR was analyzed using linear regression.

Results: In 11 patients admitted for acute chest pain (45% women, mean age 66 ± 10.5 years) PET perfusion was abnormal in 10/11 and 5/11 had reduction in global MFR (mean = 2.1 ± 0.7 ml/min/g). Regional MFR per vessel was defined by automated analysis and was not significantly different among the vascular territories (p = 0.710; LAD 2.2 ± 0.71, RCA 2.2 ± 0.93, LCx was 2.0 ± 0.63). Comparing QCA to MFR, there was moderate correlation between obstructive lesion diameter and MFR, which was more strongly observed in the LCx (LCx, R = 0.61, p = 0.046 and RCA R = 0.45, p = 0.17). Additionally, there was a strong correlation between RCA MFR and total segment length (TSL) (R = 0.62, p = 0.04) and a trend toward correlation between LAD MFR and TSL (R = 0.41, p = 0.2). However, global MFR had the strongest correlation to obstruction length of the LAD (R = 0.64, p = 0.035).

Conclusion: These data are the first to report correlation between QCA lesion characteristics and PET MFR. These data suggest per-vessel MFR correlates with severity of obstruction as quantified by QCA as well as correlation between segment length and MFR. This adds to the understanding of the underlying pathophysiologic processes of regional perfusion defects on Rb82 PET and may help elucidate potential areas for treatment. These findings suggest that the prognostic power of MFR is in part due to its ability to predict vessel specific flow-limiting lesion characteristics as defined by invasive QCA. Ongoing data acquisition will increase the correlative power of the present study.

101-04

EFFECT OF MEASUREMENT UNCERTAINTY ON CORONARY FLOW CAPACITY INTERPRETATION

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Introduction: The coronary flow capacity (CFC) map is a clinical tool for integrating stress myocardial blood flow (MBF) and myocardial flow reserve (MFR). Five thresholds for stress MBF and MFR are used to classify each myocardial pixel into one of 7 graded categories of CFC. In this work, we sought to evaluate how clinical interpretation of CFC can be influenced by uncertainty in measured MBF.

Methods: 50 intermediate risk patients (summed stress score between 8-12) who underwent rest and regadenoson stress dynamic Rb-82 PET were selected. Regional uptake parameter K1 and SD(K1) were estimated for each patient with a 1-compartment model and used to simulate an ensemble of log-normal K1 distributions for each LV region. The Lortie relation was used to map K1 to MBF. An ensemble of CFC maps was then constructed with recently published CFC thresholds and analyzed to determine median (CFCmed) and 95% confidence interval (CI) CFC maps. The fractions of LV sectors falling within each CFC category were calculated for all maps. CIs of LV fractions in each CFC category were normalized by corresponding fractions in CFCmed. Our evaluation focused on the myocardial fraction in the lowest CFC category (CFC-severe), which recent data suggested can be used to improve prognosis with revascularization.

Results: Within the 95% CIs, an average of 28 ± 13% (max 60%) of myocardial sectors changed by ± 1 category, and 2 ± 3% (max 14%) of myocardial sectors changed by ± 2 categories. Among 33 patients with any myocardium in the lowest (CFCsevere) category, the median LV fraction across patients was 6 ± 7%, and the relative 95% CI per patient was 148 ± 125%. For 17 patients (34%), the number of vascular territories with nonzero CFCsevere fraction changed within the 95% CI. A case example is shown in the figure. Two of the 17 patients had zero CFCsevere fraction according to their CFCmed maps.

Conclusions: Clinical levels of uncertainty in MBF estimates caused shifts by 1 or more CFC category for large fractions of the left ventricle. Within 95% confidence intervals, clinical interpretation of CFC maps was altered in 34% of patients.
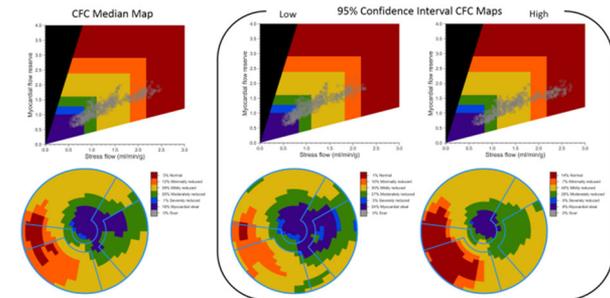
101-05

ANALYSIS OF TIME ACTIVITY CURVES FROM TWO DIFFERENT [82]RUBIDIUM GENERATORS

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Introduction: Quantification of myocardial blood flow (MBF) and myocardial flow reserve (MFR) has become an important part of coronary artery disease (CAD) diagnostics. It can particularly help risk stratification in CAD patients. With its increasing clinical significance, it is paramount to identify potential issues in dynamic studies. In this work we analyze arterial input time activity curves (TACs) obtained from two different [82]Rb generators.

Methods: We retrospectively analyzed two set of TACs. 608 TACs sampled from [82]Rb rest/stress dynamic studies acquired in 2017 with a Bracco Cardiogen-82 generator. 881 TACs from studies acquired in 2018 with a JDI Ruby-Fill generator. We investigated the delivery of the tracer by quantifying the jaggedness of the TACs by summing all positive variations over 5% of the TAC maximum after the main peak. We

compared the fraction of cases where this metric was not 0. Wilcoxon test was used to compare the distributions of the metric between 2017 and 2018.

Results: The histograms of the metric are shown in Fig 1. Based on the metric, 46.9% of cases in 2017 had jaggedness in TACs as opposed to 34.7% in 2018. Looking at rest and stress separately, the metric showed that jaggedness in rest curves decreased from 40.8% in 2017 to 29.4% in 2018. Stress curves underwent a similar improvement with 53.6% of jagged curves in 2017 compared to 41.0% in 2018. Wilcoxon test showed significant difference between 2017 and 2018: p value of 0.001 for combined rest and stress, 0.007 for rest, and 0.021 for stress.

Conclusions: In this study, we analyzed TACs from two different ^{82}Rb generators. Our preliminary results showed that the quality of the curves varied significantly between the two generators. The improvement between the generators is likely due to saline flush incorporated into the JDI generator after injection of the radiotracer, thus ensuring a more steady delivery. Further analysis is underway to quantify how the quality of the TACs affect MBF and MFR values.
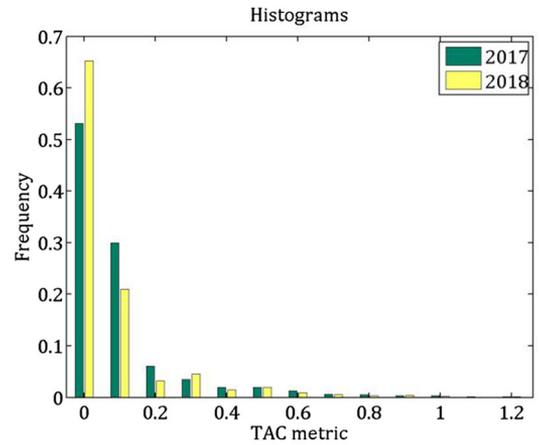

Fig1. Histograms of jaggedness metric (normalized to the total cases)

POSTER SESSION I: NATIONAL AND INTERNATIONAL PERSPECTIVES IN CARDIAC IMAGING

Thursday, September 12, 2019 6:30 p.m.-7:30 p.m.

102-01

CONSIDERATIONS IN THE GUIDELINE-BASED APPLICATION OF OBSTRUCTIVE CAD PREDICTION MODEL TO SELECT PATIENTS FOR SPECT MYOCARDIAL PERFUSION IMAGING

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Background: Guidelines recommend that choice of tests in patients with chest pain investigated for CAD should be guided by pre-test probability of obstructive coronary artery disease (OCAD). Functional imaging like SPECT myocardial perfusion imaging (MPI) should be restricted to use in the pretest probabilities of 15 to 85% as per Bayes theorem due to sensitivity and specificity of MPI. This is a wide range of pretest probability. This study aims to describe the frequency of abnormal MPI results in groups with different pre-test probability. This will help to describe where this guideline-based approach to selecting appropriate patients for tests may be applied with best effect.

Methods: Cross-sectional analysis of patient records for those with SPECT MPI done from 2012 to 2017 at our tertiary cardiac institution. Inclusion criteria were patients with chest pain. Exclusion criteria was a known history of OCAD. Data were collected on symptomatology, cardiovascular risk factors. Abnormal MPI was defined as ischemia and/or infarct.

The CAD consortium clinical model, a validated model was used to calculate pre-test probability of OCAD in the patients. OCAD that is predicted by this model is defined as 50% or more stenosis of one or more coronary arteries. The patients were divided into groups of various pre-test probabilities: 15% or less; more than 15% up to 30%; more than 30% up to 50%; more than 50% up to 85%; more than 85%.

Results: 17747 patients were included. We found that the proportions of abnormal scans within each probability group increased as predicted probability increased. However, as probability of OCAD increased, the difference between the predicted and actual abnormal MPI proportion increased.

Conclusion: As predicted probability of OCAD increases, MPI is less reflective of the former. This may be due to increased incidence of multivessel disease and balanced ischemia. This may suggest that MPI is more useful in those at the lower end in the range of 15-85%. Particularly when pretest probability is above 50%, more often than not, a negative result would be a predicted false negative.

			Obstructive CAD probability groups				
			0.15	>0.15-0.3	>0.3-0.5	>0.5-0.85	>0.85
MPI result	Normal	Count	6860	3900	2324	1205	19
		% within OCAD prob groups	92.5%	84.3%	76.0%	67.5%	65.5%
	Abnormal	Count	555	727	735	581	10
		% within OCAD prob groups	7.5%	15.7%	24.0%	32.5%	34.5%
Total		Count	7415	4627	3059	1786	29
		%	43.8%	27.4%	18.1%	10.6%	0.2%

Predicted obstructive CAD compared with abnormal MPI results

		Mean probability
OCAD probability groups	15% or less	8%
	>15-30%	22%
	>30-50%	39%
	>50-85%	62%
	>85%	88%
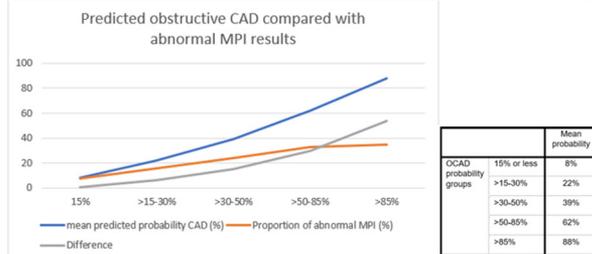
102-02

THE USE OF MUGA IN PREDICTING RIGHT VENTRICULAR FAILURE POST LEFT VENTRICULAR ASSIST DEVICE IMPLANTATION

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Introduction: Right ventricular failure (RVF) after left ventricular assist device (LVAD) placement is associated with increased mortality and morbidity. Predicting which patients are at highest risk for RVF via non-invasive methods can be challenging. We hypothesized that decreased right ventricular (RV) ejection fraction (EF) as well as qualitative assessments of RV function and dilation, as assessed by radionuclide ventriculography (multiple-gated acquisition, MUGA), are associated with an increased risk of RVF following LVAD implantation.

Methods: We retrospectively identified 46 patients from 1/2008 to 11/2017 that underwent MUGA and LVAD implantation. A chart review was performed to determine if patients developed RVF after device implantation. RVF was defined as requiring inotropes for greater than 14 days after LVAD implantation or requiring a right ventricular assist device (RVAD). MUGA derived variables of RV performance and structure were compared between patients with and without RVF post implant. Statistical analyses were performed with independent sample two-tailed t tests and Chi square tests for continuous and categorical variables, respectively.

Results: The majority of the patients were men (82.6%) and white (69.6%). Most patients had centrifugal flow devices implanted (N = 43), with other patients receiving axial flow devices (N = 3). Eight patients developed RVF after device implantation with two patients requiring RVAD support. The average RV EF on MUGA was 41.45% in those that did not develop RVF and 40.13% in those that did (p = 0.732). RV dilation (p = 0.934) and global RV function (p = 0.767) by MUGA were not statistically different between the two groups.

Conclusion: In patients that required MUGA for further assessment of RV function prior to LVAD implantation, decreased RV EF, RV dilation and global RV function on MUGA were not associated with an increased risk of RVF.

102-03

DESCRIPTION OF EFFECTIVE RADIATION DOSE OF PATIENTS AFTER MYOCARDIAL PERFUSION STUDIES IN A MEXICAN NATIONAL CONCENTRATION CENTER

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Background. Awareness of a large rise in population exposure to ionizing radiation from medical diagnostic procedures has resulted in renewed focus on efforts to decrease patient radiation doses to levels that are as low as reasonably achievable (ALARA): the median patient dose per study should be 9 mSv.

Purpose. Evaluate the effective radiation dose of the patients undergoing SPECT in our laboratory and verify compliance with the ASNC recommendation level.

Methods. Patients with a SPECT study, whether for diagnostic or prognostic purposes, radiation exposure was measured with Geiger Muller according to recommendations and the effective dose was calculated according to the 2014 International Commission on Radiological Protection Compendium. Data analysis was made with SPSS statistical

program (v 24.0). Data are presented as means and standard deviations, frequencies and percentages.

Results. Baseline characteristics: mean age 57.1 years (± 5.2), women 37.5%, systemic arterial hypertension 62.5%, diabetes mellitus type 2 68.7%, smoking 68.7%, average effective dose for SPECT study was 3.4 (range 1.0 - 4.4) mSv. Mean radiation (in mSv) for each SPECT study is in table 1, respectively grouped by sex and protocol, with emphasis on special situations. The ASNC threshold goal of 9 mSv per study is accomplished for all (100%) of SPECT studies, and with less than 4.5 mSv either if it was used 99mTc, 201 Tl or the clinical condition of the patient.

Conclusion. The ASNC radiation effective dose goal of ≤ 9 mSv per study has been uniformly achieved by our myocardial perfusion laboratory during the time evaluated.

Table 1. Effective doses (mSv) grouped by sex, protocol and special situations

PROTOCOL		
99mTc Sestamibi rest-stress	75%	3.9 ± 0.5
201Tl stress-redistribution-reinjection	6.25%	4.4 ± 0.02
99mTc Sestamibi rest only u other ≤ 10 mCi	18.75%	1.5 ± 0.6

102-04

[99M]TC-LABELED RBC-ERNA STUDY AS AN INDIRECT BIOMARKER FOR HEPATIC IRON OVERLOAD IN BETA THALASSEMIA MAJOR PATIENTS: LOOKING BEYOND THE HEART -A PILOT STUDY

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Introduction: Blood transfusions in beta-thalassemia major (TM) inevitably lead to iron deposition in the visceral organs like liver and myocardium. Based on our observation of decreased hepatic perfusion in transfusion dependent TM patients who were otherwise referred for LVEF assessment, on a pilot phase, we aimed at evaluating the potential of 99mTc-labeled RBC-equilibrium radionuclide angiocardiography (ERNA) in assessing the derangement in hepatic perfusion in TM patients, imposed by chronic iron overload, by quantifying the same and correlate it with degree of hepatic iron overload given by T2*hepatic MRI.

Methods: One hundred and twenty-five patients of transfusion-dependent TM prospectively underwent ERNA for LVEF estimation with an additional whole-body planar imaging taken for 10 min, without any additional radiation exposure or cost to the patient. Whole body planar images were analyzed quantitatively for hepatic perfusion and standardized region of interest (ROI) were drawn over segment VIII of liver (excluding vascular and biliary area) and normalization was done for background with ROI in soft tissue of thigh. Twenty-five age-matched non-thalassemic patients undergoing ERNA for different indications and additional whole-body planar imaging constituted the control population. The liver counts were correlated with degree of iron deposition estimated by T2*MRI (< 2 mg of iron/gm of dry liver taken as normal, 2-7 as light, > 7-15 as moderate and > 15 as severe iron deposition).

Results: Both TM patients (n = 125) with mean age of 23.3 ± 5.2 years (9-39; M/F = 83/42) and control group (n = 25) with mean age 30.6 ± 8.1 (12-40, M/F = 11/14) underwent ERNA study and additional whole-body planar imaging. The mean of the maximum tracer uptake in the liver (normalized to background) in the TM group was 4.5 ± 1.6 against 5.3 ± 1.2 in the control group with significant difference between the hepatic counts of two groups (p = 0.04) indicating lesser hepatic perfusion in thalassemic group likely due to iron overload. On basis of hepatic T2*MRI, TM patients were again divided into group 1 with normal/light iron deposition (n = 31) and group 2 with moderate/severe iron deposition (n = 89) and the mean hepatic perfusion counts in the two groups (4.9 ± 2.3 vs 4.0 ± 1.3 respectively) also differed significantly (p = 0.01) indicating higher degree of derangement in hepatic perfusion in group with severe iron deposition. A negative correlation (r = − 0.45) between hepatic count and the iron deposition was also noted suggesting trend of lesser perfusion in patients with higher iron overload.

Conclusions: The study demonstrates the potential of ERNA as an adjunct imaging biomarker for hepatic iron overload as additional benefit (at no extra cost/radiation exposure) to routine LVEF estimation and needs further validation to establish itself as a low-cost early predictor for hepatic iron overload.

102-05

SAFETY AND TOLERABILITY OF REGADENOSON IN MYOCARDIAL PERFUSION IMAGING: A RANDOMIZED CONTROLLED STUDY WITH DIPYRIDAMOLE OF PATIENTS REFERRED FOR PRE-OPERATIVE EVALUATION

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Background: Regadenoson is a selective A2A adenosine receptor agonist with a short half-life used in myocardial perfusion imaging. Regadenoson's main advantages are its simplified and brief protocol of administration along with its ability to be employed in patients with asthma or chronic obstructive pulmonary disease of moderate severity. A disadvantage is its higher cost in comparison with the low-cost dipyridamole.

Methods: This is a randomized controlled study of patients scheduled for medium to high-risk non-cardiac surgery who were referred for pre-operative evaluation with myocardial scintigraphy using pharmacological stress agents. Patients were randomized into two groups, patients receiving regadenoson (study) and patients stressed with dipyridamole (control).

Results: A total of 188 patients were recruited: 96 (aged 70.9 ± 8.8 years, 66 males) were randomized to pharmacologic stress with regadenoson, and 92 (aged 70.3 ± 10.4 years, 70 males) to dipyridamole (p for age and sex > 0.05). After regadenoson injection, heart rate increased by 39.5 ± 19.2% (vs 20.7 ± 15.2%, p < 0.001). Gastrointestinal disturbances (24% vs 5.4%, p < 0.001) and dyspnea (13.5% vs 0%, p < 0.001), were significantly more frequent in the Regadenoson group (figure 1). No patient (0%) in the regadenoson group developed atrioventricular (AV) conduction abnormalities, while first degree AV block was observed in 4 (4.4%) patients from the dipyridamole group (p = 0.039). Aminophylline administration did not differ between the two groups (p > 0.05).

Conclusions: Regadenoson seems to be as safe as dipyridamole. It has more frequent adverse reactions with less AV conduction abnormalities. However, the frequency of aminophylline administration was identical, indicating a faster resolution of symptoms possibly due to its shorter half-life. Along with its simplified protocol of administration it can be

justified for use in specific patient groups, such as those included in the present study.
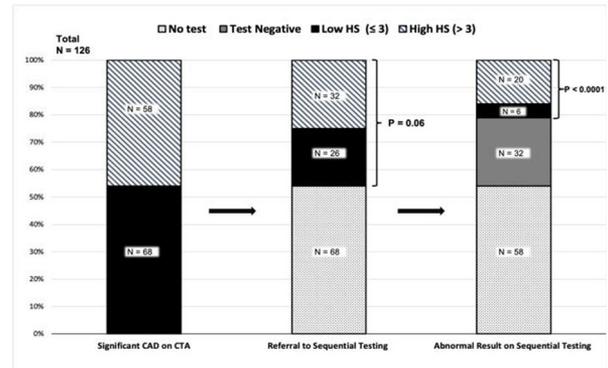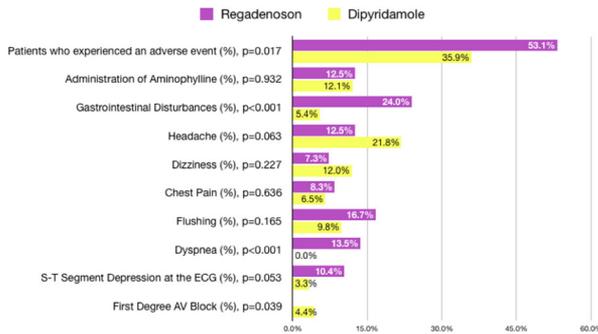
102-06

HEART SCORE STRATIFIES THE RISK CORONARY ARTERY DISEASE ON SEQUENTIAL TESTING AMONG PATIENTS WITH SIGNIFICANT ANATOMICAL DISEASE ON CARDIAC-COMPUTED TOMOGRAPHY ANGIOGRAPHY

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Introduction: HEART Score (HS) is used in the emergency department (ED) for risk stratification of patients with chest pain. Sequential testing is often performed in patients with significant CAD on coronary-computed tomography angiography (CCTA) for evaluation of chest pain. HS could allow for further risk stratification of those with an abnormal index CCTA.

Methods: CCTA performed in the ED between January 2014 and July 2016 were reviewed to identify those with significant anatomical coronary artery disease (CAD) - coronary artery calcium score $\geq$ 100 and luminal stenosis $\geq$ 50%. Electronic medical records were used to identify referral for downstream testing - functional stress test or invasive coronary angiography (ICA). HS was stratified as low ($\leq$ 3) or high ($>$ 3).

Results: A total of 923 CCTA were performed in the ED, of which 126 had significant CAD. Of these, 58 (46%, P = 0.06) underwent sequential testing, which was positive (ischemia/infarction on functional stress test or obstructive CAD on ICA resulting in revascularization) in 26 (21%, P < 0.0001). Among those with low HS (68), 26 underwent sequential testing of which only 6 were positive (23%). On the contrary, 32 patients with high HS underwent sequential testing which was positive in 20 (63%).

Conclusions: Sequential testing for CAD is positive in a substantial proportion of patients with anatomical CAD on CCTA. A high HS identifies a 2.7 times greater prevalence of an abnormal sequential test among patients with anatomically significant CAD on CCTA. HS could be used to guide in patient selection for sequential testing after a positive CCTA.

102-07

COMPARISON OF EQUILIBRIUM RADIONUCLIDE ANGIOCARDIOGRAPHY, ECHOCARDIOGRAPHY AND CINE CT FOR EARLY DETECTION OF DOXORUBICIN-INDUCED CARDIOTOXICITY
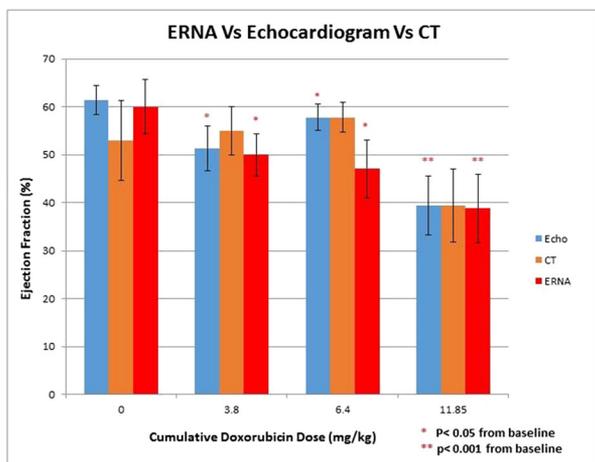
K. Chen*,[1] N. E. Boutagy,[2] A. Feher,[3] J. Stendahl,[4] C. Liu,[5] A. J. Sinusas[6]; [1]Yale University, New Haven, CT, [2]Internal Medicine (Cardiology), Yale University, New Haven, CT, [3]Yale University School of Medicine, Hamden, CT, [4]Cardiology, Yale University, New Haven, CT, [5]Yale PET Center, New Haven, CT, [6]Yale University School of Medicine, New Haven, CT

Background: Doxorubicin (DOX) is a commonly used anthracycline chemotherapeutic that is associated with cardiotoxicity that often results in irreversible injury. Echocardiographic (ECHO) assessment of left ventricular ejection fraction (LVEF) has become the first line imaging approach for detecting DOX-induced cardiotoxicity (DIC). Conversely, equilibrium radionuclide angiocardiography (ERNA) is used less frequently due to radiation exposure concerns. We directly compared ERNA and ECHO with contrast cine computed tomography (CT) for detection of LV dysfunction in a chronic canine model of DIC.

Methods: Dogs (n = 5) were treated weekly with DOX HCl (1 mg/kg) for up to 15 weeks. High-sensitivity bloodpool SPECT ERNA, ECHO and cineCT images were acquired under light sedation at baseline and following average cumulative doxorubicin doses of 3.8 mg/kg, 6.4 mg/kg and 11.85 mg/kg. Gated SPECT list-mode data were rebinned into 16 cardiac gates, and LVEF calculated from end-diastolic (ED) and end-systolic (ES) images. SPECT images were reconstructed using the maximum likelihood expected-maximization algorithm (MLEM, maximum iterations 80) with attenuation correction and resolution recovery and analyzed using Invia 4DM software. CineCT images were processed semi-automatically with the GE AW Volume Share workstation.

Results: There was a progressive and significant decline in LVEF following low cumulative doses of DOX (3.8 mg/kg) with both SPECT (p = 0.014) and ECHO (p = 0.004) compared to baseline, although cineCT failed to detect a drop in LVEF (figure). ERNA detected significant sequential declines in LVEF with less variability compared to ECHO, while CT was unable to detect these changes.

Conclusions: ERNA appears to be the most sensitive approach for serial evaluation of LVEF compared to ECHO or cineCT associated with increasing doses of DOX. These findings suggest that SPECT ERNA remains an affective modality for early identification of DIC.

ERNA Vs Echocardiogram Vs CT

Table.

| Testing Modality | Repeat Diagnostic Testing | | | Revascularization | | | Med Management Change (% Increased Post-Testing) |
	90-Day Cumulative Incidence	Adjusted HR	(95% CI)	90-Day Cumulative Incidence	Adjusted HR	(95% CI)	Cholesterol Lowering; Antihypertensive/ Antianginal Agents**
OP (N=22,083)							
ETT (N=3,836)	36.7%	2.121*	(1.946 - 2.311)	26.5%	1.004	(0.929 - 1.086)	21.0%; 21.1%
SE (N=3,532)	17.7%	Ref.	(Ref. - Ref.)	26.4%	Ref.	(Ref. - Ref.)	20.4%; 21.3%
SPECT (N=12,904)	14.1%	0.824*	(0.756 - 0.898)	27.3%	1.017	(0.953 - 1.084)	16.6%; 18.5%
CTA (N=1,075)	14.1%	0.817*	(0.690 - 0.968)	16.5%	0.727*	(0.624 - 0.846)	19.9%; 9.6%
CAC (N=484)	51.6%	2.866*	(2.538 - 3.236)	6.6%	0.370*	(0.253 - 0.541)	20.8%; 6.4%
PET (N=224)	10.0%	0.587*	(0.392 - 0.880)	19.9%	0.817	(0.618 - 1.082)	10.5%; 12.1%
MRI (N=28)	14.4%	0.942	(0.360 - 2.466)	14.8%	0.636	(0.271 - 1.495)	15.3%; 26.4%
ED (N=5,211)							
ETT (N=538)	61.0%	1.993*	(1.717 - 2.312)	11.5%	0.716*	(0.524 - 0.980)	20.4%; 21.1%
SE (N=591)	30.2%	Ref.	(Ref. - Ref.)	16.0%	Ref.	(Ref. - Ref.)	20.8%; 21.3%
SPECT (N=3,096)	47.4%	1.546*	(1.350 - 1.771)	11.9%	0.749*	(0.600 - 0.935)	19.3%; 21.8%
CTA (N=873)	24.9%	0.800*	(0.670 - 0.955)	2.5%	0.215*	(0.131 - 0.353)	18.3%; 15.0%
CAC (N=50)	60.0%	2.091*	(1.575 - 2.777)	20.5%	1.902	(0.992 - 3.645)	22.0%; 20.1%
PET (N=62)	61.4%	1.930*	(1.527 - 2.438)	0.5%	0.273*	(0.088 - 0.850)	13.0%; 16.5%
MRI (N=1)	n/a	n/a	n/a	n/a	n/a	n/a	100%; 100%

*Significant adjusted HR; adjusted HRs were considered significant if the CI did not include 1. CAC coronary artery calcium; CI, confidence interval; CTA, computed tomography angiography; ETT, exercise tolerance test; HR, hazard ratio; MRI magnetic resonance imaging; n/a, not available; PET, positron emission test; SE, stress echocardiogram; SPECT single-photon emission computerized tomography.
**Antihypertensive/Antianginal Agents include calcium channel blockers, beta blockers and combination products.

102-08

CARE PATHWAYS AND OUTCOMES FOR PATIENTS UNDERGOING NON-INVASIVE TESTING FOR CORONARY DISEASE : A COHORT STUDY COMPARING OUTPATIENT TO EMERGENCY ROOM VISITS

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Background: Real-world evidence characterizing pre- and post-assessment care pathways for patients (pts) who undergo testing for coronary artery disease (CAD) in outpatient (OP) or emergency department (ED) settings is lacking.

Methods: In this non-interventional, cohort study, retrospective data (Truven Commercial and Medicare MarketScan Research Databases) from symptomatic adults ($\geq$ 18 y) who underwent non-invasive testing to evaluate for CAD in OP (N = 303,052) or ED (N = 93,287) settings between 03/2014-12/2017 were evaluated. Study objectives were to 1) characterize these pts, 2) assess factors associated with time from presentation to imaging, and 3) describe healthcare resource utilization (HCRU) and retesting/revascularization rates 90 days post-imaging in those receiving a CAD diagnosis. Analyses were stratified by setting and diagnostic test.

Results: Gender proportions differed by setting and test; overall, 47% were male. Chest pain was primary precipitating reason for testing (OP 55%; ED 88%). While comorbidities were similar between settings (with dyslipidemia and hypertension being most common), comorbid burden differed by test. Time to testing was shorter in pts presenting in ED (typically same day) vs OP (median 12 d). After testing, 6.9% were diagnosed with CAD (OP N = 22,083; ED N = 5,211); subsequent HCRU differed by test and setting (Table). Tests conducted in ED are more likely to be repeated with another diagnostic testing either of the same or a different type. In both OP and ED, coronary artery calcium scoring was more likely than other testing modalities to be followed by another diagnostic testing. Positron emission test was least likely to be repeated in OP setting but most likely to be repeated if conducted in ED. Revascularization rates varied and cardiac medication changes were similar between settings.

Conclusion: Results indicate expected variability in patient characteristics by setting. HCRU after CAD diagnosis varied significantly by test.

102-09

MISSED OPPORTUNITIES IN PRIMARY AND SECONDARY PREVENTION IN PATIENTS REFERRED TO NUCLEAR CARDIOLOGY

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Introduction: A referral to nuclear cardiology is often the first presentation for cardiovascular services. Accordingly, referral to stress testing represents an opportunity for improvement in the delivery of preventive care, and the basis for improved outcomes. We hypothesize that a significant cohort of patients referred for nuclear stress testing fail to meet guideline thresholds for modifiable cardiovascular risk factors including dyslipidemia, hypertension, obesity, diabetes management, and tobacco use.

Methods: Prospective cohort of consecutive patients referred for nuclear stress testing in a single VA medical center from 10/1/2018-10/31/2018.

Results: Demographics of the 74 patients referred for nuclear stress testing included 97.3% males with a mean age of 69 years old (range 50-84) and 33.3% non-white race, of whom two-thirds were referred by non-cardiology physicians or nurse practitioners for typical angina (3%), atypical angina (32%), shortness of breath or fatigue (34%), or other alternative indications. As typical of a VA population, 43.2% of patients had a history of ASCVD (atherosclerotic cardiovascular disease), inclusive of myocardial infarction (16%) and revascularization (26%), along with a high burden of risk factors (diabetes 48.6%, hypertension or use of anti-hypertensives 70.3%, dyslipidemia or use of lipid lowering medications 89.2%, family history of ASCVD 48.6%, and current tobacco use 21.6%). Of the primary prevention subgroup without ASCVD, the 10-year Pool Cohort risk equation calculated risk was 21% (range 10.5-40) with a mean pretest probability of obstructive CAD of 38%. In the primary prevention subgroup with calculated ASCVD risk > 7.5%, 65.7% were taking moderate or high-intensity statin. In patient with ASCVD and/or diabetes, the mean LDL was 90 mg/dl with 52.5% having an LDL > 70 mg/dl. The use of high intensity statin was documented in 81.3% of ASCVD patients and 55.6% of diabetics without ASCVD. Blood pressure control in the cohort was distributed as normal 29.7%, elevated 16.7%, stage one 21.2%, and stage two 32.4%. Large body habitus was common with 45.7% overweight and 20.0% obese. In patients with diabetes, 44.4% had a hemoglobin A1c > 7. Of note, perfusion imaging was low risk (normal or summed difference 2-4) in 85% of the cohort.

Conclusion: Referral for nuclear stress testing represents an important opportunity for primary and secondary prevention interventions to improve management of modifiable cardiovascular risk factors, particularly given that most referred patients present with a symptom other than typical angina and have low-risk perfusion imaging. The observations from this cohort of veterans referred for stress testing suggests a need for

an expanded care model inclusive of appropriate risk factor modification of patients, as opposed to a limited focus on appropriate use of testing.

102-10

THE IMPACT OF CORONARY ARTERY CALCIUM SCORING ON INSURANCE APPROVAL FOR PCSK9 INHIBITOR THERAPY

G. Pershwitz*,[1] K. Balakumaran,[2] S. Joshi,[2] W. Chaudhry,[1] W. Duvall[3]; [1]Hartford Hospital, Hartford, CT, [2]University of Connecticut Medical Center, Farmington, CT, [3]Nuclear Cardiology, Hartford Hospital, Hartford, CT

Background: Current Food and Drug Administration (FDA) approved indications for use of anti-proprotein convertase subtilisin/kexin type 9 (PCSK9) monoclonal antibodies include established atherosclerotic cardiovascular disease (ASCVD) and familial hypercholesterolemia (FH). Currently, a coronary artery calcification (CAC) score greater than 300 or patients who fall into the $> 75^{th}$ percentile based on age and gender are appropriate for lipid lowering therapy. We seek to evaluate the utility of CAC scoring on insurance coverage approval for PCSK9 inhibitors in patients who did not achieve target low density lipoprotein (LDL) goal despite maximal tolerated lipid lowering therapy.

Methods: Records from initial consultations and follow-up visits to the Cholesterol Management Center at Hartford Hospital in patients for whom prior authorizations were submitted for PCSK9 inhibitor therapy between December 2016 and November 2018 were reviewed. Patients already receiving PCSK9 inhibitors, undergoing LDL apheresis, and those awarded partial insurance coverage were excluded. CAC scoring was performed for risk stratification and to better define treatment goals. The Dutch Criteria were used to define familial hypercholesterolemia. Statistical analysis was performed to examine significant differences in PSCK9 inhibitor approval after obtaining a CAC score (SAS 9.4).

Results: A total of 218 patients with prior authorization requests were included. All patients had an indication for lipid lowering therapy based on American College of Cardiology guidelines. 98 patients had no known ASCVD and ≤ 8 points using the Dutch Criteria for FH. In these patients, those receiving a CAC score were more likely to have prior authorization approval for PCSK9 inhibitor therapy than those without (94% vs 53%, p = 0.002). Within the cohort receiving a CAC score, 53% had either a CAC > 300 or were $> 75^{th}$ percentile based on age and gender. Patients with a CAC > 0 were more likely to have prior authorization approval for a PCSK9 inhibitor (100% vs 67%, p = 0.03) compared with those with a score of 0.

Conclusion: CAC scoring significantly increases the prior authorization approval rate for PCSK9 inhibitors in patients without ASCVD and no FH who are unable to achieve LDL goal despite maximal tolerated therapy.

102-11

PATIENT UTILITIES FOR TEST RESULTS AND THE RELATIONSHIP OF SYMPTOM BURDEN AND FUNCTIONAL STATUS IN EVALUATION OF SUSPECTED CORONARY ARTERY DISEASE: FACILITATING A SHARED DECISION-MAKING APPROACH

E. Rrapo Kaso*,[1] J. M. Bourque[2]; [1]University of Virginia Medical Center, Charlottesville, VA, [2]University of Virginia Health Systems, Crozet, VA

Introduction: A shared decision-making approach is preferred in test selection for evaluation of suspected coronary artery disease (CAD). A decision analysis framework may be useful to combine test accuracy and sensitivity with patient preferences to determine optimal test strategies. However, patient utilities in this area have not been reported. We sought to assess patient preferences for the possible test results and whether symptom severity and functional limitation impact these choices.

Methods: This prospective study included 93 consecutive patients who presented to the University of Virginia stress laboratory to undergo stress testing for chest pain evaluation. Participants rated clinical scenarios and visual aids describing the results and possible outcomes of true and false-positive and -negative ischemia assessment studies on a visual linear rating scale and utility scores were derived. Patients were separated into groups by preferred results and symptom burden (SAQ-7, Cardiac Anxiety Questionnaire) and functional status (SF-12) were compared between groups.

Results: The mean age of participants in this study was 60.8 years. There were 54% male. Co-morbidities included 69% with hypertension, 27% with diabetes, 55% with tobacco history (former or current use), and 25% with known CAD. True negative test results were preferred in 74.2% of patients (69/93); 25.8% (24/93) gave the highest utility to a true positive test result. There was no statistically significant difference in total score for SAQ-7, CAQ or SF12 between these two groups indicating no difference in angina frequency, quality of life, physical limitation, emotional health or cardiac anxiety. Both groups had mean frequency of angina monthly with mean scores between 56.25 to 69.75 for quality of life and physical limitation which are qualified good on a range of poor to excellent. By SF-12, the enrolled population has below-average health status with mean scores of 41.31 and 49.33 for the physical and mental component, respectively. Interestingly, 12 of the 69 patients favoring a true-negative result even preferred a false-positive result to a true-positive as it would mean they did not have CAD. The mean utility scores for true positive, true negative, false positive and false-negative test results were 0.76, 0.90, 0.28 and 0.13, respectively.

Conclusions: Patients have disparate utilities for the results of tests evaluating for suspected CAD with no impact of symptom burden and functional status. These findings favor a decision analysis framework to facilitate shared decision-making.

102-12

INATTENTIONAL BLINDNESS DURING INTERPRETATION OF IMAGING REPORTS

D. E. Winchester*, M. M. Kates, R. J. Beyth; University of Florida, Gainesville, FL

Background: Inattentional blindness (IAB) refers to the inability to detect a visible, but unexpected stimulus due to a person's attention being focused on another stimulus or task. This phenomenon is relevant to medical practice because it could contribute to dangerous medical errors. Prior literature on IAB in medicine has shown that clinicians are prone to this error when interpreting radiological images and when performing endotracheal intubation. IAB has not been previously assessed while reading written radiological reports.

Methods: We performed a blinded cross-sectional deception study to establish the prevalence of IAB while reading radiological reports. Recruitment of subjects occurred at grand rounds for each specialty recruited (emergency, family, and internal medicine) Physicians were provided four sample radiological reports including one myocardial perfusion scan and one computed tomography coronary angiogram. Subjects were asked to identify any abnormal findings and provide a management plan. Subjects were given 3 min per report (12 min total) to complete the task. All subjects received the same four reports. Within one of the reports, an invalid text prompt was inserted. The prompt had the same location in each report, however the specific text was randomly assigned between one of two prompts: a description of a normal eye exam or a quote from a popular science fiction television show. The primary outcome was the overall detection rate and a comparison of detection rates for each of the prompts. Secondary outcomes were comparisons made between residents/faculty and between medical specialties. Verbal informed consent was provided before participation and after the reveal of the deception. After the deception was revealed, subjects were free to anonymously participate or withdraw from the study at that time.

Results: Subjects consisted of 90 physicians (60 residents, 28 faculty, and 2 nonresponses). One half (n = 45) were from internal medicine and subspecialties; the remainder were from family medicine (n = 18), emergency medicine (n = 24), and other (n = 3). Median number of years in practice was 2 (1-5 interquartile range). Overall, only 43 (47.8%) subjects detected the invalid text in the report. When given the eye exam

invalid text, ten subjects detected it; when given the television show quote, 33 subjects detected it (21.7% versus 75.0%, P < 0.0001, Odds Ratio 10.8, 95% confidence interval 4.1-28.7). No differences were observed between specialties (p = 0.11) or stage of training (p = 0.13). **Conclusions:** When interpreting a radiological report, the majority of physicians failed to detect a deceptively inserted sentence of invalid text. Detection was more likely if the text was a more obvious, non-medical prompt.

102-13

[99M]TC-LABELED RBC ERNA AS AN ADJUNCT IMAGING BIOMARKER FOR MARROW HYPERPLASIA IN THALASSEMIA MAJOR PATIENTS -A PROSPECTIVE CASE CONTROL STUDY

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Introduction: The study aimed at evaluating the potential of 99mTc-labeled RBC-equilibrium radionuclide angiocardiography (ERNA) in assessing marrow hyperplasia in thalassemia major (TM) patients requiring repeated blood transfusions. The secondary objectives were to quantitate the marrow tracer uptake, correlate it with the hematological parameters and to compare the marrow uptake with that of non-thalassemic age-matched control population.

Methods: Based on our prior experience of increased tracer uptake in the marrow of inadequately transfused patients of TM, we prospectively evaluated marrow uptake in 125 consecutive patients of transfusion dependent TM, who underwent ERNA for LVEF estimation with an additional whole-body planar imaging for ∼ 10 min/patient, without any additional radiation exposure or cost to the patients. Twenty-five age-matched non-thalassemic patients undergoing ERNA for other indications along with whole-body planar imaging constituted the control population. The whole-body planar images were analyzed both qualitatively and quantitatively (ratio of marrow uptake to soft tissue calculated by drawing circular region of interests over the trochanter of femur and the adjoining soft tissue). Informed consent was taken from every patient and the study was duly approved by the Institute Ethics Committee.

Results: The study population consisted of 125 patients of transfusion dependent TM with mean age of 23.1 years (9-37; M/F = 75/31). All of them underwent ERNA study and additional whole-body planar imaging in the one-year study period. There was increase in the marrow uptake in TM patients both qualitatively as well as quantitatively with mean value of ratio of marrow to background was 2.0 ± 0.5 (range 1.1-3.9), whereas it was 1.2 ± 0.2 (range 0.8-1.32) in the control population with significant difference in mean values (p < 0.001). The mean value of hemoglobin in patients of TM (8.9 ± 1.4 gm/dl) at the time of ERNA had a moderate negative correlation ($r = -0.58$) with the marrow uptake indicating the trend of low hemoglobin (Hb) in patients with high marrow uptake. Similarly a moderate negative correlation was also seen between the uptake and the hematocrit values of TM patients ($r = -0.68$) and the red cell count ($r = -0.69$) suggesting that the marrow uptake correlated with degree of peripheral anemia. The mean Hb value of control group was 13.7 ± 1.9 gm/dl which was significantly higher than that of TM patients and there was no correlation in their marrow uptake with Hb values.

Conclusions: The study demonstrates potential of 99mTc RBC-ERNA study in monitoring the extent of marrow hyperplasia which might be a non-invasive indirect evidence for adequacy of blood transfusion and thus have the potential of being a low-cost adjunct imaging biomarker for marrow hyperplasia in addition to the routine LVEF assessment.

102-14

PROVIDER LEVEL INTERPRETATION HETEROGENEITY IMPACTS MYOCARDIAL PERFUSION IMAGING REPORTING

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Introduction: Myocardial perfusion imaging (MPI) for the evaluation of coronary artery disease (CAD) is widely used as the gate-keeper for invasive coronary angiography (ICA). Despite standardization of acquisition and reporting, interpretation of MPI may vary among readers, leading to potential variability in downstream testing as a consequence of interpretive heterogeneity despite decision support systems. The presence and magnitude of provider level reporting heterogeneity in MPI reporting is not well described.

Methods: We performed a retrospective review of the interpretations of exercise and regadenoson SPECT perfusion and regadenoson PET MPIs performed at Yale New Haven Hospital (YNHH) from January 2017 to present. Logistic regression was performed to determine between-provider differences for two specific variables entered by the reader: ''Overall'' and ''Perfusion'' interpretation (''normal'' vs. ''abnormal''), adjusted for age, sex, race, BMI, and pre-test likelihood of CAD.

Results: Of 6,926 MPIs, there were 2,056 exercise SPECTs, 2,361 regadenoson SPECTs, and 2,509 regadenoson PETs. For both regadenoson SPECT and PET studies, there were significant provider-to-provider differences in both ''Overall'' and ''Perfusion'' final impressions entered by one of 8 expert readers. For exercise stress SPECT studies, nuclear impression, but not perfusion impression, demonstrated significant provider-to-provider differences.

Conclusions: Our data show significant between-provider differences in MPI interpretation in a large academic medical center and warrant further study as to the impact on patient management considerations including ICA and revascularization

Table 1: Provider-to-Provider Differences by Logistic Regression per MPI modality for Perfusion and Nuclear Impressions

	Exercise Stress SPECT	Regadenoson SPECT	Regadenoson PET
Perfusion Impression	FALSE	TRUE	TRUE
Overall Impression	TRUE	TRUE	TRUE

* a provider-to-provider difference is marked 'TRUE' if p < 0.0065 by logistic regression, with adjustment for the clinical covariates described in the abstract

ePOSTER SESSION II: NEW SPECT TECHNOLOGIES

Friday, September 13, 2019 9:30 a.m.-10:30 a.m.

201-01

COMPARISON OF 3D AND 2D SPECT CONVOLUTIONAL NEURAL NETWORKS FOR PER-PATIENT DETECTION OF ABNORMAL PERFUSION: THE MULTICENTER INTERNATIONAL CREDENCE TRIAL

B. C. Lee*,[1] L. Baskaran,[1] A. R. van Rosendael,[1] G. Maliakal,[1] G. Singh,[1] M. Pandey,[1] Z. Xu,[1] W. Stuijfzand,[1] S. J. Al'Aref,[1] F. Y. Lin,[1] L. J. Shaw,[1] J. K. Min,[1] G. S. Thomas[2]; [1]Weill Cornell Medicine, New York, NY, [2]MemorialCare, Fountain Valley, CA

Background: SPECT is widely used and proven for perfusion abnormality detection. With large availability of SPECT images, deep learning-based convolutional neural networks (CNN) may aid the interpreting physician in detecting perfusion defects with little or no preprocessing of the images and segmentation of the LV myocardium. The aim of this study is to compare the diagnostic performance of 3D, 2D, and 1D image machine-learning (ML) models for per-patient perfusion abnormalities.

Methods: This study comprised 310 patients (65 ± 10yo, 73% male) from the CREDENCE trial who underwent rest/vasodilator stress Tc99 m SPECT imaging and had available sinograms. Stress images were resampled into (a) 3D volumes, (b) large 2D montage image, (c) small 2D rectangular-stretched polar map images, and (d) 1D 17-segment polar map values, as inputs into (a) 3D-modified ResNet34 CNN, (b,c) ResNet34 CNN, and (d) gradient boosting ML algorithms, respectively, for binary detection of global abnormal perfusion, defined by blinded expert core lab interpretation using summed stress scores (SSS) ≥ 4 as ground truth. All models were trained with an 80:20 train/test stratified shuffle split over ten iterations. Area under the receiver operating characteristics curve (AUC), sensitivity, specificity, and accuracy were compared.

Results: Abnormal stress perfusion was present in 44% of patients. Combined, accuracy and discriminatory power were numerically highest in the 2D rectangular-stretched polar map and 3D volume CNN models (AUC = 0.85, accuracy = 77% and AUC = 0.82, accuracy = 74%, respectively) (Figure). Sensitivity was lowest in the 1D 17-segment model (32%).

Conclusion: 3D and 2D ML models demonstrate good performance at detection of abnormal perfusion. Compared to 1D, their greater voxel number and retention of spatial relationships appear to provide superior sensitivity. More training data and model refinement are expected to further improve performance.

Graphical Example	Input Format and Model	AUC	Sensitivity	Specificity	Accuracy
	3D Volume CNN (a) (Stacked axial slices)	0.82 ± 0.05	67%	80%	74%
	2D Large Image CNN (b) (Flat montage of slices)	0.77 ± 0.06	66%	73%	70%
	2D Small Image CNN (c) (Rectangular-stretched polar map)	0.85 ± 0.05	70%	83%	77%
	1D Gradient Boosting (d) (Linear 17-segment polar map)	0.82 ± 0.04	32%	95%	67%

201-02

DEVELOPMENT AND VALIDATION OF A SPECT 3D CONVOLUTIONAL NEURAL NETWORK FOR DIAGNOSIS OF VASCULAR TERRITORY-SPECIFIC ISCHEMIA: THE MULTICENTER INTERNATIONAL CREDENCE TRIAL

B. C. Lee*,[1] L. Baskaran,[1] A. R. van Rosendael,[1] G. Maliakal,[1] G. Singh,[1] M. Pandey,[1] Z. Xu,[1] W. Stuijfzand,[1] S. J. Al'Aref,[1] F. Y. Lin,[1] L. J. Shaw,[1] J. K. Min,[1] G. S. Thomas[2]; [1]Weill Cornell Medicine, New York, NY, [2]MemorialCare, Fountain Valley, CA

Background: SPECT myocardial perfusion imaging provides better discrimination of ischemic heart disease on a per-patient than per-vascular territory basis. Deep learning-based convolutional neural networks (CNN) are a novel approach that may enable SPECT interpretation automation. The study aim was to evaluate the diagnostic performance of a CNN-based approach for vascular territory-specific ischemia.

Methods: This study comprised 310 patients (65 ± 10yo, 73% male) from the CREDENCE trial who underwent rest/vasodilator stress Tc99 m SPECT imaging, invasive coronary angiography and invasive fractional flow reserve (FFR) and had available sinograms. Stress and difference between rest/stress images with matrix size $24 \times 24 \times 24$ were inputted into 3D-modified ResNet34 CNN models for binary detection of vascular territory and patient-specific ischemia, as defined by FFR ≤ 0.80, invasive coronary angiography diameter stenosis $> 90\%$ or performance of coronary revascularization. The CNN model was trained with an 80:20 train/test stratified shuffle split over 10 iterations. Area under the receiver operating characteristics curve (AUC), sensitivity, specificity, and accuracy were compared to blinded expert core laboratory interpretation, with significant vascular territory and global ischemia defined as sum difference scores (SDS) ≥ 2.

Results: Prevalences of ischemia were 44, 18, 19, and 49% respectively in the 291 left anterior descending (LAD), 284 left circumflex (LCx), and 289 right coronary (RCA) arteries, and 251 per-patient with data available. The area under the curve for 3D CNN (< 0.1 s runtime) compared to expert core laboratory interpretation was similar for the LAD (AUC = 0.66, Figure) and LCx (AUC = 0.70) with higher discriminatory power for expert interpretation for the RCA and per-patient level.

Conclusion: Diagnosis of ischemia using SPECT 3D CNN deep learning is feasible and comparable to expert interpretation for the LAD and LCx.

Region	Model	AUC	Sensitivity	Specificity	Accuracy
LAD	SPECT 3D CNN	0.66 ± 0.10	50%	70%	61%
	SPECT SDS ≥ 2	0.67 ± 0.07	38%	90%	67%
LCx	SPECT 3D CNN	0.70 ± 0.06	41%	88%	80%
	SPECT SDS ≥ 2	0.70 ± 0.06	52%	86%	80%
RCA	SPECT 3D CNN	0.71 ± 0.03	41%	87%	79%
	SPECT SDS ≥ 2	0.75 ± 0.07*	59%	82%	78%
Per-Patient	SPECT 3D CNN	0.60 ± 0.08	58%	53%	55%
	SPECT SDS ≥ 2	0.74 ± 0.04*	67%	72%	70%

*p<0.05 compared to SPECT 3D CNN

201-03

QUANTITATIVE ASSESSMENT OF ATTENUATION COR-RECTED VS TWO VIEW SUPINE/PRONE ACQUISITIONS WITH STRESS SINGLE-PHOTON EMISSION COMPUTED TOMOGRAPHY MYOCARDIAL PERFUSION IMAGING: CORRELATION WITH EXPERT VISUAL INTERPRETA-TION

M. C. Hyun*,[1] S. W. Hayes,[1] E. Eisenberg,[2] B. K. Tamarappoo,[3] L. E. J. Thomson,[1] J. D. Friedman,[1] D. S. Berman[1]; [1]Cedars-Sinai Medical Center, Los Angeles, CA, [2]Cardiac Imaging, Cedars-Sinai Medical Center, Los Angeles, CA, [3]Imaging, Cedars Sinia Medical Center, Los Angeles, CA

Background: Both 2 view and attenuation correction (AC) are recommended for elimination of soft tissue attenuation artifacts and can be quantitatively analyzed. We sought to determine which of these approaches would be preferred by an expert reader using a single SPECT/CT system. (Siemens Symbia Intevo Bold SPECT/CT with IQ-SPECT).

Methods: We acquired supine and prone (S/P) as well as supine AC images in a prospective study of 144 patients who underwent stress-first MPI on the system used. All images were post-processed using vendor-specific CT-based iterative reconstruction techniques for resolution recovery, AC, and energy scatter correction. Cedars-Sinai MPI quantitative software (QPS) was used by an experienced technologist (MH) to generate a total perfusion deficit (TPD). A summed stress score, expressed as % of the LV (SSS%) using the 17-segment scoring system was performed by an expert reader (SH), who based the final visual interpretation on combined visual and quantitative findings. TPD results from AC and the S/P combination were compared to each other and to the visual SSS% used for clinical reporting. Agreement and correlation were evaluated with Bland–Altman analysis and intraclass correlation coefficient (ICC).

Results: Among 144 patients, (median 67 [IQR 59-74] years), 31 patients were interpreted as abnormal and 13 patients as borderline. Stress only was performed in 68% (n = 100) with normal interpretations. There was a strong correlation in TPD between the AC and S/P (r^2 = 0.78, Figure 1A). When compared with SSS%, the ICC was high and similar for AC and S/P (0.90 and 0.91, respectively); however, the correlation with SSS% was higher with AC (r^2 = 0.79, Figure 1B) than with S/P (r^2 = 0.76, Figure 1C), reflecting reader preference for the AC approach.

Conclusion: With the Siemens Symbia Intevo Bold SPECT/CT with IQ-SPECT, high correlation was observed between AC and S/P MPI methods; however, the AC method was preferred by the expert reader.
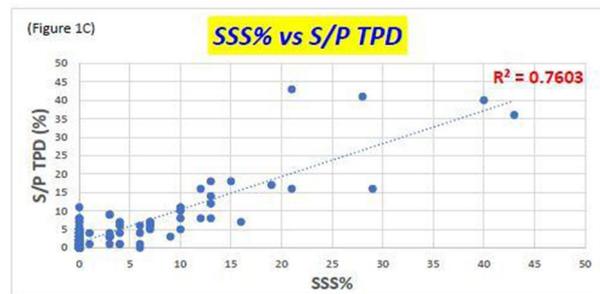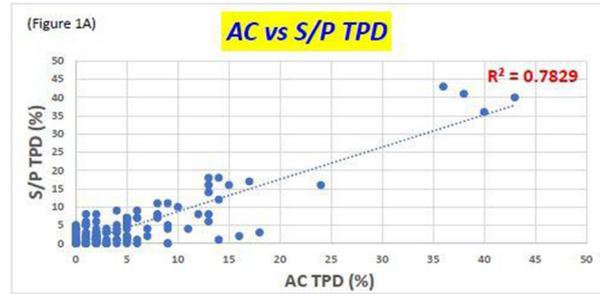
201-04

A NOVEL METHOD TO DETECT EXCESSIVE RADIO-TRACER AT INJECTION SITE DURING TC-99 M SPECT MYOCARDIAL PERFUSION IMAGING

A. Sharma*,[1] G. Pershwitz,[1] T. M. Morneau,[2] G. Heald,[1] D. Pelletier,[1] G. Tadeo,[1] F. Quevedo,[1] W. Duvall[3]; [1]Hartford Hospital, Hartford, CT, [2]Non-Invasive Cardiology, Hartford Hospital, Hartford, CT, [3]Nuclear Cardiology, Hartford Hospital, Hartford, CT

Background: Scintillation sensors have been used as quality control tools during FDG-PET studies to detect excessive radiotracer at the injection site (ERIS), however, such technology has not been used in cardiac SPECT MPI patients. The Lara® System, (Lucerno Dynamics) is a novel small, lightweight, topical scintillation sensor that dynamically detects the presence of radiotracer in a localized region following injection. We evaluated the use of this device to detect ERIS during the performance of SPECT MPI.

Methods: Consecutive patients undergoing Tc-99 m SPECT MPI over a 2-month period had sensors applied at the injection (test) and contralateral (control) site prior to rest and stress radiotracer injection. Automated analysis of sensor-derived data-generated time activity curves (TAC). The difference between the count rates acquired by the test and control sensor at the end of acquisition was used to identify suspicion of ERIS. Total counts in the myocardium at rest and stress were measured and normalized for imaging time and injected activity. When possible,

counts were also measured at the radiotracer injection site using a dedicated planar acquisition.

Results: A total of 78 patients were monitored using the Lara system with 58 having analyzable data and a total of 92 acquisitions (47 rest and 45 stress scans). The mean age was 63 years, 55.2% were male with 29 having rest planar and 27 having stress planar images of the injection site. 43 patients (74.1%) underwent vasodilator stress and 15 (25.9%) exercise stress. The potential ERIS rate based on TAC was 8.6% (5/47) for rest scans and 5.2% (3/45) for stress scans. There was statistically significant correlation between planar count rates at the injection site and the end count rate difference between sensors after the stress injection (r = 0.51, p = 0.01). There was no significant correlation after the rest injection (r = 0.06, p = 0.75). No statistically significant correlation could be found between the myocardial counts and the sensor-derived data. Patients suspected to have ERIS had a significantly greater count rate at the injection site than those who did not (2,327 vs 301 counts/sec, p < 0.0001) after the stress injection. Count rate difference was not significant for the rest injection.

Conclusion: The recognition of radiotracer infiltration during cardiac SPECT MPI studies is an important step to improving the quality of perfusion imaging and increasing the accuracy of clinical interpretation. Sensor-derived measurements acquired during SPECT imaging may prove to be a useful quality control measure to reduce infiltrations and potentially improve patient care.

201-05

HEAVY CORONARY CALCIUM BURDEN MEASURED BY MYOCARDIAL PERFUSION SPECT/CT PREDICTS ABNORMAL MYOCARDIAL PERFUSION

S. Cho*,[1] J. Kim,[1] S. Yoo,[1] S. Kang,[2] S. Kwon,[2] H. Song,[3] H. H. Bom[4]; [1]Chonnam National University Hospital, Gwang-ju, Korea, Republic of, [2]Chonnam National University Hwasun Hospital, Hwasun-gun, Jeollanam-do, Korea, Republic of, [3]Chonnam National University Hospital, Gwangju, Korea, Republic of, [4]Nuclear Medicine, CNUHH, Jeonnam, Korea, Republic of

Introduction: We assessed whether the coronary calcium scoring performed by low-dose attenuation correction CT (AC-CT) of myocardial perfusion SPECT/CT can provide useful information regarding myocardial perfusion.

Methods: We retrospectively included 225 patients with low-to-intermediate (≤ 90%) pretest probability, who underwent myocardial perfusion SPECT/CT equipped with low-dose attenuation correction CT (AC-CT) for evaluation of coronary artery disease. Patients with previous coronary artery disease, clinically suspected heart failure or left ventricular ejection fraction < 45% or wall motion abnormality on echocardiography, heart rate > 75/min, other valvular or myocardial diseases were excluded. Agatston calcium score (ACS) was calculated for each patient's resting AC-CT images. Total perfusion deficit (TPD) was calculated for stress and resting SPECT images, and ischemic TPD was also calculated (stress TPD - resting TPD). Abnormal SPECT was defined as stress TPD ≥ 5% or ischemic TPD ≥ 3%. Clinical implications of ACS by AC-CT were analyzed in terms of its correlation with TPD and its relationship with myocardial perfusion status against other coronary risk factors.

Results: Total ACS by AC-CT showed positive correlations with both stress TPD (r = 0.360, p < 0.001) and resting TPD (r = 0.369, p < 0.001), but not with ischemic TPD (r = 0.065, p = 0.335). SPECT was abnormal in 52 (23%) patients and total ACS by AC-CT was significantly higher in patients with abnormal SPECT, as compared to those with normal SPECT (319.3 ± 681.5 vs 121.2 ± 319.3, p = 0.049). Multivariate analysis revealed that total ACS ≥ 100 was the only clinical factor related to abnormal SPECT result.

Conclusions: Higher coronary calcium burden on SPECT/CT was indicative of abnormal myocardial perfusion, even after adjustment of other coronary risk factors.

Multivariate analysis for prediction of abnormal SPECT	Odds	95% CI	p
Total ACS ≥ 100	2.087	1.056-4.125	0.034
Pathologic Q on ECG	1.883	0.825-4.301	0.133
Pretest probability ≥ 64%	1.009	0.995-1.022	0.223
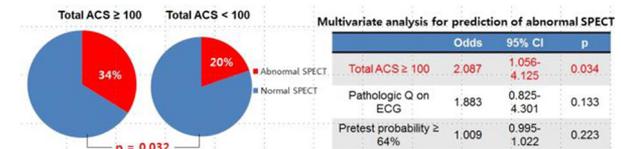
POSTER SESSION II: INNOVATIONS IN SPECT IMAGING

Friday, September 13, 2019 9:30 a.m.-10:30 a.m.

202-01

CORRELATION BETWEEN SPECKLE TRACKING ECHOCARDIOGRAPHY AND THALLIUM 201 SCINTIGRAPHY IN ASSESSMENT OF MYOCARDIAL VIABILTY

S. H. A. Azab*; Faculty of medicine, Alexandria, Egypt

Introduction: Coronary heart disease is now the leading cause of death worldwide, it is on the rise and has become a true pandemic that respects no borders. Speckle tracking echocardiography (STE)is a new non-invasive imaging technique that allows for an objective and quantitative evaluation of global and regional myocardial function.Myocardial perfusion imaging is one of the gold standard to evaluate myocardial viabilty.In this study, we assess the value of left ventricular longitudinal strain in assessment of myocardial viability using (STE) in comparison with rest-redistribution thallium 201 scintigraphy

Methods: All patients were subjected to full history taking (personal history, risk factors as, diabetes mellitus, hypertension, smoking, dyslipidemia and family history of coronary artery disease, ECG, Low-dose dobutamine stress echocardiography(LDDSE) with speckle tracking ECHO, rest - redistribution thallium scintigraphy.

Results: Comparing longitudinal strain by (STE) of viable and non-viable segments detected by Thallium 201 scan, a baseline significant difference between viable and non-viable segments of $-11.56 \pm 6.04\%$ vs. $-8.88 \pm 5.53\%$ ($p \leq 0.001$), which became more pronounced during low dose of dobutamine STE with a significant change of $4.67 \pm 4.33\%$ vs. $0.55 \pm 3.96\%$ ($p‰ \leq 0.001$) to become $-16.23 \leq 6.85\%$ vs. $-9.43 \pm 6.29\%$ ($p \leq 0.001$)corresponding to viable versus non-viable segments, respectively. Determination of viability by STE manifested a sensitivity of 65% and specificity of 70% during baseline study, during low-dose dobutamine study sensitivity increases to 75% while specificity remained the same at 70%. Change of longitidinal strain valued between baseline and low dobutamine studies manifested sensitivity of 81.1% and specificity of 80.5%.

Determination of viability by echocardiographic wall motion score index manifested a sensitivity of 72%, specificity of 66% during rest which increased to sensitivity of 78% and specificity of 74% during low-dose dobutamine study.

Conclusions: Myocardial perfusion imaging (MPI) remains the gold standard for detection of myocardial viability. Under certain circumstances where MPI is unavailable, STE can assess myocardial viability with higher sensitivity and specificity than conventional dobutamine ECHO when compared to thallium scintigraphy. Changes in longitudinal strain value is the most sensitive parameter to detect viable myocardium by low-dose dobutamine speckle tracking echocardiography. < !–[endif]–>

202-02

IS MYOCARDIAL PERFUSION IMAGING STILL USEFUL IN PRE-LIVER TRANSPLANT EVALUATION?

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Introduction: The optimal form of cardiovascular stress testing prior to liver transplantation remains controversial and the data to guide such evaluation is limited. This retrospective analysis attempts to summarize post-transplant outcomes in patients who underwent myocardial perfusion imaging (MPI).

Methods: All patients who underwent liver transplantation at one teaching hospital using a single Siemens C-cam between August 2013 and March 2018 were analyzed. This included a total of 262 cases. Results of the perfusion tests, need for angiography, and all-cause mortality were reviewed.

Results: A total of 325 patients underwent liver transplantation during that time period. Of those, 262 were included in the study and 192 underwent stress testing with an MPI. 157(60%) underwent Dobutamine MPI, 29(11%) underwent Regadenoson MPI, and 6(2.3%) had Exercise MPI's. 66(34%) had positive stress tests. The all-cause mortality was 2.4% in those that had negative stress tests and 6% in those with positive stress testing.

Conclusions: Although a cardiovascular evaluation prior to liver transplantation is recommended, the ideal type of testing is not clear. In this retrospective analysis of 262 post-liver transplant patients, over 73% of them had a nuclear stress test. The all-cause mortality was more than doubled in those with a positive MPI versus those with a negative MPI which emphasizes the importance of MPI testing in pre-liver transplant patients.

202-03

INTERMEDIATE-TERM OUTCOMES AND CHARACTERISTICS OF PATIENTS UNDERGOING INVASIVE CORONARY ANGIOGRAPHY FOLLOWING POSITIVE STRESS TESTING

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Background: Many patients with high pretest risk are referred for invasive coronary angiography (ICA) following stress testing demonstrating inducible ischemia. Despite positive stress imaging, a significant proportion of these patients are found to have normal or near-normal coronary arteries (NNCAs) or nonobstructive coronary artery disease (CAD). The outcomes of this population are not known. We aimed to compare clinical characteristics, and outcomes by presence of obstructive CAD in patients with positive stress imaging who underwent ICA.

Methods: We assessed a consecutive cohort of 300 patients who underwent ICA at the University of Virginia for positive stress testing (228 nuclear MPI, 57 echo, 7 ECG alone). The degree of stenosis was determined and the baseline characteristics were compared by T-testing and Chi square analysis between those with $< 50\%$ and $\geq 50\%$ stenosis. Cardiac death, nonfatal MI, and late revascularization were gathered prospectively and compared between stenosis groups by Kaplan–Meier survival analysis.

Results: Of the 300 patients referred following a positive stress test, 127 (42.3%) had NNCAs or nonobstructive CAD and 173 (57.7%) had obstructive CAD. Patients with NNCAs or nonobstructive CAD were younger (median age 60.5% versus 65.7%, p = 0.001) and were more often female 55.1% versus 38.7% (p = 0.005). They had lower but substantial rates of hypertension (66.9% versus 85.0%, p < 0.001) and dyslipidemia (57.5% versus 82.1%, p < 0.001). Those without obstructive CAD had high rates of diabetes (29.1%), current tobacco use (29.1%), and obesity (52.0%). They had high mean ASCVD risk (13.3%, 60.2% with ASCVD risk $\geq 7.5\%$) and 16.7% with $\geq 10\%$ LV ischemia. Kaplan–Meier analysis of cardiac events in this group at a median 2.7 years of follow-up showed a significant decrease in survival free from cardiac events for those with obstructive CAD compared with patients with NNCAs and nonobstructive CAD (p = 0.007). There was no difference between those with nonobstructive CAD or NNCA (p = 0.34).

Conclusions: This retrospective analysis with intermediate-term follow-up demonstrated that patients with positive stress testing found to have NNCA or nonobstructive CAD on ICA had very few cardiac events compared to those with obstructive CAD. This low rate was seen despite high baseline ASCVD risk and substantial LV ischemia and prevalence of CAD risk factors. It is possible that those with nonobstructive CAD would have a higher event rate over a longer-term follow-up horizon, and this analysis highlights the need for longer-term evaluation.

202-04

RISK STRATIFICATION IN PATIENTS UNDERGOING RENAL TRANSPLANT

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Introduction: Patients with end-stage renal disease have a high incidence of cardiovascular disease and are at an elevated risk of major adverse cardiovascular events (MACE) after renal transplantation. The best risk stratification strategy in preparation for renal transplant is unclear. Our aim was to determine 1) the practice of cardiac stress testing in patients having undergone renal transplant at Mayo Clinic and 2) the predictive value of non-invasive stress testing on predicting MACE.

Methods: A cohort of 250 sequential adult patients having undergone renal transplant at a single center, between 2/6/17 and 4/12/18, were analyzed retrospectively using chart review. In this initial analysis, stress tests were classified as either positive or negative for ischemia (binary classification). Metrics included comorbidities, serum troponin levels (before and 5 days after transplant), stress testing, and clinical outcomes. The primary outcome was the composite of MACE (percutaneous intervention, coronary artery bypass graft surgery, acute coronary syndromes, cardiovascular death).

Results: There were a total of 19 MACE observed in 250 patients during or after renal transplant (absolute risk of 7.6%, incidence of 5.0% per patient year). One hundred and thirteen patients (45.2%) were not risk stratified based on clinical variables and did not undergo non-invasive stress testing, with a 5.3% absolute risk of MACE. Cardiac stress testing within two years prior to transplant was performed in 137 patients (54.8%) using echocardiography (SE) in 113 (82.5%), electrocardiogram in 4 (2.9%), or nuclear positron emission tomography myocardial perfusion imaging (PET MPI)/single-photon emission computed tomography MPI (SPECT MPI) in 20 (14.6%). Stress-induced ischemia was associated with increased risk of a MACE compared to those without stress-induced ischemia (Odds Ratio [OR] 6.74; CI 2.03-22.37; p = 0.002). Patients with a positive (ischemic) SPECT or PET study had a 50% absolute risk of MACE (all planned revascularization) with no other cardiac events or MACE post-transplant. Conversely, patients with negative stress testing had a 3.6% absolute risk of MACE. Patients with diabetes (31.2% of the entire cohort) had an absolute risk of MACE of 15.4%. The absolute risk in diabetic patients who did not undergo stress testing was 25.0% compared to 3.0% in non-diabetics. Importantly, diabetic patients with negative stress testing were not at higher risk of MACE compared to those without diabetes and negative testing (OR 1.36; CI 0.26-7.03; p = 0.72).

Conclusions: These data describe current clinical practice in a tertiary medical center. Patients with diabetes should be considered high-risk and further risk stratified. Non-invasive stress testing appears to an adequate strategy to screen the diabetic population.

202-05

DO RENAL TRANSPLANTATION REVERT LEFT VENTRICULAR MECHANICAL DYSSYNCHRONY AND REMODELING? A PROOF OF PRINCIPLE STUDY BASED ON GATED SPECT MYOCARDIAL PERFUSION IMAGING

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Introduction: End-stage renal disease (ESRD) is associated with concentric left ventricular (LV) remodeling leading to hypertrophy, dilatation and a poor LV contractile function. Moreover the LV mechanical dyssynchrony (LVMD) associated with ESRD is a poor prognostic predictor. Although, renal transplant is known to improve the contractile functions of LV, the long-term effect on reversibility of

LVMD is still debatable and has not been proven in any studies based on SPECT myocardial perfusion imaging (MPI).

Methods: The study includes analysis of pre and post renal transplant LVMD parameters (Phase Band Width: PBW, Phase Standard Deviation: PSD and entropy), contractile parameters [End-Diastolic & End-Systolic volumes (EDV & ESV), LV ejection fraction (LVEF)] and remodeling indices [LV mass (grams), Sphericity Index: SI (ratio of LV long-axis diameter to LV vertical diameter on the end-diastolic vertical long-axis frame), Eccentricity Index, EI ranging from 0 (sphere) to 1 (line)] in initial ten consecutive patients (M/F = 9:1) of an ongoing Institutes Ethics Committee approved study, on gated SPECT MPI. None of these patients had myocardial ischemia in MPI. The median interval between the transplant and the second MPI was 26 months (range: 12-38). All the patients were non-dependent on dialysis having urea (mean 35 mg/dl; range) and creatinine (mean 1.1 mg/dl; range) within normal range at the time of second MPI.

Results: There was significant reduction in EDV (106.8 ± 32.1 ml in pre- vs 57.7 ± 13.6 ml in post-transplant, with mean difference of 49.1 ml; p = 0.0007) and ESV (56.4 ± 30.0 vs 16.2 ± 9.8; p = 0.001) along with significant improvement in LVEF (52.3 ± 14.4% vs 73.5 ± 12.1%, mean improvement of 21.2 ± 5.5% with p = 0.004) suggesting overall improvement in the contractile function in the post-transplant. There was significant improvement in LVMD in post-transplant MPI suggested by a decrease in the mean PBW by a factor of 29.5 ± 13.6° (57.9 ± 45.0 ° vs 28.4 ± 12 °) with a p value of 0.05 and a significant decrease in PSD (11.4 ± 4.5° vs 7.2 ± 3.2° with mean reduction of 4.2 ± 1.6 °, p = 0.03). The entropy also decreased from 57 ± 9.3 in pre-transplant to 47.1 ± 10.7 in the post-transplant (p = 0.02). Additionally the LV mass (gm) reduced significantly (p = 0.001) in the post-transplant from 166.1 ± 32.5 vs 116.4 ± 15.8 with mean reduction of 49.5 gm suggesting reversal of LV hypertrophy. We also noted improvement in the LV dilatation/remodeling parameters suggested by increase in the sphericity index (1.5 ± 0.2 vs 1.7 ± 0.3; p = 0.02) and eccentricity index (0.79 ± 0.1 vs 0.82 ± 0.1, p = 0.04).

Conclusions: The initial results of this ongoing study reveal for the first time that renal transplantation improves LVMD and LV remodeling along with contractile function, on basis of SPECT MPI. Though limited by patient number, the results are to be revalidated with a larger patient group.

202-06

LEFT VENTRICULAR SYSTOLIC AND DIASTOLIC DYSSYNCHRONY TO PREDICT CARDIAC RESYNCHRONIZATION THERAPY RESPONSE IN HEART FAILURE PATIENTS WITH DILATED CARDIOMYOPATHY

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Background: Left ventricular systolic dyssynchrony (LVSD) is an independent predictor of cardiac resynchronization therapy (CRT) response in the heart failure patients with dilated cardiomyopathy (DCM). However, there are a limited number of studies about the predictive value of LV diastolic dyssynchrony (LVDD) for CRT. This study aims to explore the predictive values of both LVSD and LVDD for CRT in DCM patients.

Methods: Consecutive eight-four CRT patients with both DCM and CLBBB who received gated rest SPECT MPI were included in the present study. The phase analysis technique was applied on resting gated short-axis SPECT MPI images to measure LVSD and LVDD, characterized by phase standard deviation (PSD) and phase histogram bandwidth (PBW). CRT response was defined as ≥ 5% improvement of

LVEF at 6-month follow-up. Variables with $p < 0.10$ in the univariate analysis were included in the multivariate cox analysis.

Results: During the follow-up period, 59.5% (50 of 84) patients were CRT responders. The univariate cox regression analysis showed that QRS duration, none-sustained ventricular tachycardia (NS-VT), systolic PSD, systolic PBW, diastolic PSD, and diastolic PBW were statistically significantly associated with CRT response. The multivariate cox regression analysis showed that QRS duration, NS-VT, systolic PSD, systolic PBW, diastolic PSD, and diastolic PBW were independent predictive factors for CRT response. Furthermore, the rate of CRT response was 94.4% (17of18) in patients whose LV lead was in the segments with both the first three late contraction and the first three late relaxation; by contrast, the rate of CRT response was only 6.7% (1 of 15, $p < 0.000$) in patients whose LV lead was in the segments with neither the first three late contraction nor the first three late relaxation.

Conclusions: Both LVSD and LVDD from gated SPECT MPI have important predictive values for CRT response in DCM patients. Pacing at LV segments with both late contraction and late relaxation has potential to increase the CRT response.

202-07

ELEVATED RIGHT VENTRICULAR UPTAKE RATIOS ON REGADENOSON NUCLEAR STRESS TESTING AS A PREDICTOR OF OBSTRUCTIVE CORONARY ARTERY DISEASE

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Introduction: Prior studies have demonstrated that increased right ventricular (RV) radiotracer uptake during exercise stress myocardial perfusion imaging (MPI) is an independent predictor of severe obstructive coronary artery disease (CAD). However, the significance of this finding in vasodilator studies is unknown. We aimed to evaluate the clinical significance of increased RV radiotracer uptake in regadenoson pharmacologic nuclear stress testing.

Methods: In this single-center retrospective cohort study, we reviewed patients with regadenoson pharmacologic nuclear stress testing from August 2017 to September 2018. Patients with qualitatively increased RV radiotracer uptake during stress imaging were verified by obtaining maximum counts per pixel in a region of interest in the RV and LV at rest and during stress. RV-to-LV uptake ratio was calculated as the ratio of stress RV-to-LV counts divided by rest RV-to-LV counts. Summed difference scores and cardiac catheterization data were reviewed.

Results: We identified 46 patients with an RV-to-LV uptake ratio greater than or equal to 1.2 and 46 controls. In the RV uptake group, 22/46 (47.8%) had significant CAD. Three (6.5%) had LM disease and 10 (21.7%) had triple-vessel disease. ROC analysis revealed increasing the established exercise stress RV-to-LV uptake ratio of 1.2 to 1.4 yielded 68.8% sensitivity and 71.2% specificity for predicting significant CAD.

Conclusions: An elevated RV-to-LV uptake ratio greater than or equal to 1.4 during regadenoson MPI is an independent predictor of underlying severe CAD.

YOUNG INVESTIGATOR COMPETITION - BASIC SCIENCE
Friday, September 13, 2019 12:15 p.m.-1:45 p.m.

210-01

FEASIBILITY OF DEEP LEARNING TO ENHANCE THE DETECTION ACCURACY OF MYOCARDIAL PERFUSION ABNORMALITY USING STRESS-ONLY IMAGING PROTOCOL

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Introduction: In myocardial perfusion imaging (MPI), stress-only protocol has the advantage of higher efficiency, lower cost and less radiation exposure over stress/rest protocol. However, the identification of normal or abnormal myocardial perfusion using stress-only protocol, which usually requires high image quality and experienced reader, remains challenging in clinical practice. In this study, a deep convolutional neural network is proposed to identify abnormal vs. normal MPI using stress-only PET and SPECT studies. Several additional features from the studies were also investigated in this study to improve the diagnostic sensitivity and specificity.

Methods: A unique neural network architecture was constructed using the ResNet34 framework for extracting features from stress-only SPECT or PET images (main input), followed by three fully connected layers that can include additional features (secondary input). The prediction (output) from the network was the probability of the abnormal MPI, which was used for automatically classifying patients into normal or abnormal MPI via thresholding. A total of 9522 anonymous patient studies (72% normal, 28% abnormal) were included in this study. The standard 17-segmental myocardial bull-eye map was used as the main input for each of the studies, and patient demography (PD) and clinical regional stress scores (SS) were used as additional features for the secondary input, while the diagnosis from experienced clinical readers was used as the label. We used 80% of the patient studies to train the networks and used the rest 20% of patient studies to test the performance of the trained networks using the label as ground truth. Three networks were trained using the same main input as well as 3 incremental secondary inputs: (1) bull-eye map only, (2) bull-eye map + PD, and (3) bull-eye map + PD + SS. The area under curve (AUC) of the specificity–sensitivity plot was calculated for comparisons of the network performance.

Results: The proposed neural networks worked reasonably well with the stress-only protocol for the prediction of normal and abnormal MPI studies. The AUC for the three different networks (trained with bull-eye map only, bull-eye map + PD, bull-eye map + PD + SS) were 0.778, 0.798, 0.854, respectively, and the sensitivity was 76.2, 69.6, and 86.1% while the specificity was 67.4, 73.9, and 71.1%, respectively, based on the label and Youden index. Our results also showed the demographic features could help improve the diagnostic accuracy, and the results were further improved when the regional stress scores were included in the neural network analyses.

Conclusions: The proposed neural network may have a great potential of automatically identifying myocardial perfusion abnormalities using the stress-only protocol and the diagnostic accuracy can be further improved with additional features such as the stress scores included in the studies.

210-02

RESIDUAL SUBTRACTION FOR A RAPID ^{13}N-AMMONIA DYNAMIC ACQUISITION PROTOCOL

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Introduction: Accurate quantification of myocardial blood flow (MBF) and myocardial flow reserve (MFR) is useful for risk stratification of known and suspected coronary artery disease patients. Because ^{13}N-ammonia has a longer half-life (598 s), the FDA package insert suggests a 40-min interval between rest and stress injections, which impairs clinical throughput. In this study, we investigate the use of residual subtraction for a rapid ^{13}N-ammonia rest-stress acquisition protocol.

Methods: 63 patients underwent a ^{13}N-ammonia rest-stress protocol, with injections of approximately 9 and 18 mCi at rest and stress, respectively. The dynamic stress dataset included 3 20-s frames prior to the injection to calculate residual myocardial activity. The intent was to perform injections with a 15-min delay although this did not always occur due to patient and technical factors. Residual subtraction was achieved by calculating the mean pre-injection activity in each sampled region and subtracting it from that region's time activity curve. Comparison was made between stress MBF calculated with and without decay correction using regression with an interaction term for time between rest and stress scans.

Results: Delays between rest and stress injections ranged from 13 to 40 min (MED = 17, IQR = 16-31, Fig. 1a), with a clearly bimodal distribution. Fig. 1b and 1c display the correlation between residual-subtracted and non-corrected MBF for patients with delay < 20 min and > 25 min, respectively. With longer delays, and doubling the stress dose, residual subtraction did not meaningfully change the estimated MBF. However, for shorter injection delays, the residual-subtracted MBF was lower than without residual subtraction by $12 \pm 2\%$ ($p = 10^{-5}$). Effect on MFR was similar to that for MBF.

Conclusions: Residual subtraction is necessary for accurate quantification of stress MBF in rapid ^{13}N-ammonia rest-stress protocols with delays between rest and stress injection under 2 half-lives.
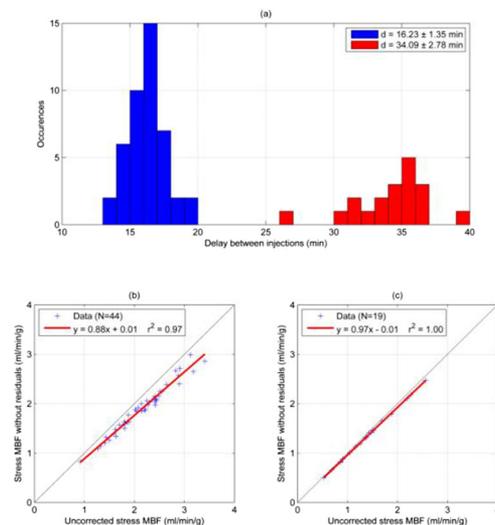
Fig. 1. Histogram of the delays between injections (a) and correlation between stress MBF with and without residuals for short (b) and long (c) delays.

210-03

ACCURACY OF ARTERIAL [18F]-FLUORODEOXYGLUCOSE UPTAKE QUANTIFICATION; A KINETIC MODELING STUDY

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Background: Despite a paucity of validation studies, $[^{18}F]$-fluorodeoxyglucose (FDG) PET is increasingly used as a standard tool for assessment of vessel wall inflammation in clinical studies. Analysis of arterial wall FDG signal is often based on standardized uptake value (SUV) or target to background (blood) ratio (TBR). However, these methods have not been validated against the net uptake rate (K_i), which is considered the gold standard estimate of FDG uptake. The objective of this study was to evaluate the accuracy of SUV and TBR for FDG signal quantification in the arterial wall in comparison with the net uptake rate of FDG using dynamic imaging and kinetic modeling.

Methods: The dataset from 13 subjects without prior history of cardiovascular disease, enrolled in a study of vascular inflammation was used in this analysis. The subjects were administrated 344 ± 30 MBq of FDG and a 2-h dynamic PET acquisition was performed on a Biograph mCT PET/CT scanner using a continuous-bed-motion protocol. PET images were reconstructed using ordered-subset expectation–maximization algorithm with corrections for attenuation and scatter. Serial arterial blood samples were collected throughout image acquisition. K_i images were generated with kinetic modeling using ex vivo measurement of plasma activity as the arterial input function and Patlak analysis with t* of 20 min. The mean K_i value of FDG in the ascending aortic wall was quantified on K_i images using a population-based thresholding method to define the volume of interest. FDG signal in the ascending aortic wall was quantified on PET images reconstructed from the final 30 min of image acquisition following recent guidelines for vascular imaging, and expressed as mean SUV_{max} or TBR. The mean K_i values were compared to mean SUV_{max} and TBR measurements.

Results: The mean K_i value in the ascending aortic wall was 4.57 ± 0.39 μl/min/cm^3 and the mean SUV_{max} and TBR values measured on images from the last 30 min of image acquisition were 3.42 ± 0.37 and 2.34 ± 0.29, respectively. The mean K_i in the ascending aortic wall correlated well with TBR (r = 0.82, $P < 0.001$) but not with mean SUV_{max} (r = 0.10, P = NS). There was a strong correlation between ex vivo measured blood activity and image-derived blood activity measured in superior vena cava on delayed PET images (r = 0.81, $P < 0.001$).

Conclusion: TBR is superior to mean SUV_{max} as surrogate measure of net FDG uptake rate (K_i) in aortic wall. These findings suggest TBR should be used as the preferred simplified quantification method in aortic FDG PET image analysis.

210-04

NOVEL MACROPHAGE ELASTASE-TARGETED TRACERS FOR IMAGING VASCULAR REMODELING IN ABDOMINAL AORTIC ANEURYSM

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Introduction: Abdominal aortic aneurysm (AAA) is responsible for $\sim$ 10,000 yearly deaths in the United States, mainly due to rupture. There is a pressing need for better evaluation of AAA rupture risk. Several MMPs are upregulated in aneurysm and contribute to aneurysm progression and rupture. Macrophage elastase, aka matrix metalloproteinase (MMP)-12, is the most altered MMP gene in human AAA and plays a key role in AAA development. Accordingly, MMP-12-targeted imaging may predict AAA rupture risk. Here we report the design, development and early evaluation of 2 novel MMP-12-selective tracers (AGA1 & AGA2) for SPECT imaging of aortic aneurysms.

Methods: Starting from 4-Methylpentanoic acid, precursors AGA1 & AGA2 with HYNIC conjugation were synthetized. Nuclear magnetic resonance (NMR) and Liquid chromatography mass spectrometry

(LCMS) were used for structural characterization, and purity analysis. MMP binding affinity and selectivity were determined by zymography. $^{99m}TcO_4^-$ radiolabeling conditions were optimized following previously described methods. Radio-HPLC and thin-layer chromatographic methods were used to assess radiolabeling efficiency. Ex vivo binding of AGA1 to AAA was evaluated by incubating the tracer with tissue sections of normal human aorta & human AAA. Biodistribution and blood kinetics of tracers were evaluated in mice (n = 3 for each tracer) by gamma well counting. Angiotensin II (Ang II) was infused for 4 weeks in male apolipoprotein (apo) $E^{-/-}$ mice to induce AAA. The surviving animals (n = 9) were injected with AGA1 (47 ± 32 MBq) and tracer uptake in AAA was evaluated by quantitative autoradiography at 2 h post-injection (p.i.). The development of vessel wall inflammation and changes in MMP-12 expression in AAA were investigated by immunostaining.

Results: NMR and LCMS characterization confirmed the structure and purity of tracers. Zymography results demonstrated selective, high affinity binding for MMP-12 (Ki: 8.5 and 8.8 nM) with at least 9.6 and 16.5-fold selectivity compared to other MMPs for AGA1 and AGA2, respectively. Ex vivo incubation showed 1.9-fold higher AGA1 binding to human AAA compared to normal aortic tissue. Both AGA1 and AGA2 displayed fast blood clearance, with respectively $3.0 \pm 0.2\%$ injected dose (ID)/mL and $1.2 \pm 0.2\%$ ID/mL residual blood activity at 2 h p.i.. MMP-12 upregulation and enhanced inflammation were confirmed by immunostaining in AAA from Ang II-infused apoE$^{-/-}$ mice. Autoradiographic analysis showed significantly higher uptake of AGA1 in AAA compared to non-remodeled aorta ($0.10 \pm 0.05\%ID/cm^2$ vs. $0.05 \pm 0.01\%ID/cm^2$, p = 0.03).

Conclusions: Two new hydroxamate tracers, AGA1 and AGA2, display high affinity and selectivity for MMP-12. AGA1 shows higher uptake in AAA compared to control aorta. Given the key role of MMP-12 in AAA development and rupture, clinical translation of these imaging agents may improve AAA risk stratification.

210-05

DEVELOPMENT AND VALIDATION OF SEMI-AUTOMATIC CT CORONARY ARTERY CALCIFICATION SCORING ALGORITHMS INTEGRATED FOR NUCLEAR CARDIOLOGISTS' DURING MPI INTERPRETATIONS

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Background: The presence and magnitude of coronary calcium has been established as a marker of increased likelihood of CAD. Moreover, cardiac hybrid PET/CT and SPECT/CT as well standalone CT continue to be increasingly used clinically. Thus, we have developed a semi-automatic CACS tools integrated into the standard Emory Cardiac Nuclear Toolbox V4.0 to promote and facilitate the clinical use of these important markers by nuclear cardiologists during MPI interpretations. Here, we describe our semi-automatic algorithms to measure Agatston scores and plaque volumes and validate them against commercially available tools.

Methods: Here, we validate Emory-CACS module against the FDA-approved Siemens SyngoVia^{TM} (Siemens Healthcare, Forchheim, Germany) toolbox. The test data comprised a group of 52 patients (age: 63.2 ± 9; 33 males; 19 females) with 110 vessels with calcified plaques that had been previously scored by Emory radiologists; the same lesions were selected by the radiologist were analyzed in the Emory-CACS module.

Results: The plaque volumes and Agatston scores were recorded for each patient and each coronary artery. SyngoVia[TM] reported per patient plaque volume ranges and Agatston scores of 0.2-1009.6 mm^3 and 0.4-1348.2 respectively. Regression analysis was performed between the SyngoVia[TM] and the Emory-CACS module. On a per patient basis, linear plaque volume regression (m = 1.10; b = 0.46) produced an r^2 = 0.99 and Agatston score regression (m = 1.01; b = 1.06) produced an r^2 > 0.99. Figure 1 demonstrates the differences between the same lesion in SyngoVia[TM] and the Emory-CACS module as well as the Agatston score regression analysis of all the calcified vessels.

Conclusions: Our newly developed and integrated semi-automatic tools to measure coronary calcification using Agatston Scores and plaque volumes exhibited excellent correlations with commercially accepted methods.
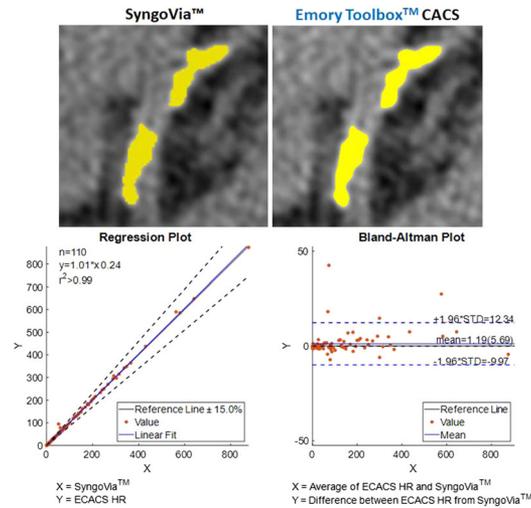
Figure 1. The top row represents a selected calcified artery in SyngoVia[TM] and Emory-CACS. The bottom row represents the regression and Bland-Altman plots of the Agatston scores from all of the calcified vessels.

ePOSTER SESSION III: INFLAMMATION AND INFILTRATIVE IMAGING

Friday, September 13, 2019 3:30 p.m.-4:30 p.m.

221-01

THE USE OF SPECT QUANTIFICATION OF 99MTC-PYP UPTAKE IN EVALUATION OF CARDIAC AMYLOID

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Background: Cardiac amyloidosis imaging with technetium-phosphate derivatives have come to the forefront in non-invasive diagnosis of ATTR amyloid now that effective therapies for the condition are emerging. Current diagnostic techniques involve a semi-quantitative visual score and a planar uptake ratio of > 1.5 with excellent sensitivity and specificity for identifying ATTR. Occasionally, sternal and rib uptake can confound the assessment of these parameters leading to equivocal studies. It is possible that SPECT image acquisition would allow for accurate diagnosis in these cases when planar data analysis is non-diagnostic.

Purpose: The purpose of this study is to investigate the utility of using SPECT volume assessment of 99mTc-PYP uptake to calculate the heart to contralateral lung ratio.

Methods: We retrospectively reviewed patients who underwent 99mTc-PYP planar cardiac imaging along with SPECT acquisition for the evaluation of cardiac amyloidosis. Standard evaluation using semi-quantitative visual score (Grade 0 to 3) and quantitative analysis using heart to contralateral lung ratio (H/CL) in planar imaging was used. Each study was then analyzed using total volume assessment of the SPECT data to calculate a heart to contralateral lung ratio. The patient charts were reviewed for demographics and the final clinical diagnosis.

Results: A total of 32 patients (Average age 73.3 ± 14.9 years and 78.1% male) were reviewed. Fourteen (43.8%) studies were consistent with amyloid based on visual and quantitative planar/SPECT imaging, one (3.1%) was equivocal, with 11 (34.4%) being positive based on the planar ratio alone. The retrospectively measured SPECT ratio was > 1.5 in 15 patients (46.9%). Overall, the correlation between the ratios was good with an r of 0.86 (p < 0.0001). The difference between SPECT and planar ratio for the visual grade 0 patients was 0.02 ± 0.33 for all other patients with visual grade 1 to 3 the difference was 0.40 ± 0.42. Using a H/CL ratio cutoff of 1.5 alone, four patients (12.5%) would have changed to a positive diagnosis with SPECT imaging. This included one study that was interpreted as equivocal due to rib and sternal activity based on the planar data and three patients with planar ratios between 1.39 and 1.44 which all had positive SPECT ratios.

Conclusions: To our knowledge SPECT quantification of 99mTc-PYP uptake for the evaluation of cardiac amyloid has not been studied. In select cases with equivocal planar imaging findings; which would include borderline H/CL ratios, significant bony uptake, or blood pool contamination the use of SPECT volumetric H/CL ratio improved our diagnostic certainty in this small test population.

221-02

TREATMENT OF SPECIFIC MICROVASCULAR ISCHEMIA IN PATIENTS WITH CHAGAS DISEASE CARDIOMYOPATHY IMPROVES SYMPTOMS AND MYOCARDIAL PERFUSION

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Introduction: Among a broad spectrum of etiologies for microvascular angina chronic Chagas disease cardiomyopathy (CCDC) has a prominent place in endemic countries. In patients chronically infected with T. cruzi chest pain is a common symptom usually accompanied by objective evidence of myocardial ischemia. We aimed to evaluate the impact of verapamil and acetyl-salicylic acid (ASA) on the quality of life and myocardial perfusion scintigraphy in CCDC patients referred to our Institution for invasive coronary angiography.

Methods: CCDC was confirmed by 2 serologic tests in 26 consecutive patients whose main complaint was chest pain warranting cardiac catheterization but had no obstructive epicardial coronary artery disease. Left ventricular (LV) systolic and diastolic function was evaluated during the hemodynamic, contrast ventriculography and echocardiography studies. SPECT myocardial perfusion scintigraphy (MPS) was performed at rest and stress before and after 3 months of treatment with verapamil and ASA. Questionnaires to evaluate quality of life (EQ-5D) and chest pain symptoms (Seattle Angina Questionnaire) were also applied before and after treatment. Comparison of pre and post scores and SPECT perfusion results were performed using Wilcoxon signed rank test for paired data.

Results: Mean age was 64 ± 10 years, 15 (57,7%) men. LV end-diastolic pressure was increased in 46% (17 ± 7 mmHg), LV end-diastolic dimension was enlarged in 32% (49 ± 6 mm), LVEF was decreased in 16% (59 ± 9%), LV mass was increased in 32% (89 ± 25 g/m^2), LV wall motion score index was abnormal in 68% of patients (1.2 [1-1.3]). In comparison to baseline, MPS showed that SDS was significantly reduced after the 3-month treatment by 55,6% from 4.5 [4-9] to 2 [0-4.25], p < 0.001). Decrease in SDS was observed in 20 (77%) patients. In the evaluation of quality of life and symptoms, enhancement in EQ-5D values (index value: 0.63 ± 0.11 vs 0.77 ± 0.17, p < 0.001) and in all dimensions of QAS post treatment were also significant (improvement > 10 points each, p < 0.001).

Conclusions: Microvascular angina associated to CCDC is characterized by abnormal LV diastolic function and increased LV mass, with preserved LV global systolic function and mild regional wall motion abnormalities. The typical occurrence of ischemic perfusion defects in these patients responds well to a prolonged regiment of a microvascular dilator (verapamil) in combination with an antiplatelet agent (ASA).

221-03

IMAGING CHARACTERISTICS AND ARRHYTHMIC OUT-COMES IN PATIENTS WITH CLINICALLY SUSPECTED CARDIAC SARCOIDOSIS UNDERGOING CARDIAC PET AND CARDIAC MRI

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Introduction: Cardiac sarcoidosis (CS) is an important and increasingly recognized disorder strongly associated with malignant cardiac arrhythmias. Multimodality imaging using both cardiac PET and MRI is key for diagnosis, assessment of activity, and prognosis in patients with CS. We sought to characterize imaging features associated with adverse arrhythmic outcomes in a subset of patients with high probability for CS in a single-center, clinical cardiology practice.

Methods: We retrospectively reviewed medical records and imaging findings of consecutive patients at our institution from 2016 to 2018 who underwent both cardiac MRI with late gadolinium imaging and cardiac Rb-82/FDG PET as part of evaluation for suspected CS. MRI was performed under a standard protocol, and was used to estimate LVEF and calculate scar burden. Patients were instructed to follow a high-fat, low-carbohydrate diet for four meals and drink a high-fat shake prior to PET scanning. PET studies were reviewed using a 17 segment bulls-eye display. A summed rest score (SRS) was derived from Rb-82 segments graded from 0-4, with 0 representing no defect and 4 severe. A summed FDG score (SFS) was derived from segments graded 0-4, with 0 representing no myocardial FDG uptake and 4 max uptake. Only segments

with perfusion/metabolic mismatch were analyzed. Mean standardized uptake values (SUV) were measured in three planes and averaged.

Results: 33 patients with suspected CS underwent both cardiac MRI and PET imaging. Of these, four patients (12%) had non-specific PET findings due to inadequate suppression of physiologic myocardial glucose uptake. 20 pts. (61%) had MRI findings probable for CS, but with no evidence of cardiac FDG uptake by PET, suggesting chronic myocarditis of unknown etiology. The remaining 9 pts. (27%) had MRI and PET findings both probable for CS, with eight having biopsy evidence of extracardiac sarcoidosis and one patient having a non-diagnostic biopsy but very strong clinical features of CS. These patients were considered to have high probability of CS, and all but one were treated with immunosuppressants. At mean follow-up of 14 months, 2/9 pts. had VF or VT requiring defibrillation. Both of these patients had six mismatched segments, with an average SRS 9, SFS 13, SUV 6.5, scar burden 27%, and LVEF 32%. The remaining 7 pts. without malignant arrhythmias had 2.43 ± 0.79 mismatched segments, with SRS 4.7 ± 2.14, SFS 5.86 ± 2.27, SUV 3.63 ± 2.38, scar burden $4.86 \pm 2.9\%$ and LVEF $53.4 \pm 11.7\%$. There were no patient deaths in any of the groups.

Conclusions: Multimodality imaging with cardiac PET and MRI provides important diagnostic and prognostic information in patients with suspected CS in a clinical cardiology practice. Simple semi-quantitative and quantitative measurements may identify CS patients at higher risk of malignant ventricular arrhythmias. Larger sample sizes and longer follow-up are needed to further validate these observations.

Interobserver (Top) and intraobserver (Bottom) Variability in Measurement of ^{99m}Tc-PYP HCL Ratio

221-04

REPRODUCIBILITY AND REPEATABILITY OF ^{99M}TC-PYROPHOSPHATE SCAN INTERPRETATION FOR DIAGNOSIS OF TRANSTHYRETIN CARDIAC AMYLOIDOSIS

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Background: ^{99m}Tc-Pyrophosphate (PYP) imaging is currently the most specific non-invasive imaging technique used to diagnosis of transthyretin cardiac amyloidosis (ATTR). Goal of this study was to determine inter- and intraobserver variability of ^{99m}Tc-PYP imaging interpretation.

Methods: Study cohort comprised 100 consecutive subjects referred for ^{99m}Tc-PYP imaging based on clinical suspicion of ATTR. 57% had biopsy proven ATTR (9-mutant and 48-wild type). Cardiac SPECT and planar images were acquired 1 - 3 h after injection of 22.7 ± 2 mCi ^{99m}Tc-PYP. Myocardial ^{99m}Tc-PYP uptake was assessed by both quantitative (heart to contralateral lung, HCL, ratio of uptake) and semi-quantitative (visual comparison of myocardial to rib uptake) methods currently used in clinical practice. Images with visual scores of ≥ 2 on planar imaging were classified as ATTR positive when myocardial uptake was also documented on SPECT. Scans were analyzed twice, at least 24 h apart, by two independent observers. Inter- and intraobserver variability were evaluated using Pearson's correlation coefficient (r) and percent differences between measurements. Bland–Altman plots and scatter plots with fitted linear regression curves were created for interobserver and intraobserver measurements.

Results: The study cohort was 75 ± 9 years of age, 84% males, 65% with New York Heart Association Class ≥ 2 symptoms (median NT-proBNP levels 3364 pg/mL). Diagnosis of ATTR by visual ^{99m}Tc-PYP grade was highly reproducible [concordance: positive scans 98.1% (52/53), negative scans 97.9% (46/47)] with excellent interobserver agreement (Cohen's kappa = 0.96, p < 0.0001). As shown in **Figure**, inter- and intraobserver correlations for HCL ratio were excellent ($r^2 = 0.90$ and 0.99, respectively); reproducibility and repeatability values on Bland - Altman plots were excellent, with coefficients of reproducibility/repeatibility 2.00% and 0.014%.

Conclusions: This study showed excellent inter- and intraobserver reproducibility/repeatability of ^{99m}Tc-PYP scan interpretation for diagnosis of ATTR.
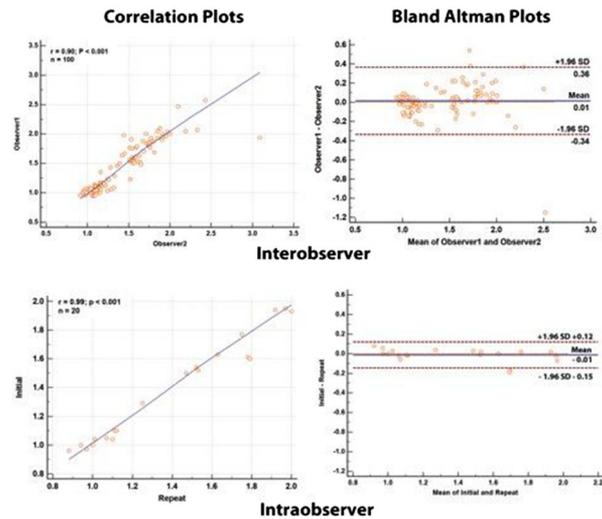
221-05

PROGNOSTIC VALUE OF TC-99M PYROPHOSPHATE CZT SPECT IMAGING IN PATIENTS SUSPECTED OF CARDIAC TTR AMYLOIDOSIS

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Introduction: SPECT Tc99 m-pyrophosphate (PYP) has been widely accepted as a highly accurate, non-biopsy approach to evaluate cardiac TTR amyloidosis. We used CZT SPECT MPI dual isotope with the Spectrum Dynamics camera to detect TTR amyloidosis and assess its prognostic value in our first year of evaluation.

Methods: In 38 patient referred for TTR amyloidosis evaluation to the University of Rochester Nuclear Cardiology Laboratory from May 2018 to April 2019, we used resting Tl-201 localization and PYP for scintigraphic evaluation with the D-SPECT CZT camera (Spectrum Dynamics, Caesarea, IS) using to the Cedars technique (ACC 2018). PYP was imaged 2 h after injection following initial localization with low dose (1 mCi) Tl-201. Acquisition of at least one million counts in the LV ROI were obtained. Mortality during the period of observation in the patients referred for study from our clinical cardiology and heart failure groups were studied. Mortality associated with positive (2 +/3 +) vs. negative (0/1 +) PYP uptake was analyzed by the Chi square test.

Results: Eight out of 38 (21%) patients were positive (2 +/3 +) for Tc-99 m-PYP cardiac uptake (mean heart to contralateral ratio [H:CL] = 2.63). Of those eight patients, 3 (38%) died within a 1 year follow-up period; One of the 29 (3%) patients who had 0/1 + uptake (H:CL = 1.08) died (Chi square P = .006). One patient could not be imaged after injection due to acute illness.

Conclusions: Early experience with dual isotope CZT SPECT Tc-99 m-PYP imaging appears to provide important prognostic assessment in selected patients referred by cardiologists for suspected cardiac amyloidosis. Confirmation of these findings in larger patient populations appears warranted.

POSTER SESSION III: NEW HORIZONS IN CARDIOVASCULAR INFECTION AND INFLAMMATION IMAGING

Friday, September 13, 2019 3:30 p.m.-4:30 p.m.

222-01

EARLY PHASE VERSUS LATE PHASE 99MTC-PYROPHOS-PHATE SCINTIGRAPHY FOR THE DIAGNOSIS OF CARDIAC AMYLOIDOSIS

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Background: Scintigraphy with ^{99m}Tc-PYP/DPD has been shown to be very accurate for the diagnosis of ATTR cardiac amyloidosis (CA). Two different approaches have been validated and integrated in the ASNC Practice Points; a quantitative heart-to-contralateral lung ratio (H/CL) calculated on planar anterior image obtained at 1 h and a visual grading of myocardial uptake relative to bone uptake on planar or SPECT images obtained at 3 h. The diagnostic yield of the two methods were compared.

Methods: The scans of 84 consecutive subjects from 2 centers who underwent PYP scintigraphy with 1 h and 3 h planar and SPECT imaging for the diagnosis of CA were reviewed. Circular regions of interest were drawn over the heart and mirrored over the contralateral chest on the 1 h planar images to calculate the H/CL. Myocardial uptake intensity on 3 h planar and SPECT images was graded using the semi-quantitative system.

Results: The distribution of uptake was as follows: Grade 0 (N = 50), Grade 1 (N = 8), Grade 2 (N = 9), and Grade 3 (N = 17). Four (5%) subjects had H/CL < 1.0, 22 (26%) had H/CL > 1.5, and 58 (69%) had H/CL between 1.0 and 1.5. The proportion of equivocal studies was significantly higher when using H/CL compared to the 3 h grading approach (p < 0.0001). Average H/CL for the different uptake grades is presented in Figure 1. The results between the two methods were discordant (positive according to one method and negative according to the other) in two subjects and the 3 h grading provided appropriate diagnosis in both cases: one patient had an H/CL of 0.91 and Grade 2 uptake with biopsy proven ATTR-CA while the other had an H/CL of 1.96 and Grade 0 uptake with biopsy proven AL-CA.

Conclusion: According to current ASNC Practice Points, 69% of subjects would have an equivocal PYP scan based on 1 h imaging alone while 9.5% of PYP scans were equivocal based on 3 h grading alone. These results suggest that the use of 1 h imaging alone may lead to high proportion of equivocal studies.

Figure 1: 1-hour heart-to-contralateral ratio (H/CL) compared to 3-hour Grade
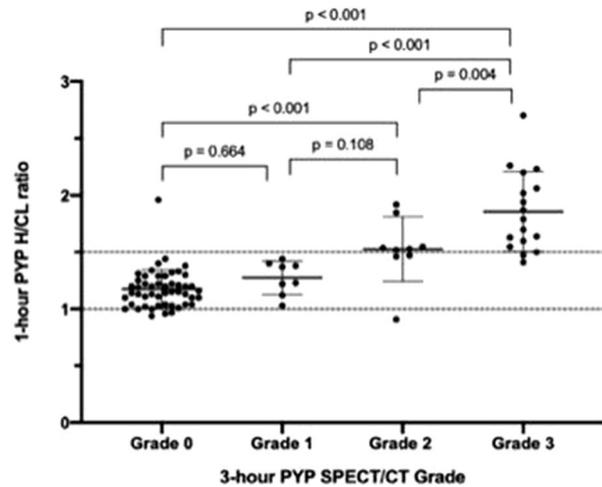
222-02

FDG PET/CT IN ASSESSING THE ASSOCIATION BETWEEN MYOCARDIAL GLUCOSE METABOLISM AND BLOOD PRESSURE

C. Rojulpote*,[1] W. Y. Raynor,[1] T. Werner,[1] A. Alavi[2]; [1]University of Pennsylvania, Philadelphia, PA, [2]Radiology, University of Pennsylvania, Philadelphia, PA

Background: Elevated blood pressure causes the myocardium to undergo maladaptive changes in response to the increased external work load. Left ventricular hypertrophy takes place and can consequently lead to heart failure. Our aim was to determine the correlation between the uptake of the left ventricular myocardium and blood pressure, hypothesizing that subjects with higher blood pressures will have higher FDG uptake in the myocardium.

Methods: We analyzed 129 subjects (62 females and 67 males, mean age 49 ± 13.7 between 21-75 years) who underwent PET/CT imaging 180 min following the injection of FDG (4 MBq/Kg) by using a 690/710, VCT, GE Discovery STE, or R system. CT imaging was done for anatomic referencing and attenuation correction with PET images. PET images were corrected for random coincidence, scanner dead time, scatter, and attenuation. Left ventricular myocardial analysis was performed on axial sections using OsiriX MD (version 9.0.02), a standard operator guided computer software. The average left ventricular myocardial SUVmean (MSUVmean) was computed for each subject. Blood pressure was measured in standardized conditions. Three consecutive recordings were done and the average of the last two of three was used. Subjects were then categorized according to their systolic and diastolic blood pressure (SBP and DBP) as per the 2017 ACC/AHA guidelines for high blood pressure in adults. Mean arterial blood pressure (MABP) was calculated as the sum of 1/3 SBP and 2/3 DBP. Univariate and multivariate regression models were employed to demonstrate the association of MSUVmean with DBP, SBP, and MABP.

Results: MSUVmean was found to be more in subjects with higher BP in comparison to those with normal BP. The association of MSUVmean was more noticeable with DBP (r = 0.30, p = 0.0006) than with SBP (r = 0.20, p = 0.024); its interrelationship with that of MABP was comparable (r = 0.28, p = 0.002). Correlations of MSUVmean with categorized BPs were: normal SBP (r = 0.21, p = 0.030), elevated SBP (r = 0.20, p = 0.023), stage 1 SBP (r = 0.21, p = 0.010), stage 2 SBP

(r = 0.21, p = 0.02); normal DBP (r = 0.30, p = 0.0005), stage 1 DBP (r = 0.31, p = 0.0004), stage 2 DBP (r = 0.34, p = 0.0002). Multivariate analysis was found to be significanct with DBP (p = 0.027), SBP (0.034), and MABP (p = 0.050).

Conclusion: Left ventricular myocardial FDG uptake was found to be higher in patients with higher blood pressures. The correlation was stronger with DBP and MAP than SBP. This data provides evidence for a possible new role of FDG PET/CT in identifying minor changes in left ventricular myocardial metabolism prior to the onset of structural changes that take place due to hypertension.

222-03

FDG PET/CT IN ASSESSING INFLAMMATION IN THE THORACIC AORTA OF LUNG CANCER PATIENTS AND ITS CORRELATION WITH BLOOD PRESSURE

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Background: We aimed to determine the role of FDG PET/CT in assessing inflammation in the thoracic aorta of patients with lung cancer and its correlation with blood pressure. Our hypothesis is that patients with cancer have altered vascular hemodynamics such as increased viscosity of blood, which, when coupled with elevated blood pressure, predisposes to aortic wall damage and inflammation that may be the beginning of atherosclerosis.

Methods: In this study, we analyzed 49 subjects with lung cancer (47 males and 2 females, mean age 66 years, range 51-81) and 86 healthy controls (40 women and 46 men, mean age 46 years, range 21-66) who underwent FDG PET/CT imaging. Healthy controls with no history of oncological disorders were selected as they would have normal physiologic hemodynamics. The lung cancer subjects were imaged after administration of FDG 5 MBq/kg. Healthy controls were imaged 180 min following the injection of FDG 4 MBq/kg. CT imaging (140 kV, 30-110 mA, noise index 25, 0.8 s per rotation, slice thickness 3.75 mm) was performed for attenuation correction and anatomic referencing with PET images. PET images were also corrected for attenuation, scatter, scanner dead time, and random coincidence. The following segments of the thoracic aorta were identified: ascending aorta (AA), arch of aorta (AR), and descending aorta (DA) using a standard operator guided computer software (OsiriX MD software, version 9.0.2). Average SUVmean (aSUVmean) was calculated for each segment of the thoracic vessel. The degree of FDG uptake in subjects and controls was noted and its correlation with blood pressure was determined.

Results: Statistically significant correlations were found between aSUVmean and blood pressures in the AR of lung cancer patients (SBP: r = 0.32, p = 0.03; DBP: r = 0.35, p = 0.01. The correlation of aSUVmean with systolic blood pressure (SBP) and diastolic blood pressure (DBP) in the AA and DA was found to be statistically insignificant (SBP: r = 0.17; p = 0.24; DBP: r = 0.18, p = 0.23) and (SBP: r = 0.20, p = 0.17; DBP: r = 0.20, p = 0.16), respectively. No statistically significant correlations were seen in healthy controls: AA (SBP: r = 0.10, p = 0.39; DBP: r = 0.05, p = 0.67); AR (SBP: r = 0.12, p = 0.30; DBP: r = 0.04, p = 0.23), and DA (SBP: r = 0.0009, p = 0.99; DBP: r = 0.12, p = 0.31).

Conclusions: As the AR bears the full brunt of the ejected blood from the left ventricle, it is the aortic section most frequently damaged. FDG PET/CT may prove to be of value in assessing aortic wall inflammation in cancer patients as a first indication of beginning stages of atherosclerosis, especially in the AR.

222-04

QUANTITATIVE EVALUATION OF MYOCARDIAL TC99 M-PYP SCINTIGRAPHY: IMPACT OF DIFFERENT ROI AND SEQUENTIAL ACQUISITION

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Introduction: The identification of amyloid deposition in the myocardium of patients with transthyretin-related (TTR) amyloidosis using non-invasive studies such as 99mTc-PYP imaging has emerged as a tool to aid with earlier diagnosis and complement the gold standard tissue biopsy. The heart-to-contralateral ratio (H/CL) is used currently to suggest the diagnosis of TTR amyloidosis, and is calculated using the images acquired at 1 h or 3 h post injection of 99mTc-PYP. The purpose of this study is to evaluate the H/CL ratio accuracy and impact of different region of interest (ROI) when using 1- and 3- hour delayed planar PYP scans in the diagnosis of cardiac amyloidosis.

Methods: 99mTc-PYP imaging scans of 11 patients for cardiac amyloidosis from 1/1/2018 to 4/1/2019 were included in this institutional IRB-approved retrospective study. Patients were included if they had negative, equivocal, or positive H/CL ratios. Those with equivocal or positive H/CL ratios were correlated with complementary echocardiographic findings or cardiac magnetic resonance imaging findings. 2D planar images were acquired at 1 and 3 h post-injection of 99mTc-PYP using dual-head gamma camera. Analysis was performed using two ROI (freehand and fixed sized ellipsoid) following the outline of the myocardium and a contralateral lung ROI was mirrored onto the region of the right lung. H/CL ratio, pixel size, standard deviation, variance, and heart and lung counts were determined at 1 and 3 h (decay corrected) for each patient. Statistical analysis was performed using Student's t test at 0.05 level of significance.

Results: 11 patients (mean age of 74.5 years, 8 M, 3 F) with myocardial uptake scans for amyloidosis as follows: 5 equivocal, 3 positive, and 4 negative. Patients with positive myocardial uptake had mean H/CL ratio of 1.85 and visual grades of 2.0, 3.0, and 3.0. Patients with equivocal myocardial uptake (mean H/Cl ratio of 1.09) each had visual grades of 1.0. Whereas the patients with negative myocardial uptake (mean H/Cl ratio of 0.92) had visual grades of 2.0, 1.0, and 0.0. The mean H/CL ratio was not significantly different at 1 and 3 h for freehand and fixed ROI within the groups and calculated p-values between fixed and freehand ROI was not statistically significant at 1 h (p = 0.44) and 3 h (p = 0.50).

Conclusions: H/CL ratio of > 1.5 strongly suggests Transthyretin Cardiac Amyloidosis. H/CL ratio could be calculated from either 1-h or 3-h decay-corrected planar images. Fixed elliptical and freehand ROI over myocardium and contralateral lung provides similar H/CL estimates.

222-05

THE USE OF COMBINED CT ATTENUATION SCANS AND SPECT IMAGING IN ASSESSMENT OF 99MTC-PYP UPTAKE FOR EVALUATION OF CARDIAC AMYLOID

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Background: Cardiac amyloidosis imaging with technetium-phosphate derivatives has become important for the diagnosis of ATTR amyloid now that effective therapies are emerging. Current planar diagnostic techniques involve a semi-quantitative visual score and a heart to contralateral lung (H/CL) ratio with excellent sensitivity and specificity for identifying ATTR. Planar acquisition alone has a number of possible confounders during study analysis including overlying sternal or rib counts or extraneous blood pool counts. The routine use of SPECT volumetric assessment of uptake in equivocal studies along with CT attenuation correction fused images can greatly facilitate study interpretation. This study investigates the utility of using CT images fused with standard SPECT images of 99mTc-PYP uptake to improve evaluation for cardiac amyloid.

Methods: We reviewed patients who underwent a 99mTc-PYP SPECT study for the evaluation of cardiac amyloidosis which incorporated CT attenuation scans. Planar and SPECT data were evaluated and each study

was then analyzed using reconstruction with CT attenuation correction images.

Results: Four patients were reviewed. All studies were clinically read as negative studies for ATTR amyloid based on visual and quantitative planar and SPECT imaging. The mean effective dose for attenuation correction CT was 1.07 mSv. Two studies had planar H/CL ratios > 1.1; after review of the fused low-dose CT and SPECT scintillation images the increased activity on planar imaging was consistent with cardiac blood pool counts. An example of one of these cases found a quantitative H/CL ratio of 1.15 with a 60 min imaging delay. The representative SPECT-CT images demonstrates the blood pool uptake and cold myocardium (Figure).

Conclusions: The use of low-dose CT attenuation anatomic data with SPECT image acquisition for cardiac amyloid studies can help with the determination of accurate SPECT volumetric H/CL ratios or distinguish blood pool counts from myocardial counts.
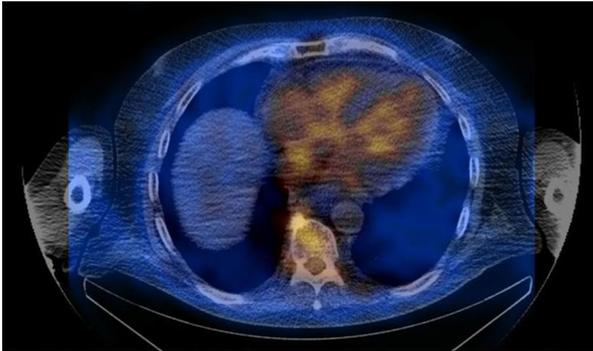
Figure – Fused low dose CT and SPECT scintillation images, with increased activity in the blood pool and cold myocardium.

222-06

CARDIAC SARCOID MIMICKING ARRHYTHOGENIC RIGHTVENTRICULAR DYSPLASIA/CARDIOMYOPATHY(ARVD/C)

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Introduction: ARVD/C is a familial cardiomyopathy resulting in progressive right ventricular dysfunction and malignant arrhythmias. It may present as a diagnostic challenge. To aid making an accurate diagnosis multiple diagnostic tests are used, with a true diagnosis having said to be made when a score of >=4 is achieved using the Task Force Criteria (TFC).

Case Study: We present a case of a 39 yr old male, who presented with ventricular tachycardia (VT) and who had a TFC score of 6 (1 major and 1 minor on MRI, 1 minor for VT morphology and 1 major point on ECG morphology).

Subsequently he was evaluated for a rash and found on skin biopsy to have ''Sarcoidal granulomatous dermatitis'' and therefore had a F18-fluorodeoxyglucose (FDG) PET (Positron Emission Tomography) study as well as a rest myocardial perfusion study with Technetium (Tc99 m) Sestamibi, to exclude cardiac Sarcoid.

He had a normal serum Angiotensin Converting Enzyme(ACE) and Calcium level. He also did not have complete heart block which is a commoner way for cardiac Sarcoid to present.

The patient had the described cardiac specific preparation and was imaged from the vertex to the mid thigh.

Figure 1 panel 1 demonstrates a fused cardiac PET and Sestamibi perfusion image, demonstrating intense FDG uptake (White) involving the RV free wall, apex and inter ventricular septum consistent with cardiac Sarcoid.

The inter ventricular septum (Crosshairs) shows concordant reduced Tc-99 m Sestamibi uptake. Normal uptake of Sestamibi is seen at the left ventricular apex and lateral wall. The second panel demonstrates the extensive extra cardiac uptake seen on the whole-body image.

Due to the extensive lymph node, splenic and bone involvement, a bone marrow aspirate and trephine (BMAT) was also performed to exclude a hematological malignancy such as lymphoma. The BMAT was consistent with Sarcoid. The patient was treated with a defibrillator, sotalol and steroid.

Conclusion: Even when a diagnosis of ARVD/C is made with confidence, alternate diagnosis such as cardiac sarcoid should be considered. In this instance, PET imaging may well be useful.
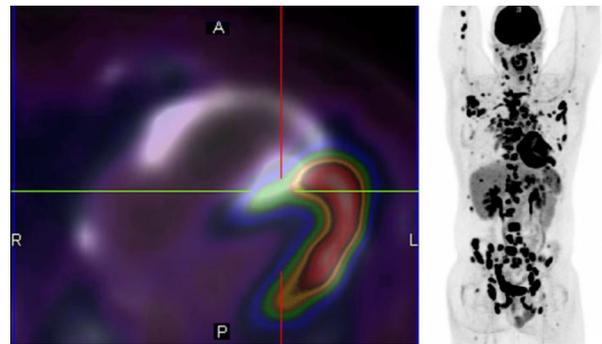
222-07

NON-INVASIVE DIAGNOSIS OF CARDIAC AMYLOIDOSIS USING 99MTC-3,3-DIPHOSPHONO-1,2-PROPANODICARBOXYLIC ACID SCINTIGRAPHY

M. Kostkiewicz*; Jagiellonian University Collegium Medicum Hospital John Paul II, Krakow, Poland

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Objectives. We investigated the diagnostic accuracy of 99mTc-3,3-diphosphono-1,2-propanodicarboxylic acid (99mTc-DPD) scintigraphy for differentiation of transthyretin (TTR)-related cardiac amyloidosis among patients with LV hyperthrophy.

Background. Transthyretin amyloidosis (ATTR) commonly lead to increased myocardial thickness and may mimic hypertrophic cardiomyopathy. Cardiac amyloidosis is characterized by a restrictive cardiomyopathy with a poor prognosis and survival. Differentiating transthyretin-related cardiac amyloidoses (ATTR) from LV hypertrophy is imperative given implications for prognosis, therapy, and genetic counseling.

Methods. To assess the value of a 99mTc-DPD scintigraphy for identifying subjects with ATTR cardiac amyloidosis, 45 consecutive patients under routine observation with and echocardiographic evidence of cardiac muscle hypertrophy were studied. Cardiac retention was assessed with a semi-quantitative visual score (range, 0; no uptake to 3, diffuse uptake). Results were confirmed by myocardial biopsy in all patients with positive scans. **Results.** The DPD scan was positive in 15/45 (33,3%) patients. All patients had moderate LV hypertrophy (median left ventricular wall thickness 1,6 cm) with no significant difference between groups with and without positive scans. Patients with amyloid deposition were older (73 ± 10 vs 62 ± 12 years),had lover LV ejection fraction(55% ± 12 vs 62% ± 7). Severe diastolic dysfunction, assessed by strain imaging, was observed in 20 patients (in all 11 with positive scan). Using myocardial biopsy as the reference standard for recognition of cardiac involvement, sensitivity and specificity of scintigraphy were both 100% for all patients with positive scans.

Conclusions. 99mTc-DPD cardiac imaging distinguishes ATTR cardiac amyloidosis and seems to be a simple, widely available method for identifying subjects with ATTR amyloidosis among patients with left ventricular hypertrophy.

ePOSTER SESSION IV: PET PERFUSION: GENERAL

Saturday, September 14, 2019 9:30 a.m.-10:30 a.m.

301-01

IMPROVED PET IMAGE QUALITY WITH SALINE-PUSH IS ASSOCIATED WITH PARAMETERS OF HEART FUNCTION
A. Ahmadi, K. Gardner, R. S. Beanlands, R. A. deKemp*; University of Ottawa Heart Institute, Ottawa, ON, Canada

Background: We have previously shown that an additional saline-push after the rubidium-82 (Rb-82) elution improves PET image quality significantly for cardiac perfusion assessment. In the current study, correlations between parameters of image quality and heart function were investigated.

Methods: Rb-82 PET perfusion images were acquired with and without 26 ± 3 mL of saline-push after tracer elution from the generator. Dynamic images used to measure the left ventricular (LV) (signal) and left atrial (LA) (background) activities as well as LA standard deviation (noise). The parameters of PET image quality (blood background coefficient-of-variation (COV), LV-to-blood signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR), and heart function (LV ejection fraction (LVEF), stroke volume (SV), heart rate (HR)) were determined. Multilinear regression was performed to determine functional predictors of improved image quality.

Results: The mean age, BMI, LVEF, SV, and HR were 62 ± 12 yrs, 32 ± 8 kg/m^2, $50 \pm 16\%$, 46 ± 15 mL, and 77 ± 13 beats per min, respectively. As expected, saline-push was associated with improved image quality as indicated by increased LV activity (x2.0 ± 0.2), SNR (x1.3 ± 0.2), and CNR (x1.4 ± 0.2). COV was reduced (x0.85 ± .02) with saline-push. The multilinear regression indicated that reduced LVEF ($p = 0.13$) and increased HR ($p = 0.05$) may be associated with improved SNR (Figure 1).

Conclusions: Saline-push after Rb-82 elution may be more beneficial in patients with lower LVEF and higher HR. This technical enhancement has the potential to be used to specifically circumvent the lower perfusion image quality in patients with reduced heart function.
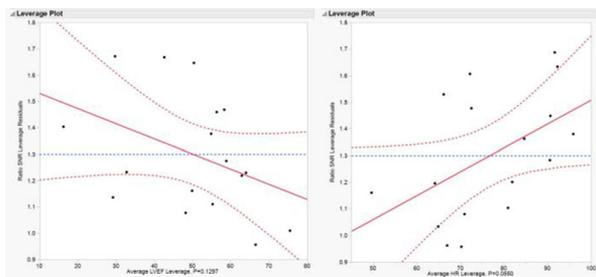
301-02

FIRST PATIENT EXPERIENCE OF 13 N-AMMONIA MYOCARDIAL PERFUSION PET/CT USING A COMPACT PRODUCTION SYSTEM
R. L. Weinberg*,[1] J. Pieper,[1] V. Patel,[1] S. Escolero,[1] J. R. Nelson,[1] C. K. Shreves,[2] N. K. Freiburger,[2] D. Hubers,[1] J. Rothley,[1] A. Poitrasson-Rivière,[3] J. G. Oliverio,[2] J. R. Corbett,[4] E. P. Ficaro,[5] V. L. Murthy[6]; [1]University of Michigan, Ann Arbor, MI, [2]Ionetix Corporation, San Francisco, CA, [3]INVIA, Ann Arbor, MI, [4]Radiology, University of Michigan, Ann Arbor, MI, [5]University of Michigan Health System, Ann Arbor, MI, [6]Frankel Cardiovascular Center, University of Michigan, Ann Arbor, MI

Background: Although 13 N-ammonia has the most favorable properties of all FDA-approved myocardial perfusion radiotracers, complexity of implementation limits its use. Here, we describe the first patient experience of 13 N-ammonia PET imaging using a compact 13 N-ammonia production system.

Methods: 13 N was produced using the ION-12SC, a 12 MeV, 10uA superconducting minimally shielded cyclotron, and reduced to 13 N-ammonia in an automated microfluidic synthesis unit. Doses were produced under FDA-approved/regulated conditions. Patients were power injected with 9.3 ± 1.1 mCi of 13 N-ammonia (Medrad® Spectris Solaris® EP Injection System), 20 mL at 1 mL/second followed by a 30 mL normal saline flush). List-mode imaging was performed for 10 min beginning at tracer injection. For stress testing, 0.4 mg of regadenoson was injected intravenously. At peak hyperemia, 18.8 ± 0.9 mCi of 13 N-ammonia was injected, 20 mL at 1 mL/second followed by a 30 mL normal saline flush. List-mode imaging was performed for 9 min, beginning one minute prior to tracer injection. Static, ECG-gated, and dynamic images were unlisted. Images were interpreted for relative perfusion, left ventricular volumes/function, and blood flow quantification, and were scored for image quality.

Results: In total, 97 patients underwent 163 13 N-ammonia PET scans (32 rest only/65 rest-stress/1 stress only). Image quality was 91.8% good or excellent, 6.1% good, and 2.0% fair. None were poor/non-diagnostic. Study durations were acceptable: 16.5 (IQR 15.8-18.0) minutes for rest only, 48.1 (IQR 47.0-60.9) minutes for rest-stress, and 29 min for stress only. Tracer-related radiation dosimetry to patients was 0.7 ± 0.1 mSv (rest only), and 1.4 ± 0.1 mSv (rest-stress). Patients per day were 4.1 ± 1.0.

Conclusion: Clinical 13 N-ammonia production by the Ionetix ION-12SC delivers high-quality myocardial PET perfusion images in a rapid protocol.
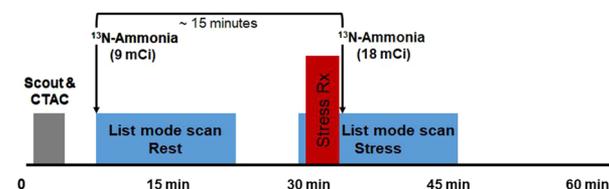
301-03

DIAGNOSTIC AND PREDICTIVE VALUE OF LV MASS MEASURED WITH 15O-WATER PET
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Introduction: Left ventricular hypertrophy (LVH) is a strong predictor of cardiovascular events. We recently developed an automated method for measuring left ventricular mass (LVM) using 15O-water PET. The diagnostic and predictive value of PET-based LVM measurements is not known.

Methods: We compared indexed LVM from 15O-water PET (LVMI-PET) blindedly to cardiac magnetic resonance or echocardiography in 95 subjects with (55%) and without known LVH. Outcome analysis was performed in two patient groups, n = 27 with cardiac amyloidosis (CA) and n = 47 with asymptomatic moderate/severe mitral regurgitation (MR). Major adverse cardiac events (MACE) were defined as cardiac death or hospitalization for heart failure, and in MR additionally as progression resulting in valvular surgery.

Results: LVMI-PET diagnosed LVH with an AUC = 0.85 (p < 0.001). The best cutoff was 100 g/m^2, with 67% sensitivity, 93% specificity and 78% accuracy. Nine patients (33%) with cardiac amyloidosis experienced a MACE (eight cardiac deaths, one hospitalization for heart failure) within a median follow-up of 36 (interquartile range (IQR) 14-48) months. LVMI-PET predicted outcome as a continuous variable, correctedfor age (HR 1.07 (95% CI 1.02-1.12) per g/m^2 increase, p = 0.002), and as a dichotomous variable (best cutoff 104 g/m^2, log-rank p < 0.001, see figure A). Fourteen patients (30%) with mitral regurgitation progressed and underwent surgery within a median follow-up of 27 (interquartile range (IQR) 17-44) months. There were no other MACE in this group. Sex was an outcome predictor (p = 0.02) because three out four women had surgery. LVMI-PET predicted outcome both as a continuous variable, corrected for sex and age (HR 1.05 (95% CI 1.02-1.09 per g/m^{2}increase), p = 0.006), and dichotomously (best cutoff 95.2 g/m^2, log rank p = 0.01, see Figure B).
Conclusion: 15O-water PET can diagnose clinically relevant LV hypertrophy.
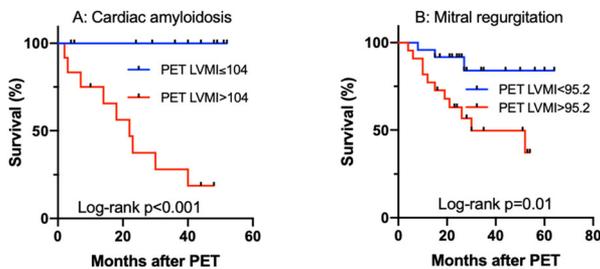
301-04

THE INFLUENCE OF AORTIC STENOSIS AND LEFT VENTRICULAR HYPERTROPHY ON THE TRANSIENT ISCHEMIC DILATATION RATIO IN RUBIDIUM-82 POSITRON EMISSION TOMOGRAPHY IMAGING

S. Biswas*, S. Mason, J. Ethington, R. McCubrey, S. Knight, D. B. Min, K. Meredith, M. Minder, V. Le, J. L. Anderson, J. B. Muhlestein, K. Knowlton; Intermountain Heart Institute, Murray, UT

Introduction: Transient ischemic dilatation (TID) ratio is an important prognostic finding in myocardial perfusion positron emission tomography (PET). An increased TID ratio is usually considered to reflect global subendocardial ischemia from multivessel coronary artery disease (CAD). In addition to CAD, however, left ventricular hypertrophy (LVH) and aortic stenosis (AS) can also produce subendocardial ischemia. Consequently, our group sought to examine the interaction of LVH and AS with the TID ratio

Methods: In this retrospective study, we reviewed all patients undergoing myocardial perfusion PET with Rubidium-82 for clinically related reasons from 2013 to 2018 (n = 22516). A total 356 patients were found with at least moderate AS according to aortic valve area (AVA). The patients were stratified into moderate (AVA = 1.0-1.5 cm^2) and severe AS (< 1.0 cm^2). In addition, a total of 4011 patients with LVH were found according to either septal wall or posterior wall thickness on echocardiography. The patients were stratified into mild (1.2-1.4 cm), moderate (1.4-1.7 cm), and severe LVH (> 1.7 cm). The AS and LVH groups had an ischemic burden < 10%. TID ratios were compared to a control group without LVH, mild or no AS (AVA > 1.5 cm^2), and with an ischemic burden < 10% (n = 13969).

Results: Both AS and LVH were associated with an increased TID ratio when compared to controls. Neither AS nor LVH showed a graded increase in TID ratio when stratified by severity; however, severe LVH was associated with an increased TID ratio compared to mild LVH.

Conclusions: AS and LVH are associated with increased TID ratios. This study highlights the contribution of factors other than coronary artery disease on the TID ratio in myocardial perfusion PET imaging. The influence of mild AS and moderate LVH on the TID ratio has prognostic implications. More research is needed to evaluate these parameters on TID, and in turn, prognosis.

Figure 1. TID ratio of patients with AS and LVH compared to controls

	TID Ratio	p value (compared to control)
Control (n= 13969)	0.99±0.14	
Moderate+severe AS (N=356) (AVA > 1.5 cm2)	1.07±0.14	<0.001
Moderate AS (N=264) (AVA 1.0-1.5 cm2)	1.06±0.13	<0.001
Severe AS (N=92) (AVA < 1.0 cm2)	1.08±0.16	<0.001
Mild LVH (N=2933) (1.2-1.4 cm)	1.04 ±0.13	<0.001
Moderate LVH (N=917) (1.4-1.7 cm)	1.04±0.13	<0.001
Severe LVH (N=161) (> 1.7 cm)	1.09±0.15	<0.001*

*when compared to mild LVH

301-05

HYPEREMIC RESPONSE OF PATIENTS WITH ADVANCED RENAL DYSFUNCTION AND END-STAGE RENAL DISEASE DURING VASODILATOR STRESS ON POSITRON EMISSION TOMOGRAPHY

A. Aljizeeri*,[1] M. Alali Alfaris,[1] D. Ahmed,[1] J. Farea,[1] A. Elneama,[1] I. Suliman,[1] A. Ahmed,[1] M. Alharthi,[1] A. Alsaileek,[1] M. H. Al-Mallah[2]; [1]King Abdulaziz Cardiac Center, Riyadh, Saudi Arabia, [2]Houston Methodist DeBakey, Houston, TX

Introduction: The diagnostic accuracy of vasodilator MPI in patients with end-stage renal disease is limited. One of the proposed mechanisms of the low diagnostic yield is high level of adenosine in the blood resulting in attenuated hyperemic response with vasodilator stress. Hence, we sought to investigate the vasodilatory response in patients with severe kidney disease and end-stage kidney disease undergoing myocardial perfusion imaging with vasodilator stress rubidium-82 Positron Emission Tomography (PET).

Methods: All consecutive patients referred to PET-MPI between May 2011 and May 2018 were reviewed. Patients with stage 4 and 5 CKD and without known CAD who had normal perfusion were included in the analysis. Patient with perfusion defects, abnormal stress electrocardiogram, significant transient ischemic dilatation and low left ventricular ejection fraction were excluded. Peak and resting myocardial blood flow are measured and compared to evaluate the vasodilatory response

Results: A Total of 315 patients were included in the analysis of which 211 (66.9%) patients have end-stage kidney disease (CKD 5) (mean age 52.8 ± 13 years, 59.7% females) and 104 patients have severe kidney dysfunction (CKD 4) (mean age 56.5 ± 11 years, 59.7% females). Traditional risk factors are equally highly prevalent among both groups. The mean resting, and peak myocardial blood flows were 1.1 ± 0.4 and 2.6 ± 1.1 ml/g/min respectively for end-stage kidney disease and 1.1 ± 0.4and 2.5 ± 0.8 ml/g/min for CKD 4, respectively. The peak myocardial blood flow was significantly higher than the rest flow in both groups (mean difference of 1.4 ± 0.4 and 1.5 ± 0.7 for CKD 4 and CKD 5, respectively).

Conclusions: Patients with severe kidney disease and end-stage kidney disease achieve significant vasodilatory response during vasodilator stress MPI. The prognostic value of these findings needs further evaluation.
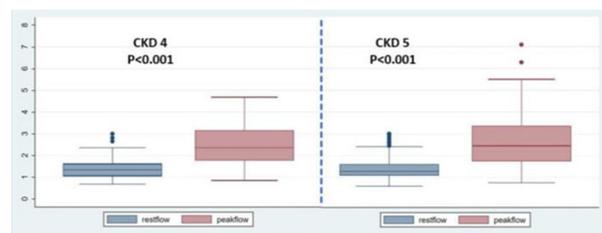
POSTER SESSION IV: ADVANCES IN MYOCARDIAL BLOOD FLOW ASSESSMENT: PET AND SPECT

Saturday, September 14, 2019 9:30 a.m.-10:30 a.m.

302-01

CHARACTERIZATION OF MYOCARDIAL BLOOD FLOW IN END-STAGE RENAL DISEASE PATIENTS

M. H. Stewart,[1] J. Englert,[1] N. Polin,[1] R. Bober*[2]; [1]Ochsner Heart & Vascular Institute, New Orleans, LA, [2]Cardiology, Ochsner Heart and Vascular, New Orleans, LA

Introduction: Coronary flow reserve (CFR), the ratio of stress to rest myocardial blood flow (sMBF, rMBF) by cardiac positron emission tomography (cPET) provides prognostic information supplemental to relative perfusion images. However, these metrics have not been characterized in patients with end-stage renal disease (ESRD). There are unique hemodynamic factors in ESRD such as arterio-venous anastomoses and altered vasoreactivity which may influence these metrics.

Methods: We evaluated ESRD patients undergoing dipyridamole cPET using Rb-82. MBF, in cc/min/g, was calculated for all patients and compared to an age-gender matched cohort with normal renal function. All studies with perfusion defects $\geq 10\%$ of the myocardium were excluded to avoid confounding epicardial coronary disease.

Results: 388 patients (194 ESRD and 194 controls, age 56.2 vs. 56.5, (p = 0.40), 54% male) were compared. rMBF in patients with ESRD was significantly higher than controls, 1.23vs. 0.86(p < 0.001). There was no difference in sMBF between the two groups, 1.75 vs. 1.76 (p = 0.857). CFR was significantly reduced in the ESRD, 1.51 vs. 2.12 (p < 0.001) driven by increased rMBF. (Figure 1) This MBF pattern remained significant when adjusted for resting rate pressure product (RPP).

Conclusions: This study demonstrates decreased CFR among patients with ESRD compared to age-gender-matched controls. Decreased CFR is driven by elevated rMBF, even after correction for RPP, without a significant difference in sMBF. The presumptive mechanism(s) behind increased rMBF and its pathophysiologic role has yet to be determined.

Figure 1-Absolute resting myocardial blood flow, stress myocardial blood flow, and coronary flow reserve in ESRD and control patients
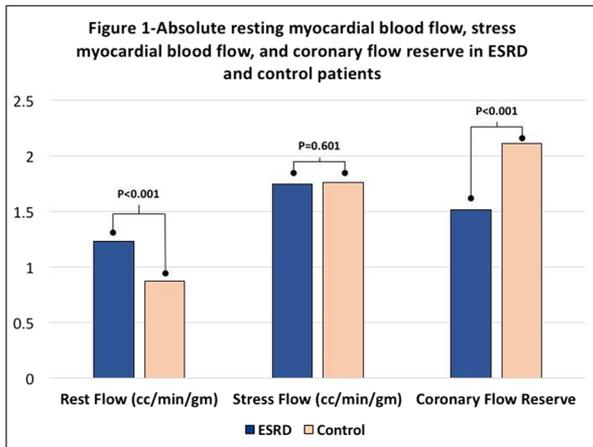
302-02

FEASIBILITY OF EXERCISE TREADMILL ^{13}N-AMMONIA POSITRON EMISSION TOMOGRAPHY MYOCARDIAL PERFUSION IMAGING USING AN OFF-SITE CYCLOTRON

D. Harland*, D. Mahlum, P. Galazka, S. Port; Advocate Aurora Health Care, Milwaukee, WI

Background: Myocardial perfusion imaging with treadmill exercise nitrogen-13 (^{13}N)-ammonia positron emission tomography (PET) presents a logistical challenge and has rarely been studied. The current literature describes the use of an on-site cyclotron for the production and immediate use of ^{13}N-ammonia. We sought to explore the feasibility of exercise treadmill ^{13}N-ammonia PET myocardial perfusion imaging using an off-site cyclotron for production of ^{13}N-ammonia.

Methods: Fifteen patients underwent rest and treadmill exercise (GXT) ^{13}N-ammonia PET MPI from February 2018 to April 2019. Resting and GXT doses of ^{13}N-ammonia were prepared at an off-site cyclotron 20 miles from our institution (Wisconsin Medical Cyclotron, West Allis, WI). Two patients underwent stress-only imaging. Each patient dose required producing about 800-900 mCi 1 hour prior to calibration. Delivery of resting and stress doses occurred separately approximately 1 h apart. Patients received a 10 MBq/kg ^{13}N-ammonia dose at rest. Five minutes after injection, patients underwent a 16 min emission scan followed by 5 min Germanium transmission scan. One hour following the resting dose, patients underwent GXT using a Bruce protocol. At a minimum of 85% maximum predicted heart rate, the patient received 10 MBq/kg ^{13}N-ammonia followed by a 5 min recovery and transition to the scanner. Emission and transmission scans were repeated. List-mode emission data were reconstructed using QPET (Cedars-Sinai). Image quality, perfusion data and clinical variables were evaluated for each patient.

Results: We analyzed 17 patients (4/13 female/male). Mean age was 61 ± 13 years and mean BMI was 35.0 ± 7.4. Average rest and GXT ^{13}N-ammonia doses were 29.8 ± 5.5 and 31.8 ± 7.6 mCi, respectively. Treadmill exercise PET was technically feasible in all patients (100%). Image quality was rated as good in 15 patients and adequate in the remaining 2. Summed stress score was 2.9 ± 3.1. Resting and GXT left ventricular ejection fractions were 65.0 ± 9.0% and 70.0 ± 11.2%. TID ratio was 1.0 ± 0.1.

Conclusion: Treadmill exercise ^{13}N-ammonia PET is feasible in a large regional medical center without access to an on-site cyclotron. This technique requires close coordination with an off-site cyclotron but expands the role of PET imaging to patients for whom exercise stress testing is more appropriate than pharmacologic stress imaging. Continued expansion of this dataset may be able to address questions of cost-effectiveness and scalability of this technique.

302-03

SENSITIVITY OF PET CARDIAC STRESS TESTING TO DETECT MYOCARDIAL PERFUSION DEFECTS IN THE SETTING OF LOW GLOBAL FLOW RESERVE

J. A. Kvasic*,[1] J. A. Rosenblatt[2]; [1]Maine Medical Center, Portland, ME, [2]Maine Health Cardiology, South Portland, ME

Cardiac stress testing using Positron Emission Tomography (PET) imaging with Rubidium-82 is a form of cardiac testing that is intended to identify obstructive coronary artery disease (CAD) as well as risk of acute myocardial infarction or sudden cardiac death. The study is performed by administrating a coronary vasodilatory pharmacologic stress agent (Regadenoson) that has the potential to cause flow heterogeneity if significant CAD is present. In addition to the assessment of regional perfusion defect(s), PET has shown to be a highly effective method to quantify global cardiac flow reserve (GCFR) which is an independent marker for cardiac risk. Patients with an abnormally low GCFR are at increased risk of adverse cardiovascular events even in the absence of regional perfusion abnormalities.

In this study, we questioned if there will be enough flow heterogeneity present to produce a regional perfusion abnormality in patients who have significantly reduced GCFR, thus identifying patients with focal CAD.

We hypothesized that a significant amount of patients would lack any regional perfusion abnormalities due to the inability to achieve flow heterogeneity, a necessary factor to identify CAD.

In a retrospective fashion, the cardiovascular imaging database at Maine Health Cardiology was queried for all patients with CFR ratio reported as ≤ 1.5 on PET cardiac stress testing during the period of 1/1/16-8/1/18. We then reviewed each patient's chart to evaluate if there was any regional myocardial uptake abnormality based on a summed stress score (SSS) ≤ 4 and compared those findings to coronary angiography performed on these patients.

On initial review, there were 2,158 patients who had PET testing completed during this time period, 406 of whom had CFR ≤ 1.5. Of these, only 29 patients had SSS ≤ 4. When the angiography reports were reviewed 3 (10.3%) had obstructive coronary artery disease (single vessel), 24.1% (7 patients) had balanced ischemia from multivessel disease and 19 patients (65.5%) had nonobstructive CAD. In addition, there were 89 patients who had CFR ≤ 1.5 and perfusion defects as reported by the PET readers or SSS > 4 who were referred for coronary angiography, with 76 of those patients (85.4%) found to have segmental CAD as documented by coronary angiography.

These findings suggest that low CFR does not necessarily mean that flow heterogeneity is not achieved. The majority of patients with GCFR ≤ 1.5 and SSS > 4 had perfusion abnormalities on PET, with subsequent CAD documented by coronary angiography, while balanced ischemia was often identified in patients with low GCFR and SSS < 4. Therefore, despite low CFRs, flow heterogeneity and subsequent diagnosis of CAD is achieved in patient with GCFR ≤ 1.5.

302-04

DOBUTAMINE VS. DIPYRIDAMOLE AS ASSESSED BY MYOCARDIAL BLOOD FLOW

M. H. Stewart*,[1] J. Englert,[2] N. Polin,[2] R. Bober[3]; [1]Ochsner Heart & Vascular Institute, New Orleans, LA, [2]Ochsner Heart & Vascular, New Orleans, LA, [3]Cardiology, Ochsner Heart and Vascular, New Orleans, LA

Introduction: Cardiac stress testing with positron emission tomography (PET) is typically performed with vasodilatory agents such as dipyridamole, however, provocative testing with dobutamine remains a viable alternative. Comparative effectiveness of these different methods has been studied in small groups of normal volunteers but has not been extensively studied in a routine clinical setting.

Methods: We identified patients undergoing dobutamine cardiac PET stress testing for routine clinical indications and compared these with age and gender matched patients who had a vasodilatory stress test with dipyridamole. Standard dobutamine protocols were used including escalating dosing until 85% of max predicted heart rate was achieved. Myocardial blood flow (MBF) was calculated at rest and stress, and coronary flow reserve (CFR) calculated as the ratio of stress to rest MBF. To exclude confounding epicardial coronary disease, all studies were screened for the presence of perfusion defects. Any study with a defect > 10% of the myocardium at rest or stress was excluded in both the dobutamine group and control. All MBF measurements were made in cc/min/gm of myocardium.

Results: 72 patients who underwent dobutamine cardiac stress testing were compared with 72 controls. Stress MBF was significantly higher in the dobutamine group than controls. 2.83 vs. 1.85 (p < 0.001). CFR was also higher in the dobutamine group 2.89 vs. 2.06 (p < 0.001). This MBF pattern remained statistically significant when adjusted for rate pressure product.

Conclusions: We demonstrate significantly higher stress MBF and CFR among patients undergoing provocative testing with dobutamine compared with dipyridamole. These findings differ from other studies performed in healthy volunteers which show fewer differences between the stress agents. Further randomized studies are needed to understand the effectiveness between these agents in a broader clinical population.

302-05

THE INFLUENCE OF AORTIC STENOSIS AND LEFT VENTRICULAR HYPERTROPHY ON CORONARY FLOW RESERVE IN RUBIDIUM-82 POSITRON EMISSION TOMOGRAPHY IMAGING

S. Biswas*, S. Mason, J. Ethington, R. McCubrey, S. Knight, D. B. Min, K. Meredith, M. Minder, V. Le, J. L. Anderson, K. Knowlton; Intermountain Heart Institute, Murray, UT

Introduction: In myocardial perfusion positron emission tomographic (PET) imaging, a decreased coronary flow reserve (CFR) is felt to reflect either multivessel coronary artery disease (CAD) or widespread microvascular CAD. The influence of other conditions on CFR, such as left ventricular hypertrophy (LVH) and aortic stenosis (AS), is unknown. Our group sought to examine the influence of LVH and AS on CFR using myocardial perfusion PET with Rubidium-82.

Methods: In this retrospective study, we reviewed all patients undergoing myocardial perfusion PET Rubidium-82 for clinically related reasons from 2013 to 2018 (n = 22516). A total 356 patients were found with at least moderate AS according to aortic valve area (AVA). The patients were stratified into moderate (AVA = 1.0-1.5 cm^2) and severe AS (< 1.0 cm^2). In addition, a total of 4011 patients with LVH were found according to either septal wall or posterior wall thickness. The patients were stratified into mild (1.2-1.4 cm), moderate (1.4-1.7 cm), and severe LVH (> 1.7 cm). The LVH and AS groups both had an ischemic burden < 10%. CFR values were compared to a control group without LVH, mild or no AS (AVA > 1.5 cm^2), and with an ischemic burden < 10% (n = 13969).

Results: Both AS and LVH were associated with decreased CFR when compared to controls. However, neither AS nor LVH showed a graded decrease in CFR when stratified by severity.

Conclusions: AS and LVH are associated with decreased CFR. This study highlights that CFR is not just affected by either epicardial or microvascular CAD. In addition, the influence of mild LVH and moderate AS on CFR has implications on the clinical significance of mild disease states as well as prognostic implications. More research is needed to evaluate these parameters on CFR, and in turn, prognosis.

Figure 1. CFR of patients with AS and LVH compared to controls

	CFR (ml/min/g)	p value (compared to control)
Control (n = 13969)	2.35±0.80	
Moderate+severe AS (N=356) (AVA > 1.5 cm2)	1.71±0.66	<0.001
Moderate AS (N=264) (AVA 1.0-1.5 cm2)	1.71±0.66	<0.001
Severe AS (N=92) (AVA < 1.0 cm2)	1.74±0.68	<0.001
Any LVH (N=4011)	2.03±0.76	<0.001
Mild LVH (N=2933) (1.2-1.4 cm)	2.04 ±0.76	<0.001
Moderate LVH (N=917) (1.4-1.7 cm)	2.02±0.74	<0.001
Severe LVH (N=161) (> 1.7 cm)	1.99±0.75	<0.001

302-06

MYOCARDIAL PERFUSION GATED SPECT IN POST-MENOPAUSAL WOMEN WITH SUSPECTED OR ACTUAL ISCHEMIC HEART DISEASE: IS IT WORTH?

A. Puente*, V. Gomez, C. Martinez, L. Delgado Espejel; Centro Medico Nacional 20 de Noviembre ISSSTE, Mexico, Mexico

Introduction: In postmenopausal women, the presence of risk factors for ischemic heart disease (IHD) increases; in addition, typical symptoms are not always present. Therefore, sex-specific IHD therapeutics should be explored trough myocardial perfusion gated SPECT (g-SPECT). The purpose of this study was to evaluate posttest risk and decision-making by g-SPECT in in postmenopausal women with suspected or actual IHD.

Methods: This study retrospectively assessed 220 g-SPECT results of postmenopausal women with multiple risk factors for IHD. Statistical analysis was performed using central tendency measures and percentages.

Results: Mean age was 66.7 ± 9.9 [26-89]. Risk factors (%): hypertension 60, 50.5 diabetes, 41 tabaquism, 40.5 dyslipidemia and 2.3 chronic kidney disease. Indications for testing in women with typical symptoms (%): 43.2 previous myocardial infarction (MI), 20.5 sub acute MI, 1.4, stable angina, 6.8 unstable angina, 1.4 previous stroke; and 20 atypical symptoms. G-SPECT: severe ischemia 6.3%, moderate 66%, mild 19.7%, and no ischemia 8%. Posttest risk: Vast majority of women intermediate risk 62.7%, low-risk 29.5, high-risk 7.8% Catheterization was done in 30%; therapy option: 20% percutaneous coronary intervention and 10% surgical revascularization.

Conclusions: The posttest risk after g-SPECT in postmenopausal women with suspected or actual IHD was found predominantly intermediate, regardless presence of multiple risk factors and kind of symptoms. Those data support the idea that the assessment of ischemia via g-SPECT in postmenopausal women with multiple risk factors is worth to be performed in order to enhance accurate therapeutic decision.

YOUNG INVESTIGATOR COMPETITION - CLINICAL RESEARCH

Saturday, September 14, 2019 12:15 p.m.-1:45 p.m.

310-01

WORLDWIDE DIAGNOSTIC REFERENCE LEVELS FOR ADMINISTERED ACTIVITY IN SINGLE-PHOTON EMISSION COMPUTED TOMOGRAPHIC MYOCARDIAL PERFUSION IMAGING: RESULTS FROM THE IAEA NUCLEAR CARDIOLOGY PROTOCOLS STUDY (INCAPS)

C. B. Hirschfeld*,[1] M. Dondi,[2] T. Pascual,[3] J. Vitola,[4] N. Better,[5] G. Karthikeyan,[6] D. Paez,[3] A. J. Einstein[1]; [1]Columbia University Medical Center, New York, NY, [2]Human Health, International Atomic Energy Agency, Vienna, Austria, [3]International Atomic Energy Agency, Vienna, Austria, [4]Quanta Diagnostico & Terapia, Curitiba, Brazil, [5]Nuclear Medicine, Royal Melbourne Hospital, Parkville, Victoria, Australia, [6]All India Institute of Medical Sciences, New Dheli, India

Background: Diagnostic reference levels (DRL) were introduced to establish radiation dose benchmarks to compare individual laboratories against aggregated data, helping to identify sites in most need of dose reduction strategies for improved radiological protection. DRLs for SPECT MPI have previously been derived from national or regional registries. This is the first multi-regional report and comparison of DRLs for SPECT MPI, using results from the International Atomic Energy Agency's Nuclear Cardiology Protocols Study (INCAPS).

Methods: Data on MPI protocols were submitted voluntarily to the INCAPS registry, a multinational, cross-sectional study of 308 labs in 65 countries. After excluding PET studies, 7,409 SPECT studies were included in this analysis. DRLs and achievable administered activities (AAA) were calculated by protocol for aggregated worldwide data as well as by region (North America, Latin America, Europe, Asia, Africa, and Oceania).

Results: The aggregated worldwide DRLs for rest/stress studies employing Tc-99 m labeled radiopharmaceuticals were 11.0 mCi (rest) and 33.0 mCi (stress) for one-day protocols and 21.9 mCi (rest) and 23.5 mCi (stress) for multi-day protocols. Corresponding AAAs were 10.3 mCi (rest) and 30.5 mCi (stress) for one-day protocols and 15.4 mCi (rest) and 17.6 mCi (stress) for multi-day protocols. Worldwide DRLs for Tc-99 m stress/rest studies were 12.5 mCi (stress) and 27.8 mCi (rest) for one-day protocols and 24.0 mCi (stress) and 24.1 mCi (rest) for multi-day protocols. Corresponding AAAs were 10.0 mCi (stress) and 20.9 mCi (rest) for one-day protocols and 19.0 mCi (both doses) for two-day protocols. For stress-only Tc-99 m studies, the worldwide DRL was 18.0 mCi and AAA was 12.5 mCi. Tc-99 m protocols were used in greater than 93% of studies in all regions except for Asia where 20% of studies were performed using either Tl-201 or dual isotope protocols. Significant differences in DRLs and AAAs were observed between world regions.

Conclusions: This study reports DRLs for SPECT MPI for each major region of the world from one of the largest international registries of clinical protocols. Despite the diversity of protocols, worldwide and region-wide DRLs may be useful in establishing or revising guidelines or simply comparing individual laboratory protocols to regional trends. Efforts to reduce radiation exposure in SPECT MPI should continue through standardization of protocols and adherence to industry best practices.

310-02

ASSOCIATION OF RIGHT-VENTRICULAR MYOCARDIAL BLOOD FLOW WITH DIASTOLIC DYSFUNCTION, RIGHT-VENTRICULAR PRESSURES AND ADVERSE EVENTS IN CARDIAC AMYLOIDOSIS

H. J. Harms*,[1] S. Rosengren,[2] T. S. Clemmensen,[3] L. P. Tolbod,[1] J. Sörensen[4]; [1]Aarhus University Hospital, Aarhus, Denmark, [2]Uppsala University Hospital, Uppsala, Sweden, [3]Cardiology, Aarhus University Hospital, Aarhus N, Denmark, [4]Uppsala University, Uppsala, Sweden

Background: Cardiac amyloidosis (CA) is associated with severe diastolic dysfunction as characterized by increased biventricular filling pressures and stiffness. Increased left ventricular (LV) filling pressures lead to an increased workload of the right ventricle (RV), in turn resulting in increased RV pressure. RV myocardial blood flow (MBF) during rest is likely to be associated with RV pressure and may, therefore, be an important marker of diastolic dysfunction in CA patients. The aim of this study is to first associate RV MBF measured using 15O-water or 11C-acetate PET with reference standard of RV pressures and then to explore its prognostic value in CA.

Methods: This study retrospectively analyzed the data of patients with CA (n = 56) undergoing 15O-water PET (n = 10), 11C-acetate PET (n = 30), or both (n = 16). RV and LV MBF were measured with an automated routine incorporated in the aQuant software. All patients undergoing 11C-acetate only underwent right-heart catherization (RHC), all other patients underwent echocardiography. In addition, ten healthy controls underwent 15O-water and 11C-acetate. Transmural MBF (MBF_T) was quantified using uptake rates for the RV and LV and normalized to a heartrate of 60. Finally, RV MBF also was expressed as a percentage of LV MBF (RV/LV MBF). CA patients were followed for occurrence of major adverse cardiac events.

Results: In CA, RV MBF_T from 11C-acetate was closely correlated with RV rate-pressure product using systolic pulmonary arterial pressure measured during RHC both without (r = 0.76, p < 0.001) and with normalization for LV MBF_T (r = 0.74, p < 0.001). RV MBF_T from 15O-water was correlated with RV RPP using systolic pressure based on echo without (r = 0.75, p < 0.001) and with (r = 0.70, p < 0.001) normalization. MBF RV was highly reproducible between 15O-water and 11C-acetate (r = 0.97, p < 0.001) as was RV/LV MBF (r = 0.99, p < 0.001). Compared to controls, RV MBF was increased in CA patients based on 11C-acetate (0.26 ± 0.08 vs 0.19 ± 0.02, p < 0.001) and trended to an increase for 15O-water (0.37 ± 0.13 vs 0.31 ± 0.05, p = 0.07). RV/LV MBF was significantly increased in CA for both tracers (47 ± 17% vs 25 ± 4% for 11C-acetate; 58 ± 16% vs 38 ± 5% for 15O-water, both p < 0.001). During a median follow-up of 32 months, 19 CA patients had adverse events. Normalized RV MBF above the median was associated with a 7.1 (2.0-25.2, p = 0.002, for 11C-acetate, 19 events) and 12.3 (1.6-109.4, p = 0.016, for 15O-water, 10 events) fold increase in adverse events.

Conclusion: Imbalance between RV and LV blood flow is associated with increased load on the right ventricle in cardiac amyloidosis. CA patients with the most severe imbalance were at significantly increased risk of adverse events. The measurement of RV MBF and RL/LV MBF can be fully automated and may serve as potent non-invasive markers of RV pressure overload.

310-03

ELEVATED RIGHT-VENTRICULAR BLOOD FLOW IS ASSOCIATED WITH DIASTOLIC DYSFUNCTION AND ADVERSE CARDIOVASCULAR EVENTS, INCLUDING HEART FAILURE WITH PRESERVED EJECTION FRACTION

H. J. Harms*,[1] V. R. Taqueti,[2] W. Zhou,[3] S. Divakaran,[4] T. Tran,[1] L. B. Campbell,[1] C. Bibbo,[1] R. Blankstein,[1] S. Dorbala,[2] J. Sörensen,[5] M. Di Carli[1]; [1]Brigham & Women's Hospital, Boston, MA, [2]Brigham and Women's Hospital, Boston, MA, [3]Radiology, Brigham and Women's Hospital, Boston, MA, [4]Brigham & Womens Hospital, Boston, MA, [5]Uppsala University, Uppsala, Sweden

Background: Diastolic dysfunction is associated with increased left ventricular (LV) filling pressures, which in turn increase right ventricular (RV) afterload. PET allows quantification of LV myocardial blood flow

(MBF), but its utility for RV MBF quantification is unclear. We quantified RV MBF at rest and explored its relationship with known markers of diastolic dysfunction and cardiomyocyte injury, and assessed its incremental prognostic value in patients without flow-limiting coronary artery disease (CAD).

Methods: Consecutive patients (n = 198) undergoing evaluation for suspected CAD with stress 82Rb PET, transthoracic echocardiography (TTE) and serum troponin (Tn) were identified. Patients with flow-limiting CAD or LV ejection fraction < 40% were excluded. MBF was quantified for the LV and RV during rest and pharmacological stress using the aQuant software. Transmitral early diastolic flow (E) and tissue Doppler relaxation (e') velocities on TTE were obtained in all patients, and RV systolic pressure (RVSP) in a subset of 122 patients. RV MBF_{rest}, RV MBF_{rest} corrected for heart rate (MBF_{corr}) and RV MBF_{rest} expressed as a percentage of LV MBF (RV/LV MBF_{rest}) were analyzed. Patients were followed (median 4.1 years) for cardiovascular death and hospitalization for nonfatal myocardial infarction or heart failure.

Results: PET-derived RV MBF_{rest} directly correlated with echo-derived RVSP, even after adjusting for HR (r = 0.46, p < 0.0001), and was associated with E/e' (p = 0.0002) and positive Tn (p = 0.015). Compared to those without diastolic dysfunction, patients with E/e' > 15 had increased RV MBF_{corr} (0.20 ± 0.05 vs 0.23 ± 0.06 mL/g/min, p = 0.003) and higher RV/LV MBF_{rest} (20.4 ± 4.8% vs 23.8 ± 6.6%, p < 0.0001). In a multivariable Cox proportional hazards model adjusting for clinical risk, Tn positivity, E/e' and LV myocardial flow reserve, RV MBF_{rest} remained significantly associated with adverse events (adjusted hazard ratio [HR] 1.64 (95% CI: 1.17-2.27) per 0.1 mL/g/min increase: p = 0.0045).

Conclusion: RV MBF assessment by PET is feasible and correlated with echocardiographic measures of RV hemodynamics. Increased RV MBF_{rest} was associated with known markers of diastolic dysfunction and myocardial injury, and independently associated with adverse cardiovascular events, including heart failure with preserved ejection fraction.

310-04

CAFFEINE EFFECTS ON MYOCARDIAL STRESS PERFUSION WITH REGADENOSON PET IMAGING

A. K. Babar*, D. Kitkungvan, K. Gould; McGovern Medical School, Houston, TX

Background: Standard protocol recommends abstaining from caffeine prior to vasodilator stress imaging. However, specific effects on severity of stress perfusion distribution have not been demonstrated, particularly in cardiac positron emission tomography for regadenoson stress in evaluating coronary artery disease.

Methods: 25 regadenoson PETs were paired, both with and without caffeine, 3 months apart and compared for stress perfusion metrics including coronary flow capacity categorized by severity distribution in the left ventricle. Paired t tests were performed for each variable, and the LV pixel histogram distributions were compared by Kolmogorov–Smirnov analysis.

Results: For paired PETs coronary flow reserve (CFR) with caffeine was 1.74 ± 0.31 versus 2.17 ± 0.41 without caffeine (p < 0.001) and for stress perfusion was 1.66 ± 0.60 versus 2.14 ± 0.51 cc/min/g (p < 0.01). Kolmogorov–Smirnov tests showed a significant difference in cumulative histograms for coronary flow capacities between the 25 subjects with and without caffeine (KS = 0.678, p < 0.00001). The largest difference was noted between the mildly reduced flow capacities, which was increased in the group with caffeine. Flow capacity was classified as at least mildly reduced in 58% of the LV distributions with caffeine as compared to just 18% without caffeine.

Conclusion: Caffeine as measured by serum levels can significantly affect the distribution of stress perfusion with regadenoson by demonstrating falsely lower levels of coronary stress flow. This caffeine effect can mimic the presence of coronary artery disease, potentially leading to unnecessary interventions.
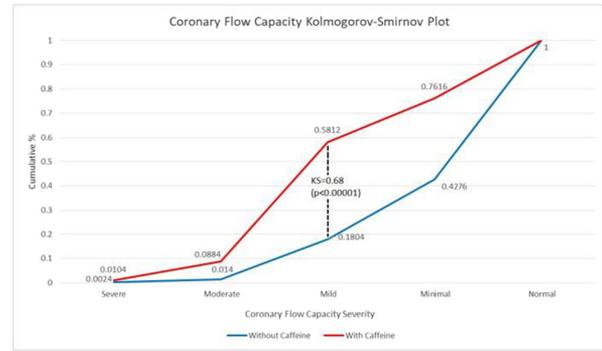
310-05

INCREMENTAL VALUE OF TRANSIENT ISCHEMIC DILATION IDENTIFIED ON REGADENOSON RUBIDIUM POSITRON EMISSION TOMOGRAPHY (PET) MYOCARDIAL PERFUSION IMAGING IN PATIENTS WITH LEFT VENTRICULAR DYSFUNCTION TO IDENTIFY MULTIVESSEL CORONARY ARTERY DISEASE

N. Borges*,[1] K. Paschke,[1] A. Schenone,[1] J. Hansen,[1] P. Cremer,[2] S. Harb,[1] W. A. Jaber[3]; [1]Cleveland Clinic, Cleveland, OH, [2]Heart and Vascular Insitute, Cleveland Clinic Foundation, Shaker Heights, OH, [3]Cleveland Clinic Foundation, Cleveland, OH

Introduction: Transient ischemic dilation (TID) has been identified as a high-risk feature in patients undergoing PET myocardial perfusion imaging (MPI). The incremental value of TID in patients with reduced left ventricular function (LVEF ≤ 40%) undergoing MPI Rb PET to identify multivessel coronary artery disease (MV-CAD) has not been evaluated to date.

Methods: We reviewed 1748 patients with LVEF ≤ 40% who underwent Regadenoson Rb MPI PET from 8/2012 to 4/2018. Data were gathered from the EMR including demographics, MPI PET and cardiac catheterization reports. Patients with a history of CABG were excluded. Statistical analysis of frequency of perfusion defects and angiographic disease severity was performed. TID ratio was defined as ≥ 1.13 based on historical data.

Results: We identified 58 patients with TID on MPI PET. Two patients had no perfusion defects but had MV-CAD on angiography. 27 patients had a perfusion defect in a single vessel distribution of which 21 had MV-CAD on angiography. The presence of TID reclassified these 23 patients into high-risk category by identifying patients who had no or single-vessel territory perfusion defects but had MV-CAD on invasive angiography.

Conclusions: In patients with LVEF ≤ 40%, TID on MPI PET appropriately reclassified 40% of patients into a higher risk group (MV-CAD) compared to semi-quantitative perfusion data alone. Although infrequent, TID remains an essential tool in risk assessment in the era of pharmacologic stress MPI PET.

ePOSTER SESSION V: SPECT DIAGNOSIS AND PROGNOSIS

Saturday, September 14, 2019 3:30 p.m.-4:30 p.m.

321-01

GLOBAL AND REGIONAL CORONARY FLOW RESERVE ASSESSED BY ROUTINE 99MTC-TETROFOSMIN SPECT
L. Philippe*, C. Prunier-Aesch, Y. El Yaagoubi; Medecine Nucleaire Tourangelle, Chambray-les-Tours, France

Background: We evaluate Coronary Flow Reserve (CFR) with routine 99mTc-tetrofosmin-SPECT (no first pass) for the myocardium, and for coronary artery territories.

Methods: CFR is computed using the ratio [myocardial stress counts/rest counts] on short-axis slices. Five corrective factors are necessary for this ratio (one day stress-rest protocol):

1. Subtraction of stress myocardial residual activity in the rest images,

2. Normalization of time acquisition duration stress vs rest,

3. Normalization of injected tracer dose activity (stress vs rest),

4. Correction of myocardial 99mTc-tetrofosmin extraction to compensate the stress uptake underestimation,

5. Normalization of the central ventricular pixel activity at stress vs rest: 10 min after tracer injection, we consider that blood pool activity is low and should be similar at stress and at rest. To apply these corrections, a five-steps software was developed (Aladdin language, GE Xeleris), completely automatic.

To validate this CFR method, for the global CFR and for coronary artery territories, we applied this method to a series of 29 patients who were addressed to our institution for routine myocardial stress and rest SPECT. An invasive coronary angiography (ICA) was realized before or after the SPECT. A coronary reserve index (CRI) was computed for each patient as well as a regional CRI (LAD, LCX and RCA territories).

Results: CRI values were compared to ICA. The optimal cutoff value to separate normal patients and coronary artery disease (CAD) patients, using ICA as a gold standard is about 2.20. According to ICA, 7 patients were normal, and 22 patients had significant CAD.

The global CRI, in seven normal patients is 3.65 ± 2.10, and 1.57 ± 0.59 for the 22 CAD patients. For CAD diagnosis using the global CRI, Sensitivity is 91% - Specificity 86% - Predictive Positive Value (PPV) 95% and Negative Predictive Value 75%. Area under Receiver-Operator-Characteristic curve is 0.87.

The main limit of this method is sometimes the presence of digestive activity, adjacent to the myocardium. ICA is considered as the gold standard, even if microvascular lesions are not routinely assessed.

Among the 22 CAD patients, 5 of them presented a multivessels disease with decreased global CRI, confirmed by the analysis of the 3 regional CRI. The difference between the maximal and minimal regional CRI, divided by the global CRI, is smaller for the 3 vessels disease (0.21 ± 0.04) than for the 17 others CAD patients (0.43 ± 0.31)

Among the 5 multivessels disease patients, 2 had a normal perfusion SPECT.

Conclusion: Assessment of global and regional CFR (coronary and microcirculation) by routine 99mTc-tetrofosmin is feasible, easy to apply on a routine basis, totally reproducible (totally automatic), with no additional time or cost to the routine SPECT. Coronary territories evaluation helps to detect three vessels disease. Sensitivity and PPV are excellent for CAD diagnosis.

321-02

CORRELATIONS BETWEEN LEFT BUNDLE BRANCH BLOCK-RELATED PERFUSION DEFECTS AND LEFT VENTRICULAR DYSSYNCHRONY
A. Rizkallah*,[1] S. L. Liao,[2] K. A. Demers,[3] J. Gerlach,[4] K. Lara,[5] P. J. Slomka,[4] W. Duvall[6]; [1]University of Connecticut - Hartford Hospital, Hartford, CT, [2]Cardiology, The Mount Sinai Medical Center, New York, NY, [3]Nuclear Cardiology, The Mount Sinai Medical Center, New York, NY, [4]Cedars-Sinai Medical Center, Los Angeles, CA, [5]Cardiology, Mayo Clinic, Rochester, MN, [6]Nuclear Cardiology, University of Connecticut - Hartford Hospital, Hartford, CT

Background: Left bundle branch block (LBBB) perfusion defects on SPECT imaging have been well-described, however, the etiology of these defects and determinants of their severity are unknown. We sought to investigate the association of left ventricular dyssynchrony, including histogram bandwidth, phase standard deviation and entropy, to the extent and severity of perfusion defects in patients with LBBB.

Methods: We retrospectively reviewed patients with LBBB and no known coronary artery disease who underwent a clinically indicated Tc-99 m SPECT MPI study using both conventional Na-I and high-efficiency CZT SPECT cameras. Patient characteristics, QRS duration, and stress test hemodynamics were collected. Myocardial perfusion and left ventricular dyssynchrony were quantified using automated quantification software (Cedars-Sinai QPS/QGS). Correlations of QRS duration and measures of dyssynchrony to global and regional total perfusion deficits (TPD) were evaluated.

Results: A total of 206 LBBB patients with a mean QRS duration of 146.4 ± 17.2 ms and LVEF of $54 \pm 15\%$ were imaged, with 110 (53.4%) imaged on the CZT and 96 (46.6%) imaged on the conventional SPECT camera. The mean rest TPD was $6.5 \pm 5.5\%$, with 5.5% in the LAD territory, 0.5% in the LCx, and 1.5% in the RCA. There were significant differences based on the SPECT camera types with the conventional camera having a higher rest TPD (7.3% vs 4.3%, p = 0.005). This difference was exclusively in the LAD territory (TPD 5.3% vs 2.3%, p < 0.0001).

In the entire cohort, QRS width was not significantly correlated with all three measures of dyssynchrony. QRS duration correlated with resting TPD (r = 0.25, p = 0.003) and only with the resting LAD territory TPD (r = 0.26, p = 0.003). Entropy correlated with rest TPD (r = 0.39, p < 0.001) and with LAD rest TPD (r = 0.35, p = 0.001) in a similar manner. Rest EF significantly correlated with all measures of dyssynchrony with (r = $-$ 0.78, p < 0.001 for entropy).

Conclusions: The LBBB SPECT perfusion defect appears to have the greatest effect on the LAD territory, but appears to be smaller when imaged with newer high-efficiency cameras. There appears to be some influence of left ventricular dyssynchrony on the extent and severity of the perfusion defect as measured by QRS duration or MPI dyssynchrony parameters.

321-03

EFFECT OF RADIOTRACER INFILTRATION ON AUTOMATED QUANTIFICATION OF SPECT MYOCARDIAL PERFUSION
A. Sharma*,[1] G. Pershwitz,[1] T. M. Morneau,[2] G. Heald,[1] G. Tadeo,[1] D. Pelletier,[1] F. Quevedo,[1] S. R. McMahon,[3] W. Duvall[4]; [1]Hartford Hospital, Hartford, CT, [2]Non-Invasive Cardiology, Hartford Hospital, Hartford, CT, [3]Cardiology, Hartford hospital, Hartford, CT, [4]Nuclear Cardiology, Hartford Hospital, Hartford, CT

Introduction: There is no routine method to determine the degree of radiotracer infiltration and the effect of radiotracer infiltration on the clinical interpretation of SPECT MPI is not well established. We sought to determine the effects of infiltration on the quantification of SPECT perfusion results by using quarter time imaging to simulate a roughly 75% dose infiltration.

Methods: In a pilot project, patients presenting for clinically indicated rest-stress Tc-99 m SPECT imaging were imaged using full-time (non-infiltrated) followed by quarter time (infiltrated) image acquisition protocols. Automated quantification using dedicated software was used to obtain Summed Rest Score (SRS), Summed Stress Score (SSS), Summed Difference Score (SDS) and Left Ventricular Ejection Fraction (LVEF) from non-attenuation corrected, full-time and quarter time rest and stress

images. This data were combined to create a simulated rest and stress dose infiltration.

Results: Ten patients were evaluated. Mean age was 64.7 years, 70% were females, mean BMI was 28.9 kg/m^2, 50% of the patients had known coronary disease, and 90% underwent vasodilator stress. There was reasonable correlation between infiltrated and non-infiltrated rest and stress LVEF's (r = 0.85, p = 0.0002 and r = 0.93, p < 0.0001). Correlation between infiltrated and non-infiltrated SRS and SSS was suboptimal (r = 0.73, p = 0.02 and r = 0.85, p = 0.0007). While the simulated rest dose infiltration patient had marginal correlation with the SDS (r = 0.83, p = 0.003), the correlation with the SDS with the stress dose infiltration was poor (r = 0.34, p = 0.33) (Figure).

Conclusions: Radiotracer infiltration during SPECT MPI can potentially affect the accuracy and clinical interpretation of the studies. This can have significant clinical implications.
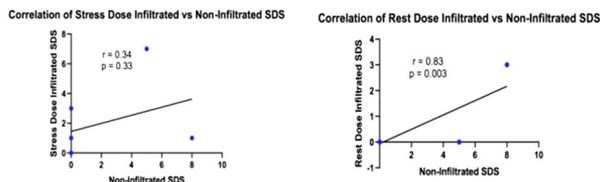
321-04

PERCENTAGE OF NORMAL PATIENTS FROM A NUCLEAR CARDIOLOGY DATABASE OF 120,000 STUDIES

C. D. Cooke*,[1] R. Eppes,[1] K. F. Van Train,[1] E. V. Garcia[2]; [1]Syntermed, Inc., Atlanta, GA, [2]Radiology, Emory University Hospital, Atlanta, GA

Introduction: Syntermed Live is a HIPAA-compliant, cloud-based Nuclear Cardiology Remote Reading and Database solution. Released in 2007, there are now over 500,000 studies stored in this database, complete with patient demographics, images and processing results from the Emory Cardiac Toolbox v3 or v4. With the release of our automated, artificial intelligence-driven structured reporting platform (AIsR) in the Emory Cardiac Toolbox v4 (ECTb4), we can now automatically report these studies. Using data from only ECTb4, from 2014 to the present, the database contains 120,802 studies (86,567 SPECT studies and 34,235 PET studies) from 30 sites. These studies represent a broad geographic representation from the United States (rural areas to large metropolitan cities) and a broad clinical representation (private practice to academic hospitals).

Methods: The Summed Stress Score (SSS) and Summed Difference Score (SDS) were automatically calculated for every study, with the AIsR set at Tradeoff Sensitivity (see https://doi.org/10.1007/s12350-018-1432-3). A study was considered normal if the SSS was <= 3. The Ischemic Burden % (IB%) was calculated as the SDS/68 * 100%, and was considered significant if it was > = 10%.

SPECT

SPECT 2014 - 2019	86,567 total studies	53.5% Normal	16.3% of Abnormal are ischemic (IB% > = 10%)
SPECT 2018	25,512 total studies	59.2% Normal	15.6% of Abnormal are ischemic (IB% > = 10%)
SPECT 2017	21,451 total studies	50.2% Normal	16.1% of Abnormal are ischemic (IB% > = 10%)
SPECT 2016	22,095 total studies	46.2% Normal	17.0% of Abnormal are ischemic (IB% > = 10%)

Results: SPECT results are shown in the table below. Based on the automatic SSS, 53.1% of all patients were automatically classified as normal (SPECT: 53.5%, PET: 52.0%, p < 0.05); 18.3% of all abnormal studies had evidence of ischemia, with IB% > = 10% (SPECT: 16.3%, PET: 23.1%, p < 0.05). SPECT data from 2016 - 2018 shows % normal studies is increasing each year (p < .05) and the % of abnormal studies with ischemia is decreasing each year (p < .05). PET shows even more significant trends for this same time period.

Conclusions: We have shown that in a large database of myocardial perfusion studies, the % of normal studies is close to the optimal percentage of 50% but is increasing each year; the % of abnormal studies with ischemia is decreasing each year.

321-05

SPECT MYOCARDIAL BLOOD FLOW QUANTIFICATION IS SUPERIOR TO MYOCARDIAL PERFUSION IMAGING FOR DETECTION OF CORONARY ARTERY DISEASE: A MULTICENTER TRIAL

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Introduction: Quantification myocardial blood flow (MBFQ) using technetium labeled myocardial perfusion tracers and dedicated SPECT cameras has become clinically feasible. Whether the diagnostic performance of SPECT MBFQ is superior to myocardial perfusion imaging (MPI) while utilizing angiography as the reference standard has not been well studied.

Methods: In three hospital centers, 191 patients with suspected or known coronary artery disease who were scheduled for SPECT MPI were consented to receive an adjunct dynamic SPECT (DySPECT) scan for MBFQ under the same rest and stress test (clinicalTrials.gov #: NCT03637725). Subjects who did not recieve coronary angiogram post MPI and DySPECT scans were excluded. Image processing of MBFQ employed full physical corrections for reconstruction of DySPECT images, one-tissue compartment for kinetic modeling, and corrections for ^{99m}Tc-Sestamibi extraction and rest rate-pressure-product to quantify stress MBF, rest MBF and myocardial flow reserve using a dedicated SPECT MBFQ software. Flow values in myocardium were further converted to corresponded flow statuses defined by the Gould's flow diagram (JACC 2012) with slight modification. The patient-based positive diagnosis of MBFQ met one of two independent criteria as 1) $\geq 3.01\%$ extent of myocardium within ischemia-steal combined flow status or 2) $\geq 20.3\%$ extent of myocardium within moderate abnormal and ischemia-steal combined status. Interpretation of MPI images were conducted by three experienced readers in a consented reading session.

MPI was considered abnormal when SSS ≥ 4 or SDS ≥ 2 or index of transient ischemia dilation ≥ 1.19. The patient-based diagnostic performance SPECT MBFQ and MPI for detecting $\geq 50\%$ stenosis in epicardial coronary artery on angiogram were compared.

Results: A total of 160 patients were included. Among this population, 33 patients presented with three-vessel disease, and 36 patients showed intermediate disease (50%–70% stenosis on angiogram). For detecting $\geq 50\%$ stenosis, MBFQ showed a sensitivity of 72.0%, a specificity of 73.8% and an accuracy of 72.5%. MPI has a relatively lower sensitivity at 47.5% (p = 0.000), a comparable specificity at 78.6% (p = 0.791) and an inferior accuracy at 55.6% (p = 0.002). MBFQ detected 90.9% of three-vessel disease (30/33), which is significantly superior to MPI (51.5%, 17/33) (p = 0.001). MBFQ also tended to detect more intermediate disease (44.4%, 16/36) than MPI (33.3%, 12/36), but the difference did not reach statistically significant (p = 0.236).

Conclusion: SPECT MBFQ has a higher sensitivity and a superior accuracy to MPI for detecting patients with significant coronary stenosis, especially for patients with three-vessel disease.

POSTER SESSION V: NEW DEVELOPMENTS IN CARDIAC PET
Saturday, September 14, 2019 3:30 p.m.-4:30 p.m.

322-01

COUNT RATE PERFORMANCE EVALUATION OF 3D PET SYSTEM FOR $^{82}RBCL_2$ MYOCARDIAL DYNAMIC IMAGING

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Introduction: Myocardial blood flow (MBF) using Rubidium-82 chloride ($^{82}RbCl2$) is becoming popular for assessment of cardiovascular diseases. MBF estimation using positron emission tomography (PET) requires initial high amount of radioactivity which may lead to the detector counting saturation, impacting the image quality and MBF flow estimates. Recently, constant activity (CA) infusion of $^{82}RbCl2$ has shown to maximize the net true counts. The purpose of this study is to characterize the PET count rates for dynamic imaging and MBF when using constant activity and constant flow (CF) infusion of $^{82}RbCl2$.

Methods: In this institutional IRB-approved retrospective study, 50 patients each undergoing rest and stress studies (50: CA, 50: CF) were analyzed by extracting the true and random counts from the list-mode $^{82}RbCl2$ acquisition. All the data were acquired using Siemens Healthcare Biograph Horizon PET/CT with lower and higher energy window 435 keV and 630 keV, respectively. $^{82}RbCl2$ was obtained from the Rubyfill^{TM} generator. True to random ratio (T/R) was calculated for each 2 s time frame. The mean injected $^{82}RbCl2$ dose was 30 ± 10 mCi. Constant activity was infused over 30 s using manufacturer proprietary technique, whereas constant flow was infused at 30 ml/sec.

Results: The PET detectors did not saturate for both the constant flow and constant activity infusion. Constant activity showed higher T/R ratio than constant flow for the initial 70 s for both the stress and rest studies. CF T/R ratio peaked 20 s earlier with higher amplitude than CA T/R ratio. Crisscrossing of trues and random curves indicated optimal infusion of $^{82}RbCl2$. Crisscrossing of trues and random curves was earlier for CF than CA infusion.

Conclusions: Studied 3D PET system showed good count rate capabilities for both the constant activity and constant flow infusion of Rubidium chloride dynamic imaging of myocardium. True to random ratio and crisscrossing of trues and random curves are important quality parameter for ascertaining the optimal infusion of rubidium chloride.

True to Random count ratio for the rest and stress studies

Curves of True and Random counts for Constant Flow and Constant activity
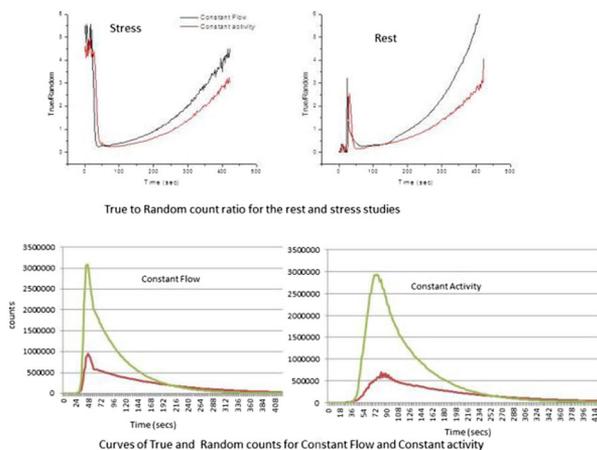
322-02

BLOOD GLUCOSE STATUS MEDIATES MICROVASCULAR DYSFUNCTION IN PATIENTS REFERRED FOR POSITRON EMISSION TOMOGRAPHY

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Introduction: Diabetes is an established risk factor for coronary artery disease. In addition, hyperglycemia has been shown to be associated with increased markers of vascular inflammation and myocardial perfusion defect on contrast echocardiography. However, data regarding the effect of blood glucose level (BS) on myocardial blood flow (MBF) on Positron emission tomography (PET) is limited. We sought to examine the effect of BS and glycosylated hemoglobin (HbA1C) on MBF and coronary artery reserve (CFR) measured by vasodilator PET.

Methods: All hospitalized consecutive patients referred to clinically indicated PET between May 2011 and December 2017 who had fasting blood glucose in the day of the test and HbA1C within three months of the test were included in the analysis. Patients with known CAD, ischemia (sum difference score > 2), scar (sum stress score > 3), transient ischemic dilatation and abnormal resting left ventricular function were excluded. MBF was measured by single compartment method and CFR is calculated as stress MBF/rest MBF.

Results: A total of 184 patients (mean age 60 ± 10, 50% female) were included. 68 patients had HbA1C above 7 mg/dl. Patients with elevated HbA1C were older and have higher prevalence of cardiac risk factors ($p < 0.001$). Using spearman correlation, there was a weak, but statistically significant correlation between CFR and HbA1C ($r = 0.2199$, $p = 0.0027$) and fasting BS ($r = 0.178$, $p = 0.0596$) However, there was no correlation between peak MBF with HbA1C($r = 0.0614$, $p = 0.4079$) or fasting blood sugar ($r = 0.0863$ $p = 0.3589$). Using multivariate linear regression, the correlation between HbA1C and CFR was significant after adjusting for confounders (Beta = 0.366, $p = 0.022$)

Conclusions: Coronary artery circulation is affected by the glucose status in the blood. Whether BS should be corrected to improve the accuracy of CFR by PET is yet to be determined.
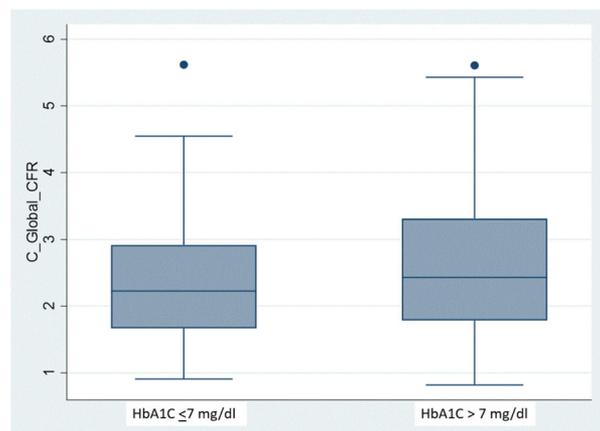
322-03

NORMAL VALUES FOR MYOCARDIAL BLOOD FLOW AND MYOCARDIAL FLOW RESERVE USING[82]RUBIDIUM AND A DEDICATED CARDIAC POSITRON EMISSION TOMOGRAPHY (PET) SCANNER WITH A HYBRID 2D/3D ACQUISITION PROTOCOL

D. Harland*, D. Mahlum, J. Falk, P. Galazka, S. Port; Advocate Aurora Health Care, Milwaukee, WI

Background: Reported normal values for PET myocardial blood flow (MBF) vary depending on the tracer, scanner, acquisition mode and software used. We previously described normal MBF using a dedicated cardiac scanner in 3D mode, but those data were thought to be confounded by frequent crystal saturation. We sought to reexamine normal MBF and myocardial flow reserve (MFR) with [82]Rubidium(Rb) and a dedicated cardiac PET scanner using a hybrid 2D/3D acquisition protocol.

Methods: One hundred and thirteen patients underwent rest and regadenoson (REG) Rb-PET MPI on a dedicated scanner with LSO crystal (SCINTRON, MiE, Elk Grove Village, IL) from December 2018 to January 2019. Patients received a 15 MBq/kg Rb dose. 2-D list-mode emission scans were acquired for 120 secs. After a 45 s delay for retraction of collimator septa, 3-D list-mode emission scans were acquired for 5 min. List-mode data were reconstructed and flow data were obtained using QPET (Cedars-Sinai) software which allowed for creation of the myocardial regions-of-interest on the 3D data set and subsequent application to the 2D data set. We excluded patients with abnormal perfusion, TID ratio > 1.2, known obstructive coronary disease, and diabetes mellitus.

Results: After exclusions, we analyzed 17 patients (15/2 f/m). Mean age was 66 ± 13 yrs, mean BMI was 38.6 ± 7.8, 76.4% had hypertension and 58.8% had hyperlipidemia. The mean TID was 1.00 ± 0.07, Resting and REG LVEF were 70.5 ± 12.7% and 74.7 ± 10.7%. Blood flow results are shown in the table. There was no crystal saturation during the 2D or 3D acquisitions.

Conclusion: Using a hybrid 2D/3D acquisition protocol, we found global resting MBF of 1.09 ± 0.43, global REG MBF of 3.23 ± 0.78, and global MFR of 3.45 ± 1.27 (mL/min/g) in the absence of a perfusion abnormality or known CAD. Findings were similar in all coronary territories and were consistent with our previous 3D flow results, suggesting that crystal saturation may not adversely affect 3D flow calculations.

	LAD	LCX	RCA	Global
Historical 3D Protocol n = 129				
Rest MBF (mL/min/g)	1.20 ± 0.27	1.23 ± 0.28	1.15 ± 0.27	1.21 ± 0.27
REG MBF (mL/min/g)	3.20 ± 0.62	3.38 ± 0.65	3.49 ± 0.53	3.34 ± 0.58
MFR	2.74 ± 0.73	2.88 ± 0.75	3.19 ± 0.81	2.90 ± 0.70
2D/3D Hybrid Protocol n = 17				
Rest MBF (mL/min/g)	1.07 ± .43	1.07 ± .46	1.11 ± .41	1.09 ± .43
REG MBF (mL/min/g)	3.02 ± .79	3.26 ± .80	3.55 ± .85	3.23 ± .78
MFR	3.34 ± 1.28	3.61 ± 1.69	3.58 ± 1.17	3.45 ± 1.27

322-04

DOES CARDIAC PET MYOCARDIAL PERFUSION IMAGING IN A CLINICAL PRACTICE CHANGE REFERRAL FOR AND OUTCOMES AT CARDIAC CATHETERIZATION?

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Background: Cardiac PET myocardial perfusion imaging (MPI) is now being implemented in many clinical nuclear cardiology laboratories throughout the United States because of higher diagnostic accuracy, better image quality and lower radiation exposure, which should change post-test referral patterns. The purpose of this study was to examine the outcomes of a similar population of medicare patients from the same cardiology group who underwent either SPECT or PET MPI. The outcome measures were cardiac catheterization and revascularizations following either testing procedure.

Methods: Consecutive Medicare patients who met AUC criteria and underwent SPECT or PET MPI were followed as to whether they underwent cardiac catheterization and intervention within 60 days of the nuclear procedure. The percentage of normal results at catheterization from each group was also determined.

Results: 1328 SPECT patients in 9 months preceding the PET program were evaluated (mean age 76.5), and compared to 703 PET patients for 6 months after program initiation (mean age 75.7). Cardiac catheterization was performed in 6.9% of SPECT MPI and 6.1% of PET MPI (11.7% reduction, p = NS). For those patients who underwent catheterization, intervention (either PCI or CABG) was performed in 43.5% of SPECT patients and a higher percentage for PET MPI, 53.5% (p = NS). Of SPECT MPI patients, 41.3% were found to have no or insignificant CAD at catheterization compared with 16.3% of PET patients (p < 0.001)) **Conclusion:** Cardiac PET MPI should affect downstream testing. We found initiation of cardiac PET myocardial perfusion imaging into a clinical cardiology practice resulted in a reduction of the number of patients referred for cardiac catheterization as well as significantly fewer unnecessary catheterizations (normal) and a higher percentage of interventions.

Outcomes of Cardiac Catheterization
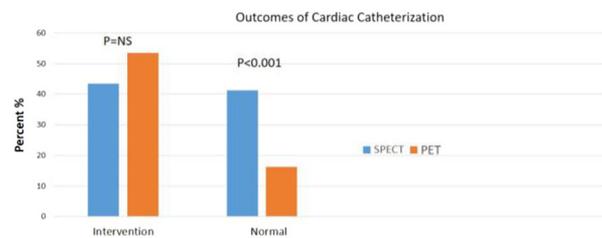
322-05

ROLE OF NAF PET/CT IN ASSESSING AORTIC VALVE CALCIFICATION AND ITS CORRELATION WITH AGE

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Background: Aortic valve calcification is a slow and progressive pathological process that can manifest in various degrees from mild thickening of the valve known as aortic sclerosis to severe calcification that hinders the leaflet motion, known as aortic stenosis. The evolving concept of aortic calcification is thought to result from infiltration of macrophages and T-lymphocytes. Moreover, the incidence of aortic valve calcification increases with age, in particular over the age of 50. In this study, we aimed to assess ^{18}F-sodium fluoride (NaF) uptake by the aortic valve on PET/CT scans performed in two age groups; 25–35 and 50–75 years of age. We hypothesized that patients aged 50-75, comprising of both healthy and high-risk for cardiovascular disease (CVD), would have higher uptake of NaF than patients aged 25-35 and further that in the former group those who were at high risk for CVD had also higher NaF uptake.

Methods: The 25–35-year group comprised of 6 males and 6 females, mean age 30 ± 3.5 years, while the 50–75-year group included 18 males and 20 females, mean age 61 ± 6.2 years. All underwent PET/CT imaging 90 min following the injection of 2.2 MBq of NaF per kg body weight. Aortic valve analysis was performed on axial sections using standard guided computer software (OsiriX MD software, version 9.0.02). The average aortic valve SUVmean was calculated for each patient. Univariate regression models were employed to determine the association of SUVmean with age.

Results: SUVmean was found to be higher in the 50–75 age group than in the 25-35 age group: 0.91 ± 0.25 and 0.86 ± 0.26, respectively. The association of SUVmean with age was much stronger in individuals aged 50-75 years ($r = 0.64$, $p = 0.00001$) than individuals aged 25-35 years ($r = 0.20$, $p = 0.53$). In addition, in the 50-75 age group the association was much stronger in subjects with a high risk of CVD than in individuals without: $r = 0.64$, $p = 0.002$ versus $r = 0.48$, $p = 0.042$. Furthermore, the SUVmean was found to be higher in the high-risk group aged 50-75 than in the low-risk healthy group aged 50-75: 0.98 ± 0.32 and 0.83 ± 0.13.

Conclusion: Aortic valve NaF uptake was higher in patients belonging to the age group of 50–75 years and correlated positively with age and high risk of CVD. These data provide evidence for a potential role of NaF PET/CT in identifying calcific changes in the aortic valve and may help direct therapeutic intervention prior to the development of symptomatic valvular disease.

Author Index

Keyword Index