Abstracts of Original Contributions
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POSTER SESSION 106 CARDIOMYOPATHIES

Thursday, September 8, 2022, 6:15 pm-7:15 pm

106-01

RELATIONSHIP BETWEEN MYOCARDIAL ENERGETICS, MYOCARDIAL BLOOD FLOW, AND MYOCARDIAL FUNCTION IN LIGHT-CHAIN AMYLOIDOSIS

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Introduction: The pathogenesis of myocardial dysfunction in light-chain (AL) cardiac amyloidosis is poorly understood. The aim of the present study is to evaluate the relationship between left ventricular (LV) myocardial mechanical external efficiency (MEE), myocardial blood flow (MBF), and myocardial function in patients with AL amyloidosis.

Methods: This prospective study enrolled 57 biopsy-proven AL amyloidosis patients. Cardiac involvement was defined by recent multi-societal consensus criteria (NT-proBNP, wall thickness, extracellular volume (ECV) and global longitudinal strain (GLS)). All subjects underwent 11C-acetate positron emission tomography (PET); myocardial oxygen consumption (MVO2) and MBF were assessed from the clearance (k2) and inflow rate constant (k1), respectively. MEE was calculated as (stroke volume*heart rate*mean arterial blood pressure*1.33*10^-4)/(myocardial mass*MVO2*20)*100 using stroke volume and mass from MRI. MBEF was adjusted by rate-pressure-product (RPP).

Results: Cardiac involvement was present in 43 patients (75%). In these patients, MEE and MBF were significantly impaired as compared to patients without cardiac involvement (MEE: 11% [8-15] vs. 15% [11-22], P = .023; MBF: 0.57 mL/min/g [0.46-0.75] vs. 0.96 mL/min/g [0.81-1.07], P < .001). Neither MEE nor MBF correlated with revised Mayo stage, 6-minutes walking distance , and quality of life from Minnesota Living with Heart Failure Questionnaire. In patients with cardiac involvement, both MEE and MBF were moderately correlated with systolic function (GLS), while only MEE was moderately correlated with diastolic function (E/e’); in patients without cardiac involvement, no significant correlations were observed (Figure).

Conclusions: Systolic dysfunction in cardiac AL amyloidosis is related to impaired myocardial blood flow and to energetic inefficiency, while diastolic dysfunction is primarily related to energetic inefficiency.

Mechanistic underpinning of myocardial dysfunction in cardiac AL amyloidosis

106-02

FINAL DIAGNOSIS IN PATIENTS WITH EQUIVOCAL TC-99 M PYROPHOSPHATE (PYP) IMAGING

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Introduction: Extra-myocardial presence of tracer often results in equivocal interpretation of PYP scans. Since scintigraphy is based on relative tracer uptake, the presence of prominent extra-myocardial tracer most likely indicates a lack of significant myocardial uptake of tracer. Therefore, we explored the final clinical diagnosis in patients with an equivocal PYP interpretation.

Methods: Data were obtained by IRB-approved retrospective review of patients who underwent a PYP scan. Planar and SPECT imaging were performed at 1 hour and 3 hours after injection of 15 mCi of Tc-99 m PYP. Positive and negative scans were defined by the presence or absence of myocardial PYP uptake on the 3 hours-SPECT scan. A scan was considered equivocal if tracer was present in the field of view but could not be definitively localized with respect to the myocardium. Serum studies for AL amyloidosis were performed in all patients. A tissue biopsy was performed when indicated clinically. Chart review was performed to determine the subsequent evaluation and final diagnostic determination of patients with equivocal PYP. Independent Student T tests were used to determine the differences in continuous variables between groups, and a χ² test was used to test the variance in categorical clinical characteristics between groups.

Results: A total of 856 PYP scans were performed between 2016 and 2021, of which 305 were databased and thus, had all clinical data available. Of these scans, 23 (7%), 78 (26%), and 204 (67%) were reported as equivocal, positive, and negative, respectively. Among studies reported as equivocal, no patient had a final diagnosis of cardiac amyloidosis. Patients with an equivocal scan were similar to patients with a negative scan in their clinical and echo features, and substantially different from patients with a positive scan [Equivocal scans: bilateral carpal tunnel 17% (vs. negative scans 19%, P = .84 and positive scans 53%, P = .003); spinal stenosis 13% (vs. negative scans 14%, P = .88 and positive scans 37%, P = .03); chronic tronnon elevation 13% (vs. negative scans 30%, P = .09 and positive scans 37%, P = .03); apical sparing 4% (vs. negative scans 25%, P = .03 and positive scans 57%, P = .011)].

Conclusion: Patients with an equivocal PYP scan rarely have a final diagnosis of cardiac amyloidosis. They have a clinical profile similar to patients with a negative PYP scan which is substantially different from patients with a positive PYP scan. These single-center data must be confirmed in multicenter analyses.

106-03

CARDIAC AMYLOIDOSIS IN LATIN AMERICA: AVAILABILITY AND USE OF DIAGNOSTIC RESOURCES. FINDINGS FROM THE AMILO-LATAM RESEARCH GROUP

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Introduction: Cardiac amyloidosis (CA) is an under-diagnosed disease with high morbidity and mortality. Wild-type transthyretin amyloid
cardiomyopathy (ATTR-CM) is more commonly seen with increasing prevalence as life expectancy grows. New diagnostic imaging techniques and novel treatments allow for a better prognosis. We have recently created an international working group on CA (AMILO-LATAM) aiming to identify potential needs in our region. This work aimed to investigate the availability and use of diagnostic ATTR-CM tools in LA.

**Methods.** An online survey was distributed among nuclear medicine centers across LA and promoted by digital means for two months (June-July 2021). We asked five questions about the availability of imaging equipment, radiopharmaceuticals, accessibility to transthoracic echocardiography (TTE), echo-strain (ESI), cardiac magnetic resonance (CMR) with parametric mapping (PM), and light chains quantification (LCQ). The information was automatically entered into a spreadsheet for descriptive statistical analysis.

**Results.** Surveys were collected from 14 LA countries, with 82 NM centers from 45 cities. All centers (100%) have access to perform SPECT, but advanced technology is lacking in some areas (SPECT/CT-44%, CZT-7%). PYP is available in most centers (83%); a minority use HMPD (12%), and four centers (5%) use MDP. Most have access to TTE (86%), but only 59% have access to ESL. Similarly, CMR is available in 76% of the centers, but only 42% have access to PM. LCQ is available in 56% of the centers. Despite the accessibility of the essential resources, 24% of the centers have not performed a single study to identify CA in the previous year. Most of the remaining ones report an average of one study per month or less.

**Conclusion.** Diagnostic imaging resources are reasonably available in the region but are under-utilized, probably because of limited awareness of clinicians about the disease. The survey demonstrated the need for educational programs and other measures to increase the utilization of diagnostic technology in ATTR-CM.

**106-04**

**64Cu-DOTATE PET METRICS IN THE INVESTIGATION OF ATHEROSCLEROTIC INFLAMMATION IN HUMANS**

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**Introduction:** The aim of this study was to assess and compare the arterial uptake of the inflammatory macrophage targeting PET tracer [64Cu]Cu-DOTATE in patients with no or known cardiovascular disease (CVD) to investigate potential differences in uptake.

**Methods:** Seventy-nine patients who had undergone [64Cu]Cu-DOTATE PET/CT imaging for neuroendocrine neoplasm-disease were retrospectively divided into three groups: A control group with no known CVD risk factors (n = 22), an "At-Risk" group with one or more CVD risk factors (n = 24), or patients with known ischemic CVD (n = 33). Both maximum, mean-of-max, and most-diseased-segment (mds) standardized uptake value (SUV), and target-to-background ratio (TBR) uptake metrics were measured and reported for the carotid arteries and the aorta. From these data, receiver operating characteristic (ROC) curves were made to determine optimal cut-point values. Intraclass correlation coefficients were calculated along with Bland–Altman plots to assess reproducibility.

**Results:** For the carotid arteries, TBRmax (P < .01), TBRmds (P < .01) and mean-of-max-TBR (P = .01) was overall shown to provide both a group-wise difference in uptake, along with similar area under the curve (AUC) values of ~ 0.73. Carotid SUV metrics also showed group-wise differences but with lower AUC’s. Only TBRmds (P = .04) showed a significant difference between groups in the aortic analysis and an acceptable AUC (0.73).

**Conclusion:** Using [64Cu]Cu-DOTATE PET imaging as a marker of atherosclerotic inflammation, we were able to demonstrate differences in some of the most frequently reported uptake metrics in patients with different degrees of CVD. Measurements of the carotid artery as either maximum uptake values or most-diseased-segment analysis showed the best ability to discriminate between the groups.

Figure shows placement of ROIs in the carotid arteries, ascending aorta, and descending aorta.
106-05

IMPACT OF TREATMENT RESPONSE ON LONG-TERM CARDIOVASCULAR OUTCOMES IN PATIENTS WITH SUSPECTED CARDIAC SARCOIDOSIS

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Introduction: Serial positron emission tomography (PET) imaging is utilized to monitor treatment response in patients with suspected cardiac sarcoidosis (CS). However, there are sparse data available on the impact of myocardial inflammation relapse on cardiovascular outcomes.

Methods: We identified 44 patients with suspected CS (51.7 ± 9.8, 23.7% females, LVEF 40.4 ± 16.7) who demonstrated myocardial inflammation at baseline diagnostic PET scan, were subsequently started on immunosuppressive treatment, and had three or more serial PET scans additionally from baseline diagnostic scan. Our cohort consisted of three groups: Group A (n = 14; non-relapse) sustained complete treatment response (CTR) without relapse on serial imaging (median scans = 6, IQR 4.25, 7); Group B (n = 21; relapse) achieved CTR on serial PET but subsequently relapsed (median scans = 8, IQR 6, 12); Group C (n = 9; no-response) never achieved CTR on serial PET imaging (median scans = 6, IQR 4, 6). Major adverse cardiovascular events (MACE) were defined as sustained ventricular tachycardia/ventricular fibrillation (VT/VF), heart failure (HF) admission, and death.

Results: From 44 patients, 80% (n = 35) achieved CTR, of which only 40% (n = 14) remained in CTR. There was no difference in median time to detect CTR in the non-relapse group (15.9 months [IQR 8.15, 43.12]) compared to relapse group (11.8 months [IQR 5.9, 20.4]; P = .52). The median time to relapse after achieving CTR was 9.6 months [IQR 7.1, 15]. There was no-response among 20% of patients (n = 9) during a median follow-up time of 30.8 months [IQR 23.7, 41.5]. Despite differences in treatment response between the three groups, there was no difference in overall MACE (Figure 1), median follow-up 91.6 months [IQR 63.4, 112.7]).

Conclusion: Patients with CS undergoing serial PET imaging who demonstrated non-relapse, relapse, and no-response had similar adverse cardiovascular outcomes despite variations in time to treatment response.

106-06

THE ASSOCIATION OF MYOCARDIAL BLOOD FLOW WITH LV SYSTOLIC DYSFUNCTION IN CARDIAC ATTR AMYLOIDOSIS: A PILOT STUDY

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Introduction: There is a high prevalence of coronary microvascular dysfunction in Cardiac Amyloidosis (CA). We explored its association with LV systolic dysfunction.

Methods: ATTR CA patient who was referred for clinically indicated myocardial perfusion imaging (MPI) was included. Rest/stress MPI and myocardial blood flow quantification were performed on a solid-state system (DSPECT) by standard protocol using 9 mCi and 30 mCi Tc-99 sestamibi, respectively. Tracer injection was performed with an automatic pump, 50–60 second after regadenoson. Data acquired in listmode were processed on the 4DM platform using a Net Retention model and applying residual subtraction. An ejection fraction (EF) of < 50% and ≥ 50% was considered reduced (rEF) and preserved (pEF), respectively. Microvascular dysfunction was defined as a Peak Stress Flow of (PSF) < 2.0 ml/g/min. A lack of vasodilator response was diagnosed when the global myocardial flow reserve (MFR) was ≤ 1.2.

Results: Among the fourteen patients included, there were no reversible perfusion defects on MPI. Five patients had rEF. Microvascular disease was present in 12 (85%) patients. Peak Stress Flow (PSF) was significantly higher in patients with pEF as compared to those with rEF (1.69 vs. 0.85, P = .004). Global MFR and rest flow (RF) trended to be higher in patients with pEF (MFR 1.69 vs. 2.08, P = .337, and RF 0.57 vs. 0.84, P = .11). All patients had a vasodilatory response.

Conclusions: Microvascular disease is prevalent in patients with ATTR-C. In this pilot study, Patients with ATTR CA and rEF have a lower peak stress flow compared to patients with pEF, which may have mechanistic and therapeutic implications.
106-07
IDENTIFYING AND TREATING COVID-19 PATIENTS USING QUANTITATIVE NUCLEAR IMAGING

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Identifying and Treating COVID-19 Patients Using Quantitative Nuclear Imaging.

Background: SARS-CoV-2 and the associated InflammaThrombotic Response (ITR) COVID-19 is associated with significant morbidity and mortality. Quantitative Nuclear Imaging using FMTVDM has been shown to identify ITR and infectious disease and can be used to both identify and track treatment responses in such individuals. This study looked at a variety of treatments and measured treatment outcomes.

Methods: 1800 patients testing positive for SARS-CoV-2 were assigned to a treatment or observation group. Three days later they were re-evaluated. Those with disease progression and diagnosis of COVID-19 were admitted to hospital, underwent further testing including quantitative evaluation of the extent of disease using FMTVDM. Patients were randomly assigned one of ten treatments and re-evaluated 72-hours later. Patients were kept on the same treatment if they improved. Patients who did not improve were randomly assigned an additional treatment and re-evaluated 72-hours later. This sequence was continued until treatment was successful or patients expired.

Results: Of the 1800 outpatients, 501 required hospitalization. Among those not admitted, 504 of the 847 not treated (59.5%) recovered without treatment. Among those treated in the outpatient setting, 795 of the 953 (83.4%) responded to a combination of treatments. Three days later while on ventilator assistance. FMTVDM correlated with IL-6 and Ferritin levels at 0.718 and 0.673, respectively.

Conclusion: Quantitative FMTVDM imaging, IL-6, and Ferritin levels provided a useful method for diagnosing and treatment guidance of patients with COVID-19.

106-08
ANALYSIS OF UPTAKE PATTERNS OF 99MTC PYP QUANTITATIVE IMAGING INATTR CARDIAC AMYLOIDOSIS

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Introduction: Transthyretin is commonly thought to be deposited homogenously throughout the myocardium inATTR cardiac amyloidosis. However, a number of studies have suggested that there may be regions of increased or decreased accumulation. We sought to use tomographic imaging of Tc-99 m pyrophosphate to allow for precise localization of counts to characterize typical myocardial involvement in wild-type ATTR amyloidosis.

Methods: This retrospective, single-center study analyzed Tc-99 m PYP uptake in consecutive patients clinically diagnosed with wild-type ATTR. Tomographic images were used to quantify tracer uptake in a 17 segment model employing commercially available software. The raw counts were normalized for the dose of radiotracer present at time of imaging using a standard decay equation for Tc-99 m. The uptake in different segments was compared.

Results: 50 patients were evaluated with an average age of 80 ± 8 years and 88% male gender. While there were small differences between the individual segments in count uptake (greatest counts in the mid septum, apical septum, and apex), there was no significant difference in the overall segmental distribution of counts (P = .34). The mean number of counts was 9.0 ± 5.8 mCi in the basal segments, 10.1 ± 6.7 mCi in the mid segments, and 10.6 ± 7.7 mCi in the apical segments (P < .0001). While there was a slightly higher mean number of counts in the apex, this was not statistically significantly greater than the basal (P = .23) or the mid (P = .74) segments.

Conclusion: Contrary to previous reports that showed differential segmental uptake, especially a paucity of apical counts, this cohort displayed no significant segmental or regional variation in Tc-99 m PYP uptake. This may be due to the inclusion of only patients with a clinical diagnosis of wild-type ATTR as patterns of uptake may differ in patients with mutant ATTR or light-chain cardiac amyloidosis.

106-09
INCREASED SYMPATHETIC TONE IN REGIONS OF NON-TRANSMURAL MYOCARDIAL INFARCTION IN PATIENTS WITH ISCHEMIC CARDIOMYOPATHY

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Introduction: Measurements of cardiac sympathetic function using positron emission tomography (PET) imaging have been shown to predict the risk of sudden cardiac death in patients with ischemic cardiomyopathy (ICM) in the PAREPET trial (JACC 2014;63(2):141) which used the PET tracer 11C-hydroxyephedrine (HED), a false neurotransmitter analog of norepinephrine. However, HED is limited in its clinical utility due to a short half-life (20 minutes). A new F-18-labeled PET tracer flubrobenguane (t1/2 = 110 minutes) is being investigated to provide regional denervation (uptake) and sympathetic tone (washout). This study sought to identify regions of increased washout in correlation to infarct on perfusion imaging in patients with ICM (with prior myocardial infarct) vs non-ICM (NICM) and healthy controls.

Methods: Patients (N = 13; 7 ICM, 4 NICM, 2 controls) completed early (30 min) and late (3 h) PET-CT imaging following injection of 3 MBq kg of flubrobenguane. Patients also underwent rest perfusion scan using 13NHD or 82Rb PET. Relative perfusion was used to define transmural (< 30% of max perfusion tracer uptake), non-transmural (30–79%), and remote (≥ 80%) regions in patients with ICM and reduced (< 80%) and normal (≥ 80%) regions in patients with NICM. The max
and mean washout rate (% reduction of early vs late uptake) were quantified on a 17-segment LV model. 

**Results**: In patients with ICM (mean LVEF, 33 ± 8%), max washout was significantly increased in the non-transmural infarct region (38 ± 12%; \( P < .05 \) vs all) compared to transmural (19 ± 9%) and remote regions (22 ± 10%). In NICM (mean LVEF, 38 ± 7%), there was minimal washout in reduced (14 ± 4%) and remote regions (15 ± 6%), and similarly in controls (13 ± 2%) (Figure 1).

**Conclusion**: This new PET tracer demonstrated significantly increased washout in non-transmural infarct regions in patients with ICM. Further research is needed to test if this phenomenon will be helpful in identifying regions of neurohormonal imbalance which may serve as a substrate for increased arrhythmogenicity, and thereby help risk stratify patients with ICM for device therapy.

**106-11**

AN AUTOMATIC DEEP-LEARNING CT-BASED SEGMENTATION TECHNIQUE FOR SIMPLIFIED DPD SPECT-CT QUANTIFICATION IN CARDIAC AMYLOIDOYSIS ASSESSMENT

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**Introduction**: Certain bone tracers are clinically used in cases with suspected ATTR cardiac amyloid involvement. The primary assessment of myocardial uptake is through visual interpretation using the well-recognized Perugini Grade (PG) from wholebody planar images. SPECT-CT is now becoming more routinely used as part of the imaging protocol and recent literature suggests quantification may be useful in disease assessment and therapy response. Several groups have evaluated Standardized Uptake Value (SUV) in the left ventricle (LV), which requires knowledge of patient weight, injected activity, and scanner sensitivity. Accurate segmentation of the left ventricle (LV) can be challenging, especially in low-grade uptake where the heart is not readily visible in the SPECT image. This work evaluates a fully automated deep-learning segmentation algorithm that delineates the LV and bloodpool (BP) cavity based on the non-contrast attenuation correction CT. From here, a simple LV:BP ratio negates the pre-requisites of an SUV calculation for measuring amyloid uptake on the SPECT image.

**Methods**: 50 consecutive patients were retrospectively analyzed. SPECT-CT was performed on a Siemens Intevo 2.5 hours post-injection of 700 MBq 99mTc-DPD. PG was determined by an experienced physician from the planar wholebody images at 3-hours post-injection and used as the clinical reference. SPECT data were reconstructed with Flash3D iterative reconstruction. LV and BP regions were defined on the low-dose CT (average 0.9 mSv) using a prototype deep-learning algorithm. This was trained by delineation of the LV and BP on > 2500 contrast-enhanced CT images then overlaying the contours on corresponding spatially registered non-contrast CT images. Regions were transferred to the SPECT, and the ratio of mean LV counts to mean BP counts (LV:BP ratio) was extracted.

**Results**: The distribution of PG was PG0: 20, PG1: 2, PG2: 23, and PG3: 5. In all cases with cardiac uptake, excellent registration of the LV region and the SPECT was observed. The mean [range] of LV:BP ratio was as follows: PG0: 0.67 [0.52-0.87], PG1: 1.02 [0.91-1.13], PG2: 2.06 [1.35-3.18], and PG3: 2.25 [1.44-2.67]. There was no overlap in the LV:BP ratio between the PG0-1 group and the high-grade PG2-3 group.

**Conclusions**: This work has demonstrated a new fully automated segmentation technique for quantitative SPECT-CT assessment of cardiac...
amyloidosis. The segmentation proved to be robust despite being performed on a low-dose CT for attenuation correction. The automated nature of the segmentation means that the technique is free from operator variability. The proposed LV:BP ratio is a simple metric that does not require the additional steps for SUV calculation and yet proved effective in differentiating high-grade disease (PG2-3) from negative cases or low-grade disease (PG0-1).

106-12

SURVIVAL ADVANTAGE OF TREATED PATIENTS DIAGNOSED WITH CARDIAC TTR AMYLOIDOSIS BY DUAL-ISOTOPE PER- FUSION METABOLISM CZT SPECT: FOUR-YEAR EXPERIENCE AT THE UNIVERSITY OF ROCHESTER

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Introduction: TTR cardiac amyloidosis (TCA) causes infiltrative cardiomyopathy and heart failure with high morbidity and mortality. Availability of effective treatments for TCA mandates efficient diagnosis and referral for therapy. Tc-99 m pyrophosphate (PYP) imaging by planar and SPECT techniques is highly accurate and routesally avoids endomyocardial biopsy to diagnose TCA. Dual-isotope perfusion metabolism amyloidosis imaging (DIPMAI) with CZT SPECT offers substantial advantages over standard planar or SPECT PYP imaging including 1. Optimizing spatial resolution of myocardial or blood pool location of PYP by use of a gold standard LV myocardium reference region of interest with very low-dose (<1 mCi) thallium-201 rest MPI; 2. Reduced dose Tc-99 m PYP (10 mCi vs. 20 mCi); and 3. Streamlined, time-efficient simultaneous dual-isotope single imaging protocol (90 minutes vs. 3 hour) to resolve PYP distribution. Despite advantages of DIPMAI with CZT SPECT, clinical effectiveness for diagnosis and referral for treatment and outcomes with this approach are not well defined.

Methods: We performed a secondary analysis of a quality assurance REDCap database, including 313 patients who underwent DIPMAI with CZT SPECT from May 2018 through February 2022. All studies were obtained using the high efficiency D-SPECT camera (Caesaria, IS). We recorded PYP scan results (positivity on a 0- to 3 + scale), number of patients referred for treatment, patients who started treatment, time from positive scan to treatment, and survival times in treated and untreated patients.

Results: Of 313 patients, 53 (17%) with follow-up in our system were diagnosed with TCA using DIPMAI. Most patients (N = 41, 75%) with positive scans were treated. Starting therapy was associated with enhanced survival of 51 treated patients (12%) died, and 5 of 12 non-treated patients (42%) died (P = .0357). Of the 10 patients who died, treatment was associated with 12 months longer mean survival (17.8 ± 4.3 vs. treated patients vs. 5.7 ± 6.8 months for untreated patients, P = .0078 by unpaired t test). Of the 12 untreated patients, 5 patients died, and 4 patients cited significant cost barriers to tafamidis. Average time from diagnosis to treatment was 62 ± 44 days.

Conclusions: Combined perfusion metabolism dual-isotope CZT SPECT perfusion imaging at 90-120 minute post injection provides accurate diagnosis of TTR cardiac amyloidosis and effectively triages patients for treatment which was associated with improved survival in our 4-year clinical experience. Treatment failures include patients unable to afford therapy. Increased availability of specialty pharmacists may enhance treatment and survival rates of patients diagnosed with TTR cardiac amyloidosis. Study of comparison of efficiency, accuracy, referral of patients to treatment, and clinical outcomes using DIPMAI with CZT SPECT vs traditional planar and SPECT appears warranted.

106-13

SPECIES DIFFERENCES IN THE SPECIFICITY OF FLUORINE-18 LMI1195 FOR THE PRE-SYNAPTIC NOREPINEPHRINE TRANSPORTER UPTAKE-1 IMAGING IN SWINE AND NON-HUMAN PRIMATE

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Introduction: Swine represent a major animal model used in translational and surgical research models, including renal denervation procedures. One limitation, however, is the absence of proven methods to non-invasively assess the efficacy of renal denervation. We hypothesize that Fluorine-18 (18F)-N-[3-bromo-4-(3-fluoro-propoxy)-benzyl]-guanidine (LMI1195) will selectively bind to the pre-synaptic norepinephrine transporter (NET) in swine, as it has similarly been shown in non-human primates (NHP).

Methods: We imaged 4 pigs and 1 NHP before and following NET blockage with intravenous (IV) desipramine (1.0-1.5 mg kg). All imaging was conducted on the PennPET Explorer, a long axial field of view PET/CT system capable of performing high sensitivity whole body dynamic imaging. 18F-LMI1195 (~ 185 MBq [5 mCi]) was administered via IV bolus, and a 3-dimensional list-mode PET scan was acquired for 90 minute, and re-sampled into 34-frame dynamic images. Maximum and mean standard uptake units (SUV) were calculated in the whole dataset as well as in the left ventricle, kidneys, and blood pool. We calculated the total binding potential (TBP) of the radiopharmaceutical defined as the area under the curve (AUC) in tissue divided by the AUC in plasma (TBP unitless = AUCtissue / AUCplasma).

Results: Overall, pre-treatment with desipramine failed to block LMI1195 uptake in swine heart (5.2 ± 0.8 SD vs. 6.6 ± 0.6 SD; P = .21), and kidneys (11.3 ± 4.1 vs. 14.7 ± 4.3; P = NS). In contrast, desipramine blocked 55% of LMI1195 uptake in the NHP heart, but, similarly to swine, renal activity actually increased ~ 40% post-desipramine in NHP (Figure 1).

Conclusions: Analysis of TBP indicates that expected selective reduction of LMI1195 binding to heart was not shown in pigs, suggesting that the radiotracer is not specific for NET in pigs, and illustrating a limitation of swine models for sympathetic imaging with LMI1195.

Figure 1. Pre- and post-desipramine cardiac imaging with LMI1195 in swine and non-human primate.

106-14

IMPROVING EVALUATION FOR TTR AMYLOIDOSIS BY INTER-ACTIVE FILTERING OF TC-99 M PYP SPECT IMAGES: THE ROLE FOR "CLEAN BLOOD POOL" IMAGING

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Introduction: Myocardial imaging with Tc-99 m PYP has assumed a central role in the evaluation of patients with suspected TTR amyloidosis. Initial recommendations advised measuring the heart to contralateral lung ratio. This approach is problematic since it cannot differentiate increased mediastinal uptake from residual blood pool versus actual myocardial uptake. This has led many investigators to favor SPECT imaging. This approach is limited since the filters employed are optimized for perfusion imaging not PYP.

Methods: We identified 98 sequential patients referred for PYP imaging. Images were obtained one and 3 hour after injection with isolated exceptions. We designed software algorithms to allow interactive filtering of the
images an overlay them on attenuation mu maps to assist localization of myocardial/mediastinal uptake. Conventional and novel filters were employed interactively to identify myocardial blood pool. Results were compared to reconstruction with a butterworth filter with a cutoff of 0.5 of the Nyquist and order 10.

**Results:** 14 of the patients were unequivocally positive and did not require further analysis. Two studies were technically inadequate due to patient malpositioning leaving 82 patients for analysis. Four patients were felt to be negative at 1 hour and did not undergo 3-hour imaging. One patient had only 3-hour imaging. We found processing with conventional filters inadequate for characterizing mediastinal uptake, only 32 (39%) of the patients' mediastinal activity could be identified as blood pool. By using a deconvolving (inverse gaussian) filter interactively could identify LV blood pool in 81 of the 82 patients (99%, chi squared for difference P < .0001). Identifying LV blood pool allows for confirmation of no activity in surrounding myocardium which we term “clean blood pool.”

**Conclusions:** Interactive filtering with a deconvolving filter allows for significantly more accurate identification of mediastinal activity as being due to blood pool. We propose the “clean blood pool” be accepted as a negative study for the presence of TTR amyloidosis.

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**106-15**

**HIDING IN PLAIN SIGHT: AN OPPORTUNITY FOR IDENTIFYING TRANSTHYRETIN CARDIAC AMYLOIDOSIS IN PATIENTS WITH BILATERAL CARPAL TUNNEL SYNDROME**

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**Introduction:** Transthyretin Cardiac Amyloidosis (ATTR-CA) has been linked to many extra-cardiac manifestations including bilateral carpal tunnel syndrome (CTS) and spinal stenosis. Bilateral CTS precedes the onset of ATTR-CA by almost a decade. The aim of this study is to analyze patients with bilateral CTS to identify patients with high-risk features or “red flags” for ATTR-CA based on clinical and imaging findings, identify if systematic screening was done for ATTR-CA, and define opportunities for improved detection.

**Methods:** Out of > 5000 patients with bilateral CTS evaluated in Henry Ford Health System (2010-2016), we studied a focused population of patients: men > 50 years and women > 60 years with bilateral CTS and atrial fibrillation, (n = 295), evaluating their demographics, clinical characteristics, and cardiac imaging workup in cases with suspected ATTR-CA. Baseline demographic, co-morbidities, electrocardiographic, and echocardiographic findings were collected. Additional “red flags” suspicious of amyloidosis were evaluated including spinal stenosis, QRS voltage, the presence of Q wave, and left ventricular hypertrophy (LVH). High-risk group (HRG) was identified as patients with any of additional “red flags” AND heart failure and LVH. This study was approved by our local institutional review boards (IRB).

**Results:** Out of 295 patients, mean age was 76.7 years, 51.2% female, 75.6% Caucasian, and 22.4% African Americans. Two-hundred seventy-six patients: men—71%; mean age—57 ± 11 years; 41%—ischemic HF. In CHF patients, who were considered as responders (n = 27), RV ESV increased from baseline to 6-month follow-up: 79 (IQR 60-135) ml to 105 (74-128) ml, P = .03; while RV EF, RV PFR, and IVD decreased significantly: 49 (39-57) % to 40 (32-45) %; 1.36 (1.24-1.67) EDVs to 0.93 (0.68-1.4) EDVs; 31 (19-45) deg to 21 (10-28) deg (P < .01), respectively. Significant differences in baseline RV indexes between responders and non-responders were found: RV EF 49 (39-57) deg vs 39 (33-53) deg, P = .01; RV PFR 1.5 (1.06-2.08) EDVs vs 1.15 (0.83-1.58) EDVs, P = .01; MFR/3 0.91 (0.66-1.3) EDVs vs 0.55 (0.41-1.12) EDVs, P = .01; IVD 31 (19-45) deg vs 16 (11-40) deg, P = .03, respectively. Univariate logistic regression analysis showed that the improvement in LV ESV after CRT was associated with baseline RV free wall PS (OR 1.59 per 10 unit increase; 95% CI 1.047-2.42; P = .005), global RV PE (OR 1.225; 95% CI 1.038-1.445; P = .001), and IVD (OR 1.807 per 10 unit increase; 95% CI 1.225-2.665; P = .001). Multivariate logistic regression analysis showed that only baseline RV free wall PS was the independent predictor of CRT response (OR 1.777; 95% CI 1.1167-2.829; P = .005).

**Conclusions:** GBPS is useful for RV contractility and function assessment in patients with CHF. CRT implantation results in the increasing of RV ESV and decreasing of RV EF, RV PFR, and IVD. The improvement of LV ESV at 6 months after CRT is associated with baseline RV free wall PSD, RV PE, and IVD. Baseline RV free wall PSD might be considered as CRT response criteria.
PILOT STUDY COMPARING A NOVEL “BURST” EXERCISE TREADMILL TEST TO THE STANDARD BRUCE TREADMILL PROTOCOL IN PATIENTS WITH HYPERTROPHIC CARDIOMYOPATHY FOR THE ASSESSMENT OF VENTRICULAR ARRHYTHMIAS.

Introduction: In patients with hypertrophic cardiomyopathy (HCM), high-intensity activity is associated with sudden cardiac death (SCD), and risk stratification is often needed prior to beginning exercise. Compared to ambulatory monitoring, the frequency of exercise-induced NSVT is much less common on standardized exercise treadmill testing (ETT); however, when detected, NSVT is associated with a 3.7-fold increased risk of SCD. We sought to investigate the feasibility and safety of a “Burst” protocol (i.e., abrupt high-intensity treadmill exercise) for risk stratification compared to a standard Bruce protocol.

Methods: In a single-center prospective safety and feasibility study, patients underwent 2 consecutive ETTs within 90 days; an initial Bruce protocol ETT and a subsequent “Burst” ETT defined as initial abrupt high-intensity exercise at the onset of testing which was equivalent to the protocol ETT and a subsequent “Burst” ETT defined as initial abrupt high-intensity activity is associated with sudden cardiac death (SCD), and risk stratification is often needed prior to beginning exercise. Compared to ambulatory monitoring, the frequency of exercise-induced NSVT is much less common on standardized exercise treadmill testing (ETT); however, when detected, NSVT is associated with a 3.7-fold increased risk of SCD. We sought to investigate the feasibility and safety of a “Burst” protocol (i.e., abrupt high-intensity treadmill exercise) for risk stratification compared to a standard Bruce protocol.

Results: Five patients completed both protocols: mean age 43 ± 10 years and 70% male. The mean Mets was 58 ± 4.9% and mean maximal wall thickness was 19.8 ± 3.96 mm. Of the 5 patients enrolled, 3 were genotype positive for Myosin Binding Protein C3 (MYBPC3), 3 with a family history of HCM. During Bruce ETT, mean MET achieved was 14.3 ± 2.7 and mean exercise time was 11.46 ± 1.9. During Burst ETT, mean MET achieved was 16.1 ± 2.4, and mean exercise time was 3:33 ± 1:1. All 5 patients successfully completed both protocols stopping for fatigue, cardiac symptoms, ischemic ECG changes, or NSVT ≥ 3 beats.

Conclusions: Our preliminary study shows that abrupt high-intensity exercise as demonstrated in a Burst ETT protocol appears to be safe and feasible for risk stratification in HCM, inducing a greater number of ventricular ectopy, which may be better at risk stratification of SCD.

CREATING AUDIT TOOLS TO MAINTAIN DATA QUALITY FOR STRESS TEST AND ACC/NCDR PCI REGISTRY ABSTRACTION

Introduction: The audit tool created is used by data abstractors to provide data audits and assess the accuracy and inter-rater reliability of abstraction performed by the abstractors for a health system. This audit tool solution has been developed across 13 registries, including ACC/NCDR registries, PCI, STS, and Get with the Guidelines.

Methods: The data audit tool was used to internally audit 34 abstractors across 15 hospitals in the United States for all data elements, including Stress test performed, type of stress test, data of stress test, results of stress test, risk/exist of ischemia, diagnostic catheterization detail, and PCI data elements for ACC/NCDR PCI registries.

Results: The data audit tool showed an inter-rater reliability of 98.18% across 34 data abstractors for the PCI registry in 60 PCI registry cases across 15 US hospitals in 2021.

Conclusions: The tool is being used internally for Cardiovascular societies and across hospital systems. The audit tool is an effective method for maintenance of data quality for diagnostic testing modalities and procedural evaluation by an external abstractor of pre-defined data dictionary fields.

IMPACT OF CHANGE OF ISCHEMIC BURDEN ON THE OUTCOMES OF ESRD PATIENTS AWAITING KIDNEY TRANSPLANTATION

Introduction: Serial SPECT myocardial perfusion imaging (MPI) testing is suggested for CAD surveillance in asymptomatic ESRD patients wait-listed for kidney transplantation (KT). It is unclear whether change in ischemic burden on serial MPI impacts the outcomes of these patients.

Methods: In a retrospective cohort of asymptomatic KT candidates with ≥ 2 serial SPECT MPI studies, we analyzed the last 2 MPIs (mean interval, 20 ± 13 months). We defined a significant change in ischemic burden as SDS change between MPIs of ≥ 2 points. Subjects were followed for major adverse cardiac events (MACE), defined as the composite of cardiac death or MI. Baseline clinical risk was assessed using the sum of risk factors set forth by the AHA/ACC statement on cardiovascular assessment of KT candidates (age > 60 years, HTN, DM, dyslipidemia, tobacco use, LVH, known CVD, dialysis > 1 years).

Conclusions: Our preliminary study shows that abrupt high-intensity exercise as demonstrated in a Burst ETT protocol appears to be safe and feasible for risk stratification in HCM, inducing a greater number of ventricular ectopy, which may be better at risk stratification of SCD.
**Results:** A cohort of 700 patients (mean age 54 ± 13 years, 60% men, mean sum of risk factors 3.7 ± 1.4) was followed for a mean of 19 ± 12 months after MPI2. Between MPIs, 29 (4%) subjects received coronary revascularization which was associated with higher proportion of reduced ischemic burden on MPI2 (31% vs. 17%, \( P = .049 \)). Among 514 patients with no ischemia on MPI1 (SDS \( B \leq 1 \)), 15% had new ischemia on MPI2 which was associated with increased MACE risk (Figure 1). Among 186 patients with myocardial ischemia on MPI1 (SDS \( C \geq 2 \)), 66% had improvement of ischemic burden on MPI2 which was associated with a significantly lower MACE risk (Figure 2). There was no significant interaction between coronary revascularization and improvement in ischemic burden impacting outcome (interaction \( P = .845 \)).

**Conclusion:** Among KT candidates who underwent serial MPI for CAD surveillance, new myocardial ischemia was associated with increased MACE risk, while improvement in ischemic burden was associated with lower MACE risk, irrespective of coronary revascularization between MPIs.

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**203-04**

DNA DAMAGE INDUCED BY IONIZING RADIATION FROM MYOCARDIAL PERFUSION SCINTIGRAPHY

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**Introduction:** Patient exposure to ionizing radiation from medical imaging has grown. Although the link between radiation from myocardial perfusion scintigraphy (MPS) and cancer has not been considered consistent, evidence from studies at the molecular level is desirable. This study evaluated the effect of ionizing radiation on the DNA of patients undergoing MPS using the comet assay, a method for detection of DNA damage, and RT-PCR, searching for the activation of repair genes in response to DNA damage.

**Methods:** Twenty-nine patients without acute diseases, recent surgery/trauma, cancer, or autoimmune diseases were studied. MPS was performed with Tc-99 m sestamibi (15-20 mCi) in a 2-day protocol. Peripheral blood was collected immediately before radiotracer injection at rest and 60-90 minutes after injection. Single-cell gel electrophoresis (comet assay) was performed with blood lymphocytes to detect strand breaks, which determine a ‘comet tail’ of variable size, visually scored by 3 observers in a fluorescence microscope (0: no damage, no tail; 1: small damage; 2: large damage; 3: full damage). A damage index was calculated as a weighted average of the individual scores. The expression of the repair genes CDKN1A, BBC3, XPC, and GADD45a was evaluated with RT-PCR (QuantStudio 5, Thermo Fisher Scientific).

**Results:** After radiotracer injection, there was a significant, although small, increase of the damage index and of classes 1-3 of damage, even though most patients remained in class 0 (Figure: A: top: percentages of damage classes before and after radiotracer; bottom: plot of DNA damage index from individual patients). There was no significant difference in the expression of CDKN1A, BBC3, XPC, GADD45a after radiotracer injection (Figure: B).

**Conclusion:** Low-grade DNA damage was detected in peripheral blood lymphocytes after a single radiotracer injection for MPS, without activation of repair genes. This may indicate that MPS, with current protocols, does not result in relevant DNA damage.
Results: Among 8610 patients (64.8 ± 12.8 years, 55.5% males, BMI 30.7 ± 7.0 kg/m²), 4787 were imaged with PET, 3092 SPECT, and 731 CCTA. Median [IQR] radiation effective doses were 5.6 [4.6, 7.2] mSv for PET, 7.3 [5.5, 9.3] mSv for SPECT, and 7.4 [4.1, 12.7] mSv for CCTA. Patients at a healthy BMI < 25 had the lowest radiation exposure with CCTA, while patients with BMI > 25 had the lowest exposure with PET (Figure). Effective dose in patients with BMI > 35 was higher in CCTA than in SPECT. Radiation exposure increased dramatically with CCTA at high BMIs, and was almost 10 × higher in patients with BMI > 45 compared with those who had a healthy BMI < 25 (median 27.2 vs 3.35 mSv).

Conclusion: While median radiation exposure across state-of-the-art PET, SPECT, and CCTA systems is modest, there are significantly different exposures across modalities based upon BMI. These data are important for making patient-centered decisions for ischemic testing.

203-06
QUANTIFICATION OF LEFT VENTRICULAR AMYLOID IN AL AND ATTR AMYLOID CARDIOMYOPATHY: A PILOT 124I-P5+14 (AT-01) PET/CT AND ECHOCARDIOGRAPHY STUDY
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Introduction: In light-chain (AL) and transthyretin (ATTR) amyloid cardiomyopathy (CMP), quantitation of cardiac amyloid may play an important role in early diagnosis, prognosis, and follow-up, but quantitative methods are limited. The aim of this pilot study was to quantify cardiac amyloid in AL-CMP and ATTR-CMP using a novel amyloid-binding radiotracer 124I-P5+14 (AT-01).

Methods: This study enrolled participants with AL-CMP, ATTR-CMP, and non-amyloid controls. Amyloidosis was diagnosed by standard criteria and cardiac involvement by imaging and/or biopsy. All subjects underwent PET/CT with 124I-p5+14 (median dose 0.97 mCi). Left ventricular (LV) mean uptake (mean SUV in voxels with ≥ 2 times left atrial blood pool activity), and LV cardiac amyloid activity (LV mean uptake times myocardial VOI volume) were estimated. Results were compared using the Wilcoxon rank-sum test. Correlation was measured with LV mass and septal thickness on echocardiography using Spearman’s rho.

Results: We included 18 participants (median age 72 years, 89% male): 7 AL-CMP (39%), 9 ATTR-CMP (50%), and 2 controls (11%). 124I-p5+14 LV mean uptake tended to be higher in ATTR-CMP than in AL-CMP (P = 0.14, Figure 1), while LV cardiac amyloid activity was similar in both groups. By contrast, both metrics were 0 in controls, as they had no uptake above 2 times blood pool. 124I-p5+14 LV mean uptake and cardiac amyloid activity were moderately correlated with LV mass and septal thickness (N = 16, rho = 0.50 and 0.45) and septal thickness (rho = 0.64 and 0.51).

Conclusion: 124I-p5+14 LV mean uptake tended to be higher in ATTR-CMP than AL-CMP, while LV cardiac amyloid activity was similar in both groups. There was no LV uptake above the blood pool threshold in controls, suggesting high specificity to amyloid. 124I-p5+14 LV mean uptake and cardiac amyloid activity correlated with LV mass and septal thickness. 124I-p5+14 appears to be a valuable tracer to quantify LV cardiac amyloid in AL-CMP and ATTR-CMP.

203-07
IMPACT OF SOCIAL VULNERABILITY ON THE RELATIONSHIP BETWEEN LV EJECTION FRACTION AND MORTALITY IN ATTR-CA PATIENTS
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Introduction: Although a preserved ejection fraction (pEF, ≥ 40%) is the typical phenotype of ATTR-CA, many patients have a reduced EF (rEF, < 40%), which is associated with a worse outcome. Socioeconomic (SE) factors influence mortality in heart disease. We explored the impact of SE vulnerability on the relationship between EF and mortality in ATTR-CA.

Methods: Clinical and mortality data of ATTR-CA patients from 2 academic centers were studied retrospectively. Zip-code-level SE data were obtained from the 2019 American family survey. Social Vulnerability index (SVI; lower = less social vulnerability; range 0 to 1) was obtained from the CDC/Agency for Toxic Substances and Disease
Conclusions: The impact of LV systolic function on mortality in ATTR-CA patients was influenced by socioeconomic vulnerability. Survival free of mortality was determined for those with rEF and pEF, across tertiles of SVI.

Results: A total of 185 ATTR-CA patients were studied (mean age = 78 years; 81% male; 35% black patients; 23% with high SVI). HFrEF was seen in 54 patients (29%). The mean age at diagnosis (77 vs 78 years, \( P = .196 \)), % hereditary ATTR (33% vs 25%, \( P = .269 \)), gender, race, and distribution of comorbid conditions were not different among the two EF groups. rEF patients more often belonged to zip codes with a higher SVI (52% vs 40% for rEF and pEF, respectively, \( P = .002 \)), and had higher overall mortality (26% vs 14%, \( P = .042 \)). However, survival analysis showed a shorter time to mortality in rEF vs. pEF patients only in the lowest tertile of SVI (0.9 + 1.2 vs 1.9 + 1.3, \( P = .001 \)). For patients in the 2nd and 3rd tertiles of SVI, there was no difference in mortality between the groups.

Conclusions: The impact of LV systolic function on mortality in ATTR-CA patients is influenced by socioeconomic vulnerability.

203-08

THE PROGNOSTIC VALUE OF HEART RATE RESPONSE TO REGADENOSON IN PATIENTS UNDERGOING MYOCARDIAL PERFUSION IMAGING: THE LARGEST COHORT TO-DATE

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Introduction: Heart rate response (HRR) has been shown to be an independent predictor of mortality in relatively small cohorts dominated by patients with DM or ESRD. We sought to evaluate the prognostic value of heart rate response (HRR) to regadenoson stress in a large cohort of all comers.

Methods: We conducted a retrospective cohort study of consecutive patients undergoing regadenoson stress SPECT myocardial perfusion imaging (MPI). HRR was calculated using the formula \( 100 \times (\text{Max HR} - \text{Baseline HR})/\text{Baseline HR} \). Kaplan–Meier plots, the log-rank test, and multivariate Cox regression model were used for survival analyses. Additionally, we used logistic regression modeling and receiver operating characteristic curve (ROC) analyses to investigate the incremental predictive value of HRR.

Results: Among 10,512 patients (mean age 62 ± 13 years, 45% men, 22% DM, 12% ESRD), followed for a mean of 35 ± 21 months, 922 (8.8%) deaths were observed. The median HRR was 35% (25th-75th percentile, 21%-50%). There was a stepwise increase in mortality with decreasing HRR (Figure 1). HRR was predictive of all-cause mortality independent of clinical parameters (age, sex, active tobacco use, dyslipidemia, HTN, DM, known CAD, ESRD), beta-blocker use, and baseline heart rate (HR 0.976 per 1% increment in HRR; 95% CI 0.972-0.980; \( P < .001 \)). ROC analyses demonstrated that a multivariate model that included HRR provided incremental prognostic value beyond clinical parameters, left ventricular ejection fraction (EF), and SSS (Figure 2).

Conclusion: In the largest cohort of consecutive patients undergoing regadenoson stress SPECT MPI, our study reaffirms both the independent and incremental prognostic value of HRR to regadenoson stress, providing an opportunity to improve risk stratification in this population.
revascularization to coronary angiography ratios (Figure 1A). In patients without early revascularization 1,568 patients (8%) experienced MACE during a median follow-up of 22 months. After adjustment, MACE rate was higher for normal versus abnormal studies in patients who had CZT SPECT (hazard ratio [HR] 5.16, 95% confidence interval [CI] 4.34-6.13) or PET MPI (HR 5.53, 95% CI 4.18-7.31) compared with patients who had conv SPECT MPI (HR 3.81, 95% CI 3.33-4.36) or PET MPI with normal perfusion and low MFR (HR 2.42, 95%CI 1.76-3.33) (Figure 1B).

Conclusions: CZT SPECT and PET MPI may be more accurate and may have higher prognostic discrimination compared with conv SPECT MPI.

203-10
QUANTIFICATION OF CARDIAC AMYLOIDOSIS FROM TC-99 M PYROPHOSPHATE PLANAR IMAGES USING A NEW SEMI-AUTOMATED APPROACH: INTRA- AND INTER-OBSERVABILITY ASSESSMENTS IN PATIENTS

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Introduction: The approval of medications that reduce mortality in cardiac amyloidosis (CA) escalates the need for approach to facilitate diagnosis of CA. We designed novel semi-automated software to calculate heart to contralateral lung (HCL) ratio and aimed to investigate Intra-observer and Inter-observer reproducibilities of HCL ratio using new software developed at Yale.

Methods: We randomly selected 95 patients from Yale Nuclear Cardiac Imaging Lab who were referred for Technetium-99 m Pyrophosphate scan based on suspicion of CA. Mean counts were calculated from conventional (Conv) heart and contralateral Region of interest (ROI) recommended by the ASNC guidelines, as well as from ROIs further refined by Region Growing (RG) we developed. Two imagers who were blinded to clinical information calculated HCL ratios using new Yale software and conventional (CV)software. Imager 1 processed all images twice, at least 48 hour apart. Imager 2 processed same images once separately.

Results: The intraobserver correlation coefficients for CV and RG were 0.94 and 0.95, respectively, showing HCL ratios quantified using both approaches are highly repeatable. The Bland Altman plots(BA) exhibited excellent repeatability for Imager 1 for both approaches. The mean difference between two quantitative HCL results was close to 0. The inter-observer correlation coefficient for CV and RG approach was 0.89 and 0.89, respectively. Also, excellent inter-observer reproducibility was discovered on BA using CV as well as RG approach. The mean HCL ratio for RG compared to CV for imager 1 was (1.25 ± 0.22, 1.23 ± 0.21), imager 2(1.31 ± 0.24,1.29 ± 0.23), respectively, with P value of < .0001. RG H/CL ratio was greater than CV, presumably due to improved signal to noise ratio.

Conclusion: The semi-automated approach results in excellent intra and inter-reproducibility of HCL quantification. The new software can be used by novice imagers, may have a potential to emerge as precise tool in diagnosing CA.

203-11
HIGHER LENGTH OF STAY AND READMISSION BURDEN IN HEART FAILURE PATIENTS WITH CARDIAC AMYLOIDOSIS THAN THOSE WITHOUT

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Introduction: Recognition of cardiac amyloidosis (CA) and initiation of novel targeted therapies are associated with improved survival and reductions in heart failure (HF) readmission. Despite the rising prevalence, it is unknown whether these outcomes remain discrepant between CA and non-CA HF patients in this contemporary era.

Methods: We collected hospitalization data for all HF patients undergoing evaluation of CA between January 2018 and December 2020. CA was confirmed by a combination of PYP imaging, cardiac magnetic resonance imaging, and assessment of paraproteinemia. Data on HF readmission, length of stay (LOS), and mortality were collected by review of electronic medical record.

Results: A total of 108 patients underwent evaluation for CA during the study period, of which 26 (24%) had CA (transthyretin = 23; light-chain = 3). Patients with CA were significantly older than patients without (mean age 77 vs 69 years, respectively, P = .003). Gender and race distribution were similar between the two groups. Patients with CA had similar HF readmission rates compared to those with non-CA HF (1.0 vs 0.9 admission/patient/year, P = .736). Cumulative LOS was significantly longer in patients with CA (10.0 vs 3.6 days/patient/year).
203-12

COMPARISON OF 99MTC PYP UPTAKE TO ECHOCARDIOGRAPHIC STRAIN IN ATTR CARDIAC AMYLOIDOSIS

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Introduction: Cardiac amyloidosis (ATTR CA) is thought to deposit homogenously throughout the myocardium, but echocardiographic left ventricular longitudinal strain suggests regional variation described as an “apical sparing” pattern. Previously reported studies found a corresponding segmental difference in Tc-99 m pyrophosphate (PYP) uptake. This study compares regional variation between Tc-99 m PYP uptake and echocardiographic strain in patients with ATTR CA.

Methods: This retrospective, single-center study compared Tc-99 m PYP uptake and echocardiographic longitudinal strain in consecutive patients clinically diagnosed with wild-type ATTR CA. SPECT volumetric assessment and quantification were obtained in 17 segments with the raw counts normalized for the dose of radiotracer present at time of imaging. Strain assessment and quantification were obtained globally and regionally in 16 segments.

Results: 50 patients with wild-type ATTR CA were included with an average age of 80 ± 8 years. 10 patients had no echocardiography or inadequate imaging to perform strain analysis and were excluded. There was no significant difference in the segmental distribution of Tc-99 m PYP (P = .53). However, there was a difference in the segmented strain with the apical segments having a lower average strain compared to the mid and basal segments (P < .0001). Correlation of Tc-99 m PYP counts and strain assessment in the basal, mid, and apical segments found no significant correlation. Dividing patients into best (least Tc-99 m PYP uptake and most negative strain) and worst (most Tc-99 m PYP uptake and least negative strain) quartiles found 0/4 and 0/4 agreement, respectively.

Conclusions: This single-center study differs from previous studies finding no correlation between Tc-99 m PYP uptake and echocardiographic longitudinal strain. Our findings may be secondary to differences in patient selection as this study included only patients with wild-type ATTR amyloid.
AUTOMATIC REORIENTATION BY DEEP LEARNING TO GENERATE SHORT-AXIS SPECT MYOCARDIAL PERFUSION IMAGES

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Introduction: It is essential to reorient the reconstructed transaxial SPECT MPI into standard short-axis slices. An approach that combines a spatial transformer network (STN) with convolutional neural networks (CNN) has been proposed for automatic reorientation of MPI. We aim to improve the approach and evaluate its performance.

Methods: A total of 254 patients were enrolled, including 228 stress SPECT MPIs and 248 rest SPECT MPIs. A fivefold cross-validation with 180 stress and 201 rest MPIs was used for training and internal validation; the remaining samples were used for external testing. The rigid transformation parameters (translation and rotation) from manual reorientation were annotated by an experienced operator and used as the ground truth. A CNN was designed to predict the transformation parameters and these parameters were used as the input of the STN for reorientation. A loss function containing mean absolute errors for translation and mean square errors for rotation were employed. A threestage training strategy was adopted for model optimization: (1) optimize the translation parameters while fixing the initial rotation parameters; (2) optimize rotation parameters while fixing the translation parameters; and (3) optimize both translation and rotation parameters together.

Results: For the external test, the correlation coefficients of the translation distances and rotation angles between the model prediction and the ground truth were 0.96 in X axis, 0.99 in Y axis, 0.98 in Z axis, 0.96 along X axis, 0.98 along Y axis, and 0.99 along Z axis, respectively. For the 48 stress MPIs, the Pearson correlation coefficients were 0.98 (P = .94) in scar burden and 0.97 (P = .93) in summed stress score; for the 47 rest MPIs, the Pearson correlation coefficients were 0.94 (P = .98) in scar burden and 0.95 (P = .93) in summed rest score.

Conclusions: Our deep-learning-based reorientation method is able to accurately generate the short-axis images.
COMPARATIVE EFFECTIVENESS OF PET AND SPECT MYOCARDIAL PERFUSION IMAGING FOR PREDICTING MAJOR ADVERSE CARDIOVASCULAR EVENTS AFTER RENAL TRANSPLANTATION

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Introduction: Advanced chronic kidney disease (CKD) is associated with high cardiovascular risk, even after renal transplant. Pre-transplant cardiac testing may identify patients who benefit from risk optimization. Our objective was to determine the relative prognostic utility of pre-transplant positron emission tomography (PET) and single-photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI) for post-transplant cardiovascular outcomes.

Methods: We performed a retrospective cohort study of patients who underwent PET and SPECT MPI 2003–2020 and subsequently received a renal transplant. The primary outcome was major adverse cardiac events (MACE) including myocardial infarction, stroke, heart failure, and cardiac death. To determine associations of MPI with MACE, we utilized Cox proportional hazards regression with propensity score weighting for PET vs SPECT, and adjustments for sex, age, race, and cardiac risk factors.

Results: 356 patients (191 PET, 165 SPECT) underwent pre-transplant MPI and were followed for mean 7.2 years post-transplant. 57% were male with mean age 57 years. Pre-transplant cardiac risk factors were common including hypertension (87%), diabetes (32%), and dyslipidemia (53%). A minority had abnormal MPI (n = 50, 14%) and severe coronary artery calcification (17%). In propensity-weighted Cox regression, Abnormal pre-transplant PET but not SPECT MPI was associated with coronary calcification (17%). In propensity-weighted Cox regression, PET vs SPECT (5.2% vs 2.4%, P = .01, Figure). More patients were revascularized after abnormal pre-transplant PET but not SPECT (Figure). Finally, PET was associated with lower post-transplant MACE vs SPECT (3.0% vs 4.2% yearly event rate, P = .01, Figure).

Conclusion: Advanced CKD patients are at high cardiovascular risk post-transplant, despite a minority having obstructive CAD or severe calcified plaque on pre-transplant MPI. PET MPI findings predict MACE, and may better identify higher risk patients who benefit from pre-transplant risk optimization compared with SPECT.

Figure: Pre-transplant patient and myocardial perfusion imaging factors associated with post-transplant major adverse cardiovascular events, in propensity-weighted Cox hazards regression

| Covariate | Hazard ratio (95% CI) for post-transplant major adverse cardiovascular events (MACE) | P value |
|-----------|---------------------------------------------------------------------------------|--------|
| Patient Factors | | |
| Age at transplant (per 10 years) | 1.33 (1.10-1.54) | 0.009 |
| History of coronary artery disease | 2.43 (1.34-4.44) | 0.004 |
| History of diabetes | 1.68 (1.03-2.76) | 0.04 |
| Stress Test Factors | | |
| Pre-transplant PET versus SPECT | 0.57 (0.34-0.90) | 0.01 |
| Abnormal MPI (SSS > 3) | 1.90 (1.09-3.31) | 0.02 |
| PET/MP abnormal | 3.39 (1.56-7.37) | 0.003 |
| SPECT MPI abnormal | 1.09 (0.44-2.75) | 0.85 |
| Severe coronary calcification | 2.16 (1.02-4.97) | 0.04 |
| Post-MPI revascularization | 3.84 (1.08-13.77) | 0.03 |

Integration of coronary artery calcium scoring from CT attenuation scans by machine learning improves prediction of adverse cardiovascular events in patients undergoing SPECT/CT myocardial perfusion imaging.

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Introduction: Machine learning (ML) has been previously applied for prognostication in patients undergoing SPECT myocardial perfusion imaging (MPI). We evaluated whether including attenuation CT coronary artery calcification (CAC) scoring improves ML prediction of major adverse cardiovascular events (MACE) in patients undergoing SPECT/CT MPI.

Methods: From the REFINE SPECT Registry, 4,770 patients with SPECT/CT performed at a single center were included (age: 64 ± 12 years, 45% female). ML algorithm (XGBoost) inputs were clinical risk factors, stress variables, SPECT imaging parameters, and expert-observer CAC scoring using CT attenuation correction scans performed to obtain CT attenuation maps. The ML model was trained and validated using repeated hold-out (tenfold cross-validation). Receiver Operating Characteristic (ROC) curves were analyzed for prediction of MACE (death, myocardial infarction, or late coronary revascularization > 90 days). MACE-free survival was evaluated with standard survival analyses.

Results: During a median follow-up of 24.1 months, 475 patients (10%) experienced MACE. Among clinical, imaging and, stress parameters, stress heart rate, stress diastolic blood pressure, and stress end-diastolic wall volume had highest variable importance in ML score and CAC score had highest variable importance for CAC-ML score. Higher area under the ROC curve for MACE was observed with ML when CAC scoring was included (Figure 1A, CAC-ML score, 0.77, 95% confidence interval [CI]: 0.73-0.79) compared to ML without CAC (ML score, 0.75, 95% CI 0.73-0.77, P = .005) and when compared to CAC score alone (0.71, 95% CI 0.68-0.73, P < .001). On survival analysis, patients with high CAC-ML score (> 0.091) had higher event rate when compared to patients with low CAC-ML score (Figure 1B).

Conclusions: Integration of attenuation CT CAC scoring improves the predictive value of ML risk score for MACE prediction in patients undergoing SPECT MPI.
213-03

NON-INVASIVE ASSESSMENT OF THE PATHOPHYSIOLOGICAL MECHANISMS OF INOCA WITH CZT-SPECT

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Introduction: One of the proposed causes of INOCA syndrome (Ischemia with Non-Obstructive Coronary Arteries) is microvascular dysfunction (MVD), which can be assessed non-invasively by quantifying myocardial blood flow (MBF) and myocardial blood flow reserve (MFR). Myocardial perfusion imaging (MPI) and dynamic CZT-SPECT at rest—dipyridamole—and cold pressor test (CPT) allow the presence of MVD to be established by evaluating different pathophysiological mechanisms: independent or dependent endothelium, respectively. This study aimed to evaluate the usefulness of CZT-SPECT in the diagnosis of MVD and the different pathological mechanisms involved, in patients with a diagnosis of INOCA.

Methods: 93 patients with a diagnosis of INOCA, who underwent MPI and dynamic images with CZT-SPECT at rest-dipyridamole-CPT, were included consecutively and prospectively. The MBF was quantified with the 4DM software. An abnormal response to dipyridamole was considered to be MFR less than 2 and MBF variation (ΔMBF) less than 1.5 with CPT. MVD was defined as the presence of one or both abnormal responses. Four groups were obtained after combining the results obtained in our sample of patients: (1) normal MFR and normal ΔMBF, (2) abnormal MFR and abnormal ΔMBF, (3) abnormal MFR and normal ΔMBF, and (4) normal MFR and normal ΔMBF.

Results: The CZT-SPECT detected MVD in 85% (n = 79) of the patients with INOCA. 42% had an abnormal response to both stress (group 2), while the remaining 43% showed an altered ΔMBF response to CPT alone (group 1). 15% of patients had no MVD (group 4). We did not find any patients in group 3. The hemodynamic parameters at rest and after both stress tests, MFR and ΔMBF, are shown in Table 1.

Conclusions: The use of CZT-SPECT employing both stresses allowed to evaluate different pathophysiological mechanisms that cause MVD present in most patients with INOCA. Evaluation with CPT should be included in the non-invasive assessment of INOCA patients, as MVD may be present even with normal MFR with dipyridamole stress test.

Table 1. Hemodynamic values and results obtained by group

| Group | HR (bpm) | SBP (mmHg) | DBP (mmHg) | MBF (mL/min/g) |
|-------|----------|------------|------------|----------------|
| 1     | 65 (58-75)* | 130 (120-135)* | 80 (80-80)* | 1.05 (0.81-1.29)* |
| 2     | 64 (59-70)* | 130 (120-130)* | 80 (80-80)* | 1.18 (0.93-1.32)* |
| 3     | 62 (59-71)* | 130 (120-140)* | 80 (70-90)* | 0.71 (0.66-1.15)* |
| 4     | 65 (58-75)* | 120 (117-130)* | 80 (70-80)* | 2.69 (2.15-3.32)* |

213-04

PARAMETRIC IMAGING OF MYOCARDIAL BLOOD FLOW WITH Rb-82 PET

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Introduction: Rb-82 PET is used routinely for myocardial perfusion imaging (MPI) and quantification of myocardial blood flow (MBF) and reserve (MFR). MBF quantification improves risk stratification and normal-to-defect contrast compared to standard MPI in regions of impaired flow. MBF results are typically interpreted using 2D polar-maps of the left ventricle (LV), whereas MPI interpretation is based on the 3D volume images of tracer uptake—often with sub-optimal contrast due to slow blood clearance and incomplete tracer retention. This study evaluated the potential of MBF parametric imaging to improve image quality compared to standard MPI.

Methods: N = 20 patient scans were identified with a wide range of uptake defect severities on Rb-82 stress PET perfusion imaging. Each voxel in the cine-dynamic image series was fit to a one-tissue-compartment model yielding parametric volume images of MBF [mL/min-g] at rest and stress. Quantitative accuracy of the MBF image values was validated against standard polar-map values in the LV myocardium using intraintraclass correlation (ICC) and Bland–Altman analysis. Signal-to-noise ratios (SNR), heart-to-blood contrast (LV:BL), and contrast-to-noise ratios (CNR) were compared between standard MPI and parametric MBF imaging at rest and stress.

Results: Per-patient, per-vessel, and per-segment parametric MBF values in the LV were highly correlated with the standard polar-map values at rest and stress (ICC = 0.81-0.94). Parametric imaging MBF values were underestimated slightly at rest (− 9% ± 11%, P < .01) and stress (− 13% ± 10%, P < .001) leading to small overestimation of stress/rest MFR values on average (± 4 ± 8%, P < .05). Compared to standard MPI, parametric MBF image SNR increased dramatically by a factor of 2.8 ± CNR by 4.7 × , and LV:BL by 16 × (all P < .001) as shown in the figure below.

Conclusions: Parametric imaging of rest and stress MBF is feasible using Rb-82 PET, producing images with minimal bias and significantly improved SNR and CNR compared to standard MPI.

213-05

FAILED DIETARY PREPARATION IN CARDIAC PET INFLAMMATION STUDIES: THE ROLE OF BETA-HYDROXYBUTYRATE

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Introduction: Low level of beta-hydroxybutyrate (BHB) is a potential cause of failed dietary preparation in PET inflammation studies. The effect of BHB on inflammation has not been previously studied.

Methods: 7 patients with chronic kidney disease (CKD) were divided into two groups: control and intervention group. Both groups ingested a low BHB diet for 3 days. On the day before the PET scan, intervention group ingested 10 g BHB salts. PET scans were performed before BHB ingestion and 2 h after BHB ingestion in a random order.

Results: There was no significant difference in the levels of BHB before and after BHB ingestion (p = 0.82). The levels of C-reactive protein (CRP), interleukin-1 (IL-1), and interleukin-6 (IL-6) were significantly lower after BHB ingestion compared to before BHB ingestion (p < 0.05).

Conclusions: BHB ingestion can significantly reduce inflammation levels in patients with CKD. This study suggests that BHB is a promising agent for failed dietary preparation in PET inflammation studies.
Introduction: For patients undergoing Fluorodeoxyglucose Positron Emission Tomography (FDG PET), it is difficult to evaluate if they followed the dietary preparation ensuring myocardial suppression or if the preparation regimen was sufficient. We aimed to use serum beta-hydroxybutyrate (BHB) levels as a marker to identify that suppression in the left ventricle.

Methods: Consecutive patients, who underwent FDG PET imaging, were included. Serum BHB levels were measured in all patients on the day of imaging prior to injecting FDG. Receiver operating characteristics (ROC) were used in a random 30% sample of the complete population (derivation cohort) to identify optimal threshold of BHB. Test characteristics for thresholds were then evaluated from the remaining 70% of sample in a separate validation cohort.

Results: A total of 256 images from 220 patients were included. Patients with sufficient left ventricular suppression had significantly higher BHB levels (median (IQR) BHB 0.6 (0.3-0.8) vs. 0.2 (0.2-0.3) mmol/l, \( P < .001 \), in patients with suppressed vs. 35 patients with non-suppressed myocardium, respectively). Similarly, significantly lower Standardized Uptake Values (SUV) were seen in patients with sufficient left ventricular suppression (median (IQR) SUV max 3.2 (2.5-4.3) vs. 8.6 (4.7-15.4), \( P < .001 \), median (IQR) SUV mean 2.2 (1.9-2.8) vs. 5.0 (2.9-8.5), \( P < .001 \), in patients with suppressed vs. non-suppressed myocardium, respectively). ROC analysis in the derivation cohort showed a BHB level of 0.335 mmol/l as optimal to identify suppression, with a sensitivity and specificity of 85.51% and 87.50%, respectively, in the validation cohort. All patients (100%) with BHB \( \geq 0.41 \) mmol/l had myocardial suppression compared to only 29.63% of patients with BHB \( \leq 0.20 \) mmol/l.

Conclusions: In this study, we have shown how serum BHB levels can be used at the point of care to identify sufficient left ventricular myocardial suppression.

Introduction: Coronary 18F-sodium-fluoride (18F-NaF) positron emission tomography (PET) showed promise in imaging coronary artery disease activity. Currently, image processing remains subjective due to the need for manual registration of PET and computed tomography (CT) angiography data. We aimed to develop a novel fully automated pipeline to register coronary 18F-NaF PET to CT angiography using pseudo-CT generated from non-attenuation corrected (NAC) PET by generative adversarial networks (GAN).

Methods: A total of 169 patients, 139 in the training and 30 in the testing sets, were considered. Conditional GAN with a modified UNet generator was trained to generate pseudo-CT images from NAC PET images. Automatic end-to-end registration was performed for evaluation of 30 patients with 88 coronary vessels.

Results: Difference in displacement motion vectors between GAN-based and observer-based registration in the x, y and z directions was 0.8 ± 3.0 mm, 0.7 ± 3.0 mm, and 1.7 ± 3.9 mm, respectively. TBRmax had a coefficient of repeatability (CR) of 0.31, mean bias of 0.03, and narrow limits of agreement (LOA) (95% LOA: -0.29 to 0.33). SUV-max had CR of 0.26, mean bias of 0, and narrow LOA (95% LOA: -0.26 to 0.26).

Conclusions: Pseudo-CT generated by GAN from PET, which are perfectly aligned with PET, can be used to facilitate quick and fully automated registration of PET and CT angiography.
223-01
DECREASED SKELETAL MUSCLE ATTENUATION IS INDEPENDENTLY ASSOCIATED WITH CORONARY MICROVASCULAR DYSFUNCTION AND ADVERSE CARDIOVASCULAR EVENTS

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Introduction: Coronary microvascular dysfunction (CMD) is prevalent in patients with cardiometabolic disease and associated with adverse cardiovascular outcomes, including death and heart failure (HF) with preserved ejection fraction (HFpEF). Skeletal muscle attenuation (SMA) is a marker of muscle lipid content and has been linked to the development of cardiometabolic impairment, but its association with CMD and adverse outcomes has not been determined.

Methods: Consecutive patients (N = 400) referred for CAD evaluation with positron emission tomography (PET) demonstrating normal perfusion and preserved ejection fraction (LVEF) who had an available abdominal CT were followed over a median of 6.0 (IQR 4.1-7.3) years for the occurrence of a primary composite endpoint of major adverse events (MACE), including death and hospitalization for myocardial infarction or HF. Coronary flow reserve (CFR) was determined as stress/rest myocardial blood flow from PET. Cross-sectional SMA (in Hounsfield units, HU), subcutaneous (SAT), and visceral adipose tissue (VAT) areas (in cm²) were extracted from CTs at the L3 level using a validated, fully automated neural networks algorithm. CT-derived hepatic attenuation was measured in available studies (N = 380).

Results: Median age was 63 years and 71% were female. Lower SMA, reflecting increased muscle fat content, correlated with higher BMI (r = -0.24, P < .001) and lower hepatic attenuation (r = 0.18, P < .001). Patients with CMD (CFR < 2, N = 196) demonstrated significantly lower SMA compared to those with preserved CFR (P = .005). After adjustment for traditional CV risk factors, nonwhite race, estimated glomerular filtration rate (eGFR), LVEF, and total adiposity, SMA remained independently associated with CFR (β = 0.12, P = .038). In adjusted analyses, lower CFR and lower SMA, but not VAT, SAT or hepatic attenuation, were independently associated with MACE (HR 1.64 95% CI 1.33-2.93, P = .01 per -1U CFR and HR 1.82 95% CI 1.45-2.28, P < .001 per –10 HU, respectively), especially HF (HR 2.17 95% CI 1.64-2.87, P < .001 per –1U CFR and HR 2.06 95% CI 1.46-2.92, P < .001 per –10 HU).

Conclusions: Lower SMA, a marker of increased muscular adiposity, is associated with CMD and MACE, especially heart failure hospitalization. These findings were independent of traditional CV risk factors, central adiposity, and hepatic attenuation.

223-02
INCREMENTAL PROGNOSTIC ROLE OF PET-DERIVED REGIONAL CORONARY FLOW RESERVE

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Introduction: Global myocardial flow reserve (MFR) derived from positron emission tomography (PET) myocardial perfusion imaging (MPI) is an important risk-stratifying tool to tailor the management of patients with coronary artery disease. We aimed to assess the prognostic role of the regional MFR over clinical variables and global MFR.

Methods: Consecutive patients who had clinically indicated PET MPI were included. Patients were followed from the date of imaging to incident major adverse cardiovascular events (MACE: inclusive of all-cause death, myocardial infarction, and late revascularization—percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG) > 90 days after imaging). The lowest MFR within the myocardium was identified, and the difference between the lowest/regional lowest to global MFR (normalized to rate-pressure product) was determined.

Results: The study population consisted of 1,866 consecutive patients with clinically indicated PET MPI (mean age 66±12), 53% male, 47% Caucasian). Cardiovascular risk factors were prevalent (88% hypertension, 80% dyslipidemia, 48% diabetic, 19% ever smoking). After a mean follow-up of 13 ± 7 months, 141 patients (7.6%) experienced MACE (78% D/26 MI/43 PCI/11 CABG). In multivariable Cox regression models adjusted for clinical variables and global MFR, the lowest regional MFR as illustrated by the difference between global to lowest MFR was significantly associated with incident events (one unit increase in difference: HR 2.26 95% CI 1.38-3.68, P = .001).

Conclusion: Our findings indicate that the lowest MFR was independently associated with incident events after adjusting for global MFR and clinical variables.

223-03
IMPACT OF THE COVID-19 PANDEMIC ON THE USE OF MYOCARDIAL PERFUSION IMAGING FOR THE ASSESSMENT OF CORONARY ARTERY DISEASE

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Introduction: The COVID-19 pandemic—more specifically, the lockdown period—had effects on non-COVID healthcare, with reductions in the access to tests and treatments. As myocardial perfusion imaging (MPI) has a well-established role in the evaluation of coronary artery disease (CAD), delayed diagnoses may occur, with adverse consequences. Therefore, understanding of the trends of the diagnoses of myocardial perfusion abnormalities by MPI is central in this context.

Methods: Consecutive patients, with or without known CAD (myocardial infarction, myocardial revascularization, or chronic/stable disease with angiographically defined, significant CAD), who underwent stress/rest MPI at a Brazilian, outpatient, private Nuclear Cardiology laboratory, were studied. The number of tests, stress modality (exercise or pharmacologic), frequency of abnormal tests, and frequency of ischemic MPI tests (those with reversible perfusion defects) were registered in three 30-day time intervals: immediately pre-pandemic (mid-February to
Conclusions: 18F-FDG has a very high sensitivity and good specificity among the time intervals (21%, 18%, and 21%), as well as the overall frequency of myocardial ischemia (13%, 11%, and 15%). However, all tests labeled as ischemic occurred in patients with known CAD; among patients without known CAD, ischemic MPI tests dropped to zero (from 77% before lockdown, returning to 88% after containment release).

Methods: The PubMed and Embase databases were searched for relevant studies, and a meta-analysis was performed as per the PRISMA guidelines. The sensitivity and specificity forest plots were created using RevMan software. Bivariate analysis and receiver operating characteristic (ROC) curves were created for the summary estimate and the corresponding 95% CI with R software package. Risk of bias and heterogeneity were checked to ensure internal validity.

Results: A total of 219 patients from 7 studies were included in this meta-analysis. One study used dobutamine, while the others used exercise stress 18F-FDG imaging. The results are depicted in the figure. The pooled sensitivity and specificity of stress 18F-FDG were found to be 0.87 (95% CI 0.80-0.91) and 0.90 (95% CI 0.67-0.98), respectively. Four of these studies also provided data on MPI. The pooled sensitivity and specificity for MPI were found to be 0.65 (95% CI 0.55-0.74) and 0.98 (95% CI 0.31-1.00), respectively. The area under the ROC curve was higher for 18F-FDG than MPI. The risk of bias was low, and the heterogeneity between studies was low.

Conclusions: 18F-FDG has a very high sensitivity and good specificity for direct myocardial ischemia imaging. These results warrant further large-scale studies to establish its role in routine clinical practice.
**223-06**

**EFFECT OF RENAL TRANSPLANTATION IN LEFT VENTRICULAR MECHANICAL DYSYNCHRONY AND REMODELING: A PROSPECTIVE STUDY BASED ON GATED-SPECT MYOCARDIAL PERFUSION IMAGING**

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**Background:** End-stage renal disease (ESRD) is associated with concentric left ventricular (LV) remodeling leading to hypertrophy, dilatation and poor LV contractile function. Moreover the LV mechanical dys synchrony (LVMD) associated with ESRD is a poor prognostic predictor. Though, renal transplant is known to improve the contractile functions of LV, the long-term effect on reversibility of LVMD is still debatable and studies have shown conflicting results.

**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 (gm), 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 twenty-three consecutive patients (M/F = 18:5) of an on-going Institutes Ethics Committee approved study, on gated-SPECT myocardial perfusion imaging (MPI). None of these patients had myocardial ischemia in MPI. The median interval between the transplant and the second MPI was 24 months (range 4-50). All the patients were non-dependent on dialysis having urea (mean 44 mg/dl; range12-67) and creatinine (mean 1.2 mg/dl; range 0.85-1.62) within normal range at the time of second MPI.

**Results:** There was significant reduction in EDV and ESV (ml) (109.8 ± 51.1 vs 61.9 ± 21.0; mean difference of 47.9, and 56.7 ± 37.6 vs 19.0 ± 14.2; mean difference of 37.7; P = .0001, respectively) from pre- to post-transplant period along with significant improvement in LVEF (55.1 ± 16.1% vs 71.6 ± 12.3%, mean improvement of 16.5 ± 4.2%, P = .0003) suggesting overall improvement in the contractile function of LVMD in post-transplant MPI suggested by a decrease in the mean PBW by 34.9 ± 8.2° (71.3 ± 36.1° vs 36.4 ± 15.9°; P = .0001) and a significant decrease in PSD by 4.1 ± 1.3° (12.5 ± 4.6° vs 8.4 ± 4.1°; P = .002). The entropy also decreased from 53.2 ± 9.9 to 46.3 ± 9.7 from pre-transplant to post-transplant (P = .02). Additionally, the LV mass (gm) reduced significantly from 180.7 ± 37.4 vs 122.2 ± 22.3 in the post-transplant with mean reduction of 58.5 ± 9.9 g (P = .001) suggesting reversal of LV hypertrophy. We also noted improvement in the LV dilatation/remodeling parameters suggested by increase in the sphericity index (1.57 ± 0.14 vs 1.72 ± 0.2; P = .013) and eccentricity index (0.79 ± 0.04 vs 0.82 ± 0.05, P = .04).

**Conclusion:** Results of the on-going study objectively shows that renal transplantation does improve LVMD and LV remodeling along with contractile function, on basis of SPECT MPI parameters.

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**223-07**

**THE PROGNOSTIC VALUE OF MYOCARDIAL ENERGY ESTIMATED BY AMMONIA PET FOR MAJOR ADVERSE CARDIAC AND CEREBROVASCULAR EVENTS**

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**Background:** Myocardial flow reserve (MFR), which is quantitatively measured by 13N-ammonia positron emission tomography (NH3-PET), is a prognostic factor in patients with ischemic and non-ischemic heart disease. We have developed the world’s first PET-dedicated cardiac function analysis algorithm that can measure regional myocardial strain ratio (MSR) of stress to rest MS, applying feature-tracking technique to NH3-PET. We propose myocardial energy (ME), which combines PET-derived MSR and MFR as independent vectors. We aimed to investigate the potential of ME as prognostic factors in patients with ischemic heart disease (IHD).

**Methods:** Between January 2017 and January 2019, 263 consecutive patients performed resting and stressed myocardial NH3-PET because of known or suspected coronary artery disease at a single center were enrolled. We excluded patients without coronary artery stenosis of ≥50%, diagnosed by coronary computed tomography angiography, from this cohort. Furthermore, patients with congenital heart disease, a transplanted heart or adenosine ineffectiveness were excluded. MSR was defined as the ratio of strains at stress and rest, and ME was calculated from the following equation. The endpoint was major adverse cardiac and cerebrovascular events (MACCEs) comprising all-cause death, acute coronary syndrome, hospitalization due to heart failure, revascularization, and cerebrovascular disease. The ability to predict MACCE was assessed using the receiver operating characteristic (ROC) analysis. The predictability of ME was analyzed using Kaplan–Meier analysis. The Cox proportional hazards regression model was used to calculate hazard ratios (HR) with 95% confidence intervals (CI).

**Results:** Consecutive 95 patients were analyzed. The ROC curve analysis demonstrated a cutoff of 2.29 for MACCE with ME, and Kaplan–Meier analysis showed that patients with ME < 2.29 had a significantly higher MACCE rate than those with ME ≥ 2.29 (P = .0016). Multivariate analysis indicated that ME was an independent marker that could predict MACCE in imaging and clinical parameters (HR 6.72, 95% CI 1.56–29.0, P = .011). The Cox proportional hazards regression model was used to calculate hazard ratios (HR) with 95% confidence intervals (CI).

**Conclusion:** ME helped identify patients at higher risk of MACCE, and it may be a new index for risk stratification in IHD.

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**223-08**

**NON-INVASIVE RISK STRATIFICATION IN A GROUP OF PATIENTS WITH END-STAGE RENAL DISEASE AND 3 YEARS PROGNOSIS. DOES THE SEX MATTER?**

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**Introduction:** The risk of death and major cardiovascular events (MACE) is higher in end-stage renal disease (ESRD) patients, being an independent risk factor for ischemic heart disease. Myocardial perfusion imaging by gated single-photon emission computed tomography (Gated-SPECT) is a non-invasive method useful in cardiovascular risk stratification in patients with ESRD. Objectives: to correlate post-test risk by...
gated-SPECT with mortality, MACE and major non-cardiac events at 3 years in patients with ESRD according to sex.

**Methods:** Retrospective and analytical study. Post-test risk was classified according to the results obtained in the Gated-SPECT of 170 patients with ESRD. Gated-SPECT: semiquantitative visual analysis following the guidelines of the American Society of Nuclear Cardiology. Post-test risk was classified as low, moderate, or high, and a 3-year follow-up was performed assessing mortality, MACE, and major non-cardiac events according to sex. Statistical analysis: Epi Info software, version 7.2.5.0, was used. The results were expressed in percentages and standard deviation.

**Results:** Of the 170 patients included 96 (58%) were men, with a mean age 44 ± 13 years. Other cardiovascular risk factors were arterial hypertension in 136 (80%), dyslipidemia in 69 (41%), tobacco use in 52 (31%), type 2 diabetes mellitus in 44 (26%), and 3 (2%) patients had previous ischemic heart disease. Cardiovascular risk factors according to sex were most in men, except for ischemic heart disease, that was more prevalent in women. According to the findings in the Gated-SPECT, 143 (84%) were reclassified in low risk, and 27 (16%) in moderate/high risk of which 78 (55%) and 20 (74%) were men, respectively. In the 3-year follow-up, 5 (3%) patients died, all from the low-risk group, and from non-cardiovascular causes, 3 (60%) were men. There were no MACE, but major non-cardiac events occurred in 10 (7%) patients, 9 (90%) in the low-risk group and 1 (10%) in the moderate/high-risk group, the majority were men in both groups (5.55% and 1.100%, respectively).

**Conclusions:** The majority of the patients were reclassified as low risk (84%). Death and most of the major events were of non-cardiovascular origin, predominantly in men and in the low-risk group. Therefore, there is no correlation during the 3-year follow-up between the post-test risk and the development of major events and mortality according to sex. Gated-SPECT is a useful non-invasive method for risk stratification in patients with ESRD.

**223-09**

**TRANSMURAL MYOCARDIAL PERFUSION IN CARDIAC AMYLOIDOSIS, HYPERTENSIVE HEART DISEASE, AND HEALTHY CONTROLS**

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**Introduction:** Microvascular dysfunction is common in cardiac amyloidosis (CA). Although the burden of amyloid deposition is generally greater in transthyretin (ATTR) CA, severe subendocardial deposits are more frequent in light-chain (AL) CA. Whether these differences affect the pattern of transmural myocardial perfusion is not known. The aim of this study is to compare the risk and stress transmural perfusion gradient (TPG) in patients with AL- and ATTR-CA, hypertensive heart disease (HHD), and healthy controls (controls).

**Methods:** This sub-analysis from two prospective, cross-sectional trials includes 42 patients. Twenty-seven patients with CA (15 AL-CA, 12 ATTR-CA), 7 patients with HHD, and 8 controls underwent rest and vasodilator stress N-13 ammonia PET. Global left ventricular myocardial blood flow (MBF) was quantified at rest and during peak hyperemia. Following pixel-wise parametric mapping, TPG was calculated as subendocardial over subepicardial MBF, for both rest and stress scans.

**Results:** MBF differed significantly between patients with CA, HHD, and controls at rest (0.64 ± 0.19, 0.97 ± 0.14 and 0.93 ± 0.15 mL/g/min, P < .001) and at stress (1.08 ± 0.33, 2.02 ± 0.73 and 2.79 ± 0.48 mL/g/min; P < .001). Overall, TPG decreased by 12% from rest to stress (1.12 ± 0.13 to 1.03 ± 0.13; P < .001). However, while TPG decreased by 12% from rest to stress in AL-CA (1.14 ± 0.16 to 1.00 ± 0.15; P = .001), it remained unchanged in ATTR-CA (1.13 ± 0.10 to 1.10 ± 0.16; P = .672) (Figure). Of note, there were no differences in global longitudinal strain (P = .541), wall thickness (P = .693), E/e’ (P = .343), or coronary calcifications (P = .153) between AL-CA and ATTR-CA.

**Conclusions:** The transmural perfusion gradient decreases from rest to vasodilator stress in AL-CA, hypertensive heart disease, and healthy controls, but remains unchanged in ATTR-CA. This disparity in transmural myocardial perfusion may suggest different mechanisms of microvascular dysfunction in AL-CA and ATTR-CA.
223-11

ENDOCARDIAL VIABILITY RATIO PREDICTS MORTALITY AND ADDS PROGNOSTIC VALUE TO MYOCARDIAL PERFUSION RESERVE IN PATIENTS UNDERGOING STRESS 13 N-AMMONIA PET MYOCARDIAL PERFUSION IMAGING AND RIGHT HEART CATHETERIZATION

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Introduction: The endocardial viability ratio (EVR) on right heart catheterization approximates the balance of oxygen supply and demand in the myocardium. EVR is the ratio of diastolic pressure–time index, a product of coronary perfusion pressure and diastolic time that approximates coronary blood supply, over the tension-time index, the product of systolic pressure and systolic time that represents oxygen demand. Prior work by our group has shown that increased EVR is associated with all-cause mortality in patients with heart failure. We sought to characterize the value of EVR in patients with myocardial perfusion reserve (MPR) assessment on PET myocardial perfusion imaging (MPI).

Methods: We identified 89 patients who had undergone both a stress 13 N-ammonia PET MPI study with MPR assessment and a right heart catheterization within 180 days between 2014 and 2021. EVR was calculated from hemodynamic data collected at the time of catheterization. Kaplan–Meier analysis was used to identify the relationship of EVR and MPR with all-cause mortality individually and in combination.

Results: The mean age of the study cohort was 64.3 years with 55% female. The follow-up period was a median of 36 months (range 24 days-2575 days). The median global MPR was 1.93 (IQR 1.61-2.40) and median EVR was 1.3 (IQR 0.973-1.512). Global MPR predicted all-cause mortality (P = .0009) consistent with prior published analyses (Figure, panel A). EVR also predicted all-cause mortality (P = .03). Stratifying patients with MPR above the median (1.93) by EVR above or below the median (1.29) separated a high-EVR group with 100% 3-year survival and a low-EVR group with intermediate survival (P = .0015) (Figure, panel B).

Conclusions: In patients undergoing stress PET MPI and right heart catheterization, EVR and MPR predict all-cause mortality. EVR identifies a group with normal MPR but an increased risk of all-cause mortality.

223-12

SERUM-FREE THYROXINE TO TRIIODOTHYRONINE (FT4/FT3) RATIO: A NOVEL BIOMARKER PREDICTS CORONARY MICROVASCULAR DYSFUNCTION (CMD) IN EUTHYROID PATIENTS WITH INOCA

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Background: Increased free thyroxine (FT4) to free triiodothyronine (FT3) ratio is associated with an increased risk of cardiovascular diseases, but whether it can be a novel risk marker for predicting coronary microvascular dysfunction (CMD) in euthyroid patients with ischemia and no obstructive coronary artery disease (INOCA) is still unclear.

Methods: This prospective study (ChiCTR2000037112) enrolled 71 INOCA patients without previous thyroid disease history. Coronary flow reserve (CFR) was non-invasive assessed by D-SPECT and CFR < 2.5 was defined as CMD group. LASSO and multivariate logistic regression were used to determine the predictors of CMD.

Results: Among 71 INOCA patients (15 [21.1%] CMD), FT4 and FT4/FT3 ratio in CMD group were significantly higher. Meanwhile, FT4 and FT4/FT3 ratio both showed significantly moderate correlation with CFR (r = −0.25, P = .03; r = −0.34, P = .03, respectively). The ROC curve analysis revealed that the FT4/FT3 ratio had highest efficacy for predicting CMD with a cutoff value > 3.39 (AUC 0.78, P < .01, sensitivity, 80.0%; specificity, 71.4%). Multivariate logistic regression showed that FT4/FT3 ratio was an independent predictor of CMD (OR 7.62, 95% CI 1.12-51.89, P for trend = .006).

Conclusion: Increased FT4/FT3 ratio levels likewise predict the occurrence of CMD in euthyroid INOCA patients, presenting a novel biomarker for improving the risk stratification.
303-01

WHILE VISUAL ESTIMATION OF CORONARY ARTERY CALCI-FICATION FROM CT ATTENUATION CORRECTION SCANs IN HYBRID SPECT/CT PROVIDE SIMILAR PROGNOSTIC VALUE, QUANTIFICATION OF CORONARY CALCIIFICATION WITH ATTEN-UATION CT CALCIUM SCORE MAY OFFER AN ADVANTAGE

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Introduction: The prognostic utility of visually estimated coronary artery calcification (VECAC) from low-dose computed tomography attenuation correction (CTAC) scans is unknown, specifically how it compares to coronary artery calcifications (CAC) quantified by calcium score on CTACs (CTAC-AS). Therefore, we sought to evaluate the predictive value and correlation of VECAC and CTAC-AS.

Methods: From the REFINE SPECT Registry, 4247 patients without prior coronary stenting with SPECT/CT performed at a single center were included (age: 64 ± 12 years, 47% female). VECAC grade (zero, mild, moderate, or severe) was defined by the most severely graded vascular territory. CAC scoring of CTACs was performed at the REFINE SPECT core lab with dedicated software. VECAC was correlated with categorized CTAC-AS (zero: 0, mild: 1-99, moderate: 100-399, severe: 400). The association between VECAC or CTAC-AS and major adverse cardiovascular event (MACE) was evaluated with Kaplan–Meier and Cox regression analyses.

Results: A high degree of association was observed between VECAC and CTAC-AS, with 72% of VECACs in the same category as CTAC-AS and 98% within one category. There was substantial agreement between VECAC and CTAC-AS (weighted kappa: 0.76 with 95% confidence interval: 0.75-0.78), (P < .001). During a median follow-up of 25 months, 372 patients (9%) experienced MACE. In survival analysis, both VECAC and CTAC-AS were associated with MACE (Figure. 1A, B). In univariate Cox regression analyses, both VECAC and CTAC were predictors of MACE (Figure 1C). The ROC area under the curve (AUC) for MACE was similar for VECAC vs categorized CTAC-AS (0.715 vs 0.72, respectively, P = .20), but ROC AUC was better for continuous CTAC-AS when compared to VECAC (0.731, P = .007).

Conclusion: Visual assessment of CAC on low-dose CTAC scans provides good estimation of CTAC-AS. CTAC-AS has slightly better prognostic value for MACE in comparison to visually assessed CAC.
303-03
PRONE MYOCARDIAL PERFUSION IMAGING (MPI) IMPROVES INFERIOR AND APICAL ARTIFACTS IN SPECT/CT MPI COMPARED TO SUPINE MPI WITH OR WITHOUT ATTENUATION CORRECTION
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Introduction: Myocardial perfusion imaging (MPI) combined with computed tomography (CT) for attenuation correction and calcium scoring is gaining more popularity as detection of coronary artery calcification can identify nonobstructive CAD and adds prognostic value in predicting cardiac events. IQ-SPECT (Siemens AG, Munich, Germany) is a highly sensitive single-photon emission computed tomography (SPECT) camera system using cardiofocal collimation for MPI and can reduce scan time or radiation dosage compared with conventional SPECT with a parallel-hole collimator. Although apical and inferior artifacts are frequent findings with IQ-SPECT and reduce specificity, although computed tomography-derived attenuation correction (CTAC) may reduce attenuation artifacts in supine images, apical defects are usually worse. We evaluated the use of prone imaging to reduce artifacts in the apical and inferior segments and improve specificity.

Methods: Thirty-seven patients with suspected coronary artery disease and visually normal perfusion in the inferior and apical segments on cadmium-zinc-telluride (CZT) SPECT MPI using 99mTc-tetrofosmin underwent repeat MPI with IQ-SPECT. Stress images acquired with the patients in the prone position (35 patients) were compared with supine images with (S-CTAC) and without CTAC (S-NCTAC). Normalized tracer uptake (NTU) and semiquantitative stress scores were determined for the 17 standard myocardial segments and summed stress scores (SSS) were calculated for each patient. Results were compared using ANOVA for the 17 standard myocardial segments and Friedman testing for ordinal variables.

Results: The study population of 37 patients had a mean age of 60 ± 9 year, mean BMI of 28.4 ± 3.7 kg/m², and included 25 males. Image quality did not differ between S-NCTAC, prone, and S-CTAC images. The prevalence of apical artifacts was significantly different between S-NCTAC (5 patients, 13.5%), prone (1 patient, 2.7%), and S-CTAC (15 patients, 40.5%) images (P = .004). In all the patients, NTU in the inferior segments in prone and S-CTAC images was greater than S-NCTAC. However, for the apex, NTU increased with prone and decreased with S-CTAC images compared to S-NCTAC images. SSS was significantly different between S-NCTAC, prone, and S-CTAC images (P < .0001). With post hoc analysis, SSS was lower with prone (0.6 ± 1.1) compared to S-NCTAC (2.4 ± 2.5, P = .001), and did not differ between S-NCTAC and S-CTAC (0.9 ± 1.2) images.

Conclusions: Prone 99mTc-tetrofosmin MPI images with IQ-SPECT had less apical and inferior artifacts than S-CTAC and S-NCTAC images and improve specificity. The importance of high specificity is increasing as fewer patients referred for SPECT MPI have obstructive CAD. Adding coronary calcium evaluation and reducing radiation doses with this new IQ-SPECT-CT technology will make SPECT MPI more competitive.

303-04
THE PROGNOSTIC VALUE OF SYSTOLIC BLOOD PRESSURE RESPONSE TO REGADENOSON STRESS
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Background: Systolic blood pressure response (SBPR) to exercise has been shown to predict adverse cardiac events. Heart rate response (HRR) to vasodilator stress has been shown to be a strong predictor of mortality. The aim of this study is to investigate the prognostic value of SBPR to regadenoson and to compare it to HRR.

Methods: We conducted a retrospective cohort study of consecutive patients who underwent regadenoson stress SPECT myocardial perfusion imaging (MPI). SBPR was calculated using the formula 100 * (minimum SBP – baseline SBP)/baseline SBP and HRR was calculated as 100*(Max HR – Baseline HR) / Baseline HR. Kaplan–Meier plots, the log-rank test, and Cox regression models were used for survival analysis. We used logistic regression modeling and receiver operating characteristic (ROC) analyses to determine the incremental prognostic value.

Results: Among 10,511 patients, followed for 35 ± 21 months, 921 (8.8%) deaths were observed. The median SBPR was -9.4% (25th to 75th percentile, -17.1% to -1.9%). There was a stepwise increase in mortality with decreasing SBPR (Figure 1). SBPR was independently and incrementally associated with survival (HR 0.99; 95% CI 0.984-0.996; Δγ² 11.8; P < .001), after adjusting for clinical parameters (baseline SBP, age, sex, HTN, DM, dyslipidemia, smoking, CAD, ESRD), left ventricular ejection fraction (EF), and SSS. Compared to SBPR, HRR provided significantly greater prognostic value (Figure 2).

Conclusion: SBPR to regadenoson provides a modest, independent, and incremental predictive value for mortality. HRR to regadenoson provides greater prognostic value than SBPR.
303-05
FEASIBILITY OF SAME-DAY PHARMACOLOGICAL STRESS TEST PRIOR TO FDG PET FOR ASSESSMENT OF CARDIAC SARCOIDOSIS
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Introduction: Performance of strenuous exercise is to be avoided for at least 12 hour prior to FDG PET for assessment of cardiac sarcoidosis (CS). However, there are insufficient data to extend this restriction for pharmacological stress testing prior to FDG PET for CS. We sought to evaluate the feasibility of same day pharmacological stress test followed by FDG PET, in patients with suspected CS also requiring ischemic evaluation.

Methods: As a part of our lab protocol, all FDG PET orders for CS were reviewed to determine if additional ischemic evaluation would be beneficial based on known or suspected coronary artery disease. Stress test was performed after discussion with the referring physician. We conducted a retrospective analysis of clinical and imaging data of consecutive patients who underwent 82Rb-PET/CT stress and 18F-FDG PET/CT over a period of 18 months. All patients followed a high-fat low-carb dietary preparation as per lab protocol.

Results: A total of 190 patients were included in the analysis (mean age 60 years; 57% men). Patients undergoing stress testing were more often men (83% vs. 25%, P < .0001), had a greater prevalence of known CAD (48% vs. 6%, P < .0001), CAD risk factors, and chronic kidney disease. Ischemia was noted in 23 (15%) patients who underwent stress testing. There were no significant differences in the prevalence of a positive FDG PET study (P = .34), and scans with inadequate myocardial suppression (P = .34) (Figure).

Conclusions: In carefully selected patients, pharmacological stress test performed on the same day prior to FDG PET for CS does not adversely impact myocardial suppression or result in incorrect diagnosis. In addition, it allows for diagnosing ischemia that would have otherwise been missed. Such an approach may allow for single-day imaging permitting concomitant assessment for CAD and CS. This in turn would enhance patient convenience and compliance especially for those traveling from remote locations to tertiary care advanced cardiac imaging centers, as well as increase the efficiency of busy labs.

303-06
THE BENEFIT OF A FULLY AUTOMATED DATA-DRIVEN MOTION CORRECTION APPLIED TO DYNAMIC RUBIDIUM-82 DATA FOR MYOCARDIAL BLOOD FLOW MEASUREMENT
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Introduction: Studies have shown that fully automated data-driven motion correction (DDMC) can provide substantial benefits for static perfusion images in cardiac PET. It is well known that motion in dynamic reconstructions results in significant errors in MBF. DDMC acts on the entirety of the acquired data and so expanding its application to dynamic reconstructions provides an attractive all-in-one approach to addressing motion in cardiac PET. Current methods of dynamic motion correction involve adjusting the data in a frame-by-frame (FBF) fashion, which is susceptible to operator variability. We propose that if FBF correction of DDMC data produces no clinically significant change in MBF, then DDMC alone is sufficient, alleviating the need for a manual FBF process.

Methods: 40 anonymised 21-frame dynamic rubidium-82 datasets with evidence of motion (6 mild; 16 moderate; 18 severe) from a Siemens Biograph Vision 600 were reconstructed with DDMC and without (RAW). Both reconstructions were processed with Cedars QPET with and without manual FBF motion correction to give 4 datasets: DDMC + FBF, DDMC-FBF; RAW + FBF, RAW-FBF. The cumulative absolute frame shifts (CAFS), in mm, were derived from each FBF correction along standard cardiac orientations. The mean and 95% confidence intervals (95% CI) of the percentage change in MBF (%ΔMBF) for global and regional values were recorded for DDMC + FBF vs. DDMC-FBF and RAW + FBF vs. RAW-FBF. The latter comparison acted as a control and reference to quantify the impact of FBF correction on this study cohort.

Results: The CAFS were significantly lower along every cardiac orientation for DDMC data than the RAW data where LAD was -18% to -28%, and RCA was -28% to +21% (P < .0001 in all cases).

Conclusions: This study has shown that the percentage differences in MBF from DDMC data with and without secondary manual FBF motion correction are well within the reported rubidium-82 test-retest variability and significantly lower than the changes from FBF correction acting on the original data. Hence, these preliminary findings suggest that standalone DDMC provides a unified solution for addressing motion in both static relative perfusion images and dynamic datasets for rubidium cardiac PET. This would also remove any operator variability inherent in a manual FBF approach.
303-07

COMPARISON OF AUTOMATED AND MANUAL FRAME-BY-FRAME MOTION CORRECTION FOR RUBIDIUM-82 DATA USING SIPM PET DATA
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Introduction: Segmentation failures due to motion are a major cause of errors when calculating Myocardial Blood Flow (MBF) and arguably more problematic on higher quality images from SiPM PET systems where spatial resolution is superior. Current methods of dynamic motion correction involve manually adjusting the data in a frame-by-frame (FBF) fashion, which is both labor-intensive and susceptible to operator variability. This work compares a prototype automatic motion correction algorithm with the current commercial manual FBF technique.

Methods: 44 anonymized 21-frame dynamic rubidium-82 datasets with various degrees of motion (7 mild, 17 moderate, 20 severe) acquired on a Siemens Biograph Vision 600 were analyzed. Manual FBF correction (ManMC) was performed by a single operator on all frames using the current commercial version of Cedars QPET Kinetic (v2017) and then repeated in a prototype QPET version with automatic motion correction (AutoMC). The absolute differences in each frame shift, for AutoMC vs ManMC, were determined along the standard cardiac orientations. These differences were pooled (44 datasets × 21 frames) and the median and interquartile range (IQR) were calculated. In addition, median and IQR were determined for each individual frame calculated across the 44 datasets. Finally, the mean and 95% confidence intervals (95% CI) of the percentage change in MBF (%ΔMBF) for global and regional values were recorded for AutoMC vs. ManMC.

Results: The AutoMC processing took approximately 15 s to complete on each data set, as opposed to several minutes for manual correction which is dependent on motion severity and operator experience. The median [IQR] of the absolute shift differences for the pooled data was 0.8 [0.2-1.7] mm along the septal-lateral direction, 0.7 [0.2-1.5] mm along the anterior-posterior direction, and 1.0 [0.3-2.1] mm along the base-apex direction. No individual frame had a median absolute shift difference greater than 1.6 mm. The mean %ΔMBF for global MBF (%ΔgMBF) and all regional values was < 5%. The 95% CI for the %ΔgMBF for gMBF was -3.3% to +9.3%; for regional MBF was LAD: -4.8% to +12%, LCx: -7.5% to +17%, and RCA: -9.7% to +10%, hence all falling within the reported 20% test–retest variability for rubidium-82 MBF data.

Conclusions: This work has shown the differences in frame shifts between AutoMC and ManMC are very small and well within the typical resolution of newer SiPM PET systems. The percentage changes in MBF between manual and automatic correction are small and well within reported variability. The use of this automatic correction would provide workload and reproducibility benefits for MBF processing.

303-08

MODELS FOR PREDICTION OF CORONARY DISEASE AND MORTALITY WITH A CADMIUM–ZINC–TELLURIDE CAMERA: A COMPARISON OF UPRIGHT AND SUPINE IMAGING
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Introduction: Perfusion imaging scores strongly predict the presence of coronary artery disease (CAD), while cardiac volumes and left ventricular ejection fraction (LVEF) strongly predict mortality. Compared to Anger cameras, cadmium–zinc–telluride (CZT) cameras provide differen volumetric measurements due to increased spatial resolution and upright patient positioning. We explored models for predicting CAD and mortality, comparing accuracy of upright versus supine imaging.

Methods: Patients underwent both supine and upright exercise or pharmacologic stress and rest imaging on a D-SPECT CZT camera and underwent coronary angiography within 3 months. Blinded experts interpreted the SPECT and angiographic studies. All-cause mortality and demographic data were obtained through EMR review. Univariate and multivariable analyses were performed using logistic regression and Cox proportional hazards models. The best logistic regression and Cox models were compared using Vuong’s closeness test and partial likelihood ratio test, respectively.

Results: 392 consecutive patients satisfied inclusion criteria, 169/392 (43.1%) were female. 210/392 (53.6%) had significant angiographic CAD. 78/392 (19.9%) died over a median follow-up of 75 months. The best multivariable model for CAD included supine summed stress score (SSS) and supine stress LVEF, with an AUROC of 0.862, sensitivity 76.7%, specificity 82.4%, and showed superiority over other models (P value < .001). The best multivariable model for mortality included age, gender, and end-systolic volume (ESV). Upright stress ESV and supine rest ESV provided equivalent prediction results. The figure displays mortality for younger and older males stratified by tertiles of supine ESV. High ESV corresponded to highest risk, but low ESV also appeared to have an unfavorable effect.

Conclusions: Angiographic CAD was best predicted by supine SSS and LVEF. Mortality was best predicted by ESV in combination with age and gender, with equivalent results from supine or upright images.

303-09

DUAL-STEP GLUCOSE LOADING FOR BETTER RESULT IN FDG PET CARDIAC VIABILITY STUDY AMONG SELECTED PATIENTS—OUR EXPERIENCE
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Introduction: FDG PET cardiac study is crucial for assessing the viability of cardiac segments and determining the course of management. However, achieving hyperinsulinemic euglycemic status is quite challenging in some patients, especially among diabetics and rapid insulin responders. Sometimes it may lead to poor/ sub-optimal quality of images or may mandate a repeat scan. In order to tackle this, we propose the dual-step glucose loading method.

Methods: Category 1—in diabetics—depending on the baseline glucose level, give oral glucose(25-100 g), if blood glucose peak does not reach beyond 200 mg.dL, immediately administer 25 g more oral glucose.
Once the sugar level reaches plateau, give 2U of regular insulin injection and wait till blood glucose gradually falls below 150 mg/dL. FDG injection can be done after blood glucose falls below 150 mg/dL.

Category 2—In rapid insulin responders—Some patients normally achieve the blood glucose peak after oral glucose intake but rapidly respond to insulin. Some may even show massive drop in blood glucose level (> 75 mg/dL drop within short span of 15 minute) after insulin injection. In such a scenario, immediately we can administer 25–50 g glucose and wait to achieve the peak. Inject 2U of insulin and wait till blood glucose to gradually falls below 150 mg/dL. FDG injection can be done after blood glucose falls below 150 mg/dL.

**Result:** Twenty-four cases were evaluated during time frame of 2020 to 2022. 14 male and 10 female. 21 diabetes and 3 non-diabetic. 19 patients belong to category 1 and 5 belong to category 2. All these patients were subjected to two-step glucose loading method as discussed above. All patients showed excellent imaging outcome with crisp wall definition and no blood pooling.

**Conclusion:** FDG PET cardiac study is vital to define the viability of the cardiac segments. Decision for cardiac intervention or medical management depends on the outcome of the viability study. Excellent imaging results in no dilemma for taking such crucial decisions. We propose a simple and effective dual-step glucose loading method, which might help clinicians to achieve better result.

**303-10**

**REPEATABILITY OF MYOCARDIAL FLOW RESERVE MEASUREMENT USING QUANTITATIVE DYNAMIC SPECT PERFUSION IMAGING**

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**Introduction:** Dedicated CZT cardiac cameras provide accurate measurements of absolute myocardial blood flow (MBF) and flow reserve (MFR). Reproducibility of MBF and MFR remains unclear, but critical for reliable clinical use. In this study, we evaluated the reproducibility of SPECT MBF and MFR measurement in patients referred for coronary artery disease (CAD) screening.

**Methods:** We retrospectively analyzed 124 patients referred for Myocardial Perfusion Imaging (MPI). SPECT data were acquired on a CZT-based pinhole cardiac camera (Discovery NM530c, GE Healthcare, Haifa, Israel) in listmode using a stress (251 ± 13 MBq) rest (512 ± 27 MBq) one-day Tc-99 m-tetrofosmin protocol. Kinetic analyses were done with Corridor4DMTM software using a 1-tissue-compartment model and converted to MBF using a previously determined extraction fraction correction. MFR was analyzed and compared globally and regionally. Motion detection was applied, but no attenuation correction.

**Results:** 124 patients (64 male, 60 female) were included, and SPECT acquisitions were twice reconstructed by the same nuclear medicine board-certified physician for 50 patients and by two different physicians for 74. Mean global MFR was 2.39 ± 0.89. MFR was not significantly different between the two measurements (P = .68); mean difference was 0.008 (from –1.86 to 1.51). This result was similar regarding intra- and inter-observer variation but tend to be better when the measurement is repeated by the same physician ($P = .93$ vs $P = .67$; spearman correlation coefficient of 0.88 and 0.84, respectively, for intra- and inter-). The average discrepancy between the evaluations on the Bland-Altman was –0.003, with 95% limits of agreement of –0.82 to 0.81, with similar results on the intra- and inter-observer comparisons. Using the MFR threshold of 2, we noticed a good agreement when the two measurements were made by the same physician, whereas it was moderate when the observer was different (kappa of 0.75, 95% CI 0.56-0.94 vs 0.56, 95% CI 0.36-0.75, respectively).

**Conclusions:** MFR remains globally similar between different measurements, whether the analysis is performed by the same or by two different physicians. However, the limits of agreement seem to be quite wide regarding the threshold of MFR. An automatization of the reconstruction and analysis could help to improve the reproducibility.
303-13

DOES NPO STATUS PRIOR TO SPECT MYOCARDIAL PERFUSION IMAGING INFLUENCE IMAGE QUALITY?

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Introduction: There is little published literature about how NPO status affects the image quality of myocardial perfusion imaging. There are no standard SPECT guidelines in regard to PO status and patients are kept NPO 3 hour to overnight depending on individual facility protocols. We aimed to see any differences in count statistics reflective of image quality between NPO and not NPO status prior to undergoing SPECT MPI.

Methods: Consecutive patients undergoing Tc-99 m SPECT MPI at our facility with pre-test NPO status prospectively recorded were included. Rest and stress (exercise and regadenoson stress) were compared based on NPO status (NPO > 4 hour vs not NPO having ingested something within 2 hour of testing). Anterior projection of the SPECT images was used to create a region of interest (ROI) encircling the heart, and a similar sized region in the lungs, liver, and sub-diaphragmatic region under the left hemi-diaphragm. Total counts per pixel in the ROI were obtained and the ratios of heart/sub-diaphragm, heart/lung, and heart/liver were calculated and compared based on NPO status.

Results: A total of 67 patients, including 28 in the NPO and 39 in the not NPO group. No significant difference in age, gender, or BMI between groups was found. 29 patients underwent exercise stress testing and 37 underwent regadenoson stress. For the rest images, only the heart/liver ratio (0.73 vs 0.89, P = .02) was significantly different between NPO and not NPO, as the heart/lung (2.1 vs 1.9, P = .07) and heart/sub-diaphragm (0.78 vs 0.89, P = .61) were not significantly different. There were no statistically significant differences between NPO and not NPO for stress images (heart/lung 2.22 vs 2.03, P = .09, heart/sub-diaphragm 1.14 vs 1.02, P = .36, and heart/liver 0.84 vs 0.88, P = .48). This included similar findings with exercise and vasodilator stress.

Conclusion: In this pilot study, there was no significant difference in count ratios between NPO and not NPO patients at rest and with stress, both exercise and vasodilator. Using these ratios as a surrogate for image quality, NPO status does not appear to affect SPECT MPI image quality.
PERFORMANCE AND REPORTING OF CARDIAC POSITRON EMISSION TOMOGRAPHY IN THE UNITED STATES: AN ANALYSIS OF DATA FROM INTERSOCIETAL ACCREDITATION COMMISSION

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Introduction: Cardiac positron emission tomography (PET) has seen a rapid growth in recent years. However, little is known about equipment, imaging protocols employed, and performance and reporting of dynamic imaging data.

Methods: Data from laboratories applying for cardiac PET accreditation between 2016 and 2022 were analyzed. Individual laboratory protocols were reviewed to collect information on equipment, types of PET studies performed, isotope dose, and pharmacologic stress agent. Laboratory protocol and corresponding reports were evaluated to determine if dynamic imaging with assessment of myocardial blood flow (MBF) is performed and reported, along with assessment of coronary artery calcium.

Results: Accreditation data from 157 PET laboratories and 934 PET reports were evaluated. Average age of the PET scanner was 18 years (range 3-32 years), with 77% being non-hybrid PET systems. Rubidium-82 was used as a perfusion tracer in 94% laboratories, and Regadenoson employed as the stress agent by 87%. Of the laboratories performing hybrid PET (with computed tomography), only 20% mentioned assessment of coronary calcium burden in their reports. A total of 30 laboratories (19%) were identified with a mention of performance of dynamic imaging in their protocol; however, review of individual protocols revealed that this was correctly performed in only 16 (of 30) laboratories, all of which reported data on MBF.

Conclusions: PET scanners employed in contemporary practice for cardiac imaging are of high vintage, and majority are non-hybrid systems. Among laboratories with hybrid systems, a small proportion report assessment of coronary calcium burden, while only 10% of all the PET laboratories correctly perform and report dynamic imaging data. Growth in PET cardiac imaging has not kept pace with software and other technological advances.

THE UTILITY OF CORONARY ARTERY CALCIUM SCORE CT TO ACCURATELY SUBSTITUTE SPECT/CT ATTENUATION CORRECTION SCANS FOR THE PURPOSE OF ATTENUATION CORRECTION

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Background: SPECT-CT MPI employs a non-ECG gated, low-dose, 5 mm slice, free-breathing scan for attenuation correction (AC) which differs from formal coronary artery calcium (CAC) score acquisition. The AC CT scan can identify CAC but cannot formally assess a CAC score. We investigate use of a formal CAC score scan to substitute an AC CT scan for processing of SPECT AC perfusion imaging.

Methods: Consented patients without known CAD presenting for a routine SPECT MPI were included. Standard AC was performed along with a formal CAC score and both were used to process AC perfusion images. Automated quantification was used to obtain segmental raw counts, summed stress (SSS), summed rest (SRS), and summed difference scores (SDS), and total perfusion deficit (TPD). Visual quantification of SSS, SRS, and SDS was obtained. Comparison was made between the results for a standard AC scan and the CAC score.

Results: A total of 23 patients (mean age 64.4 ± 9.4, 65.2% male) were included (Figure). Raw counts in the three coronary territories were significantly greater in the AC CT processed images compared to the CAC score images. The average TPD stress and rest values were 2.7 ± 9.1 (P = .16) and 3.4 ± 9.2 (P = .1) higher in the CAC score group, with no discrepancy in the TPD difference value 0.0 ± 3.5 (P = .96). The mean difference in the automated SSS, SRS, and SDS was similar. The mean difference between groups was 0.5 ± 1.1 (P = .58) in the visual SSS, -0.5 ± 4.2 (P = .61) in the SRS, and 1 ± 3.3 (P = .17) in the SDS.

Conclusion: In this pilot study, a significantly lower amount of raw counts was seen in each vascular territory when using the CAC score instead of the AC scan. While this resulted in higher automated TPD, SSS, and SRS, this was not statistically significant, nor was the difference in the difference scores. The use of CAC score CT scan for the purpose of AC is feasible and appears to result in accurate perfusion images. However, a larger study to confirm these findings is needed.
323-01

**QUANTITATIVE RELATIONSHIP OF CZT SPECT GLOBAL AND REGIONAL STRESS MYOCARDIAL BLOOD FLOW, MYOCARDIAL FLOW RESERVE AND CORONARY ARTERY STENOSES**

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**Introduction:** Myocardial blood flow (MBF) quantitation with CZT SPECT may offer incremental diagnostic and prognostic value compared to MPI defect size. However, the relationship of global and regional CZT SPECT MPI defects, stress MBF, MBF reserve (MFR), and angiographic CAD stenosis severity is complex since flow and prognosis also involve microvascular dysfunction, coronary vasomotion, and diffuse CAD plaque. Our aim was to correlate blood flow indices of CZT SPECT with angiographic CAD.

**Methods:** We performed retrospective analysis of 35 patients with CZT SPECT MBF using D-SPECT camera (Spectrum Dynamics, Caesaria, IS) and coronary angiography using a quality improvement database extracted from the electronic medical record. Using logistic regression, global and regional MFR, global and regional stress flow (MBFs), and MPI (as measured by both ischemia and total perfusion defect) were used as independent variables, and their association with severe angiographic CAD was analyzed.

**Results:** Regional MFR in LAD and LCX territories was associated with severe regional angiographic CAD. Trends of association were found for MBFs in LAD and LCX territories and severe angiographic CAD. MFR and MBFs of RCA had the weakest association with severe CAD (Table). A trend of association was found between global MFR (P = .15), global MBFs (P = .19), ischemia on MPI by total perfusion defect (P = .06), and severe angiographic CAD.

**Conclusions:** Regional MFR in the LAD and LCX territories was associated with severe regional angiographic CAD. Trends of association were found for MBFs in LAD and LCX territories and severe angiographic CAD. MFR and MBFs of RCA had the weakest association with severe CAD (Table). A trend of association was found between global MFR (P = .15), global MBFs (P = .19), ischemia on MPI by total perfusion defect (P = .06), and severe angiographic CAD.

**Baseline Characteristics**

| Significant CAD, N = 15* | No Significant CAD, N = 20* | P-value\(^1\) |
|-------------------------|-----------------------------|-------------|
| Age                     | 62 (55, 67)                 | 64 (60, 68) | 0.680 |
| Sex                     | Male                        | Female      | 0.958 |
|                        | 21 (64%)                    | 18 (64%)    |      |
|                         | Female                      | Male        |    |
|                        | 12 (56%)                    | 10 (48%)    |    |
| Body mass index (kg/m²) | 32.1 (30.0, 33.9)           | 33.3 (32.3, 36.5) | 0.430 |
| Hypertension            | 28 (95%)                    | 29 (95%)    | 0.056 |
| Type 2 diabetes mellitus| 17 (52%)                    | 21 (70%)    | 0.059 |
| Prior known CAD         | 11 (31%)                    | 16 (51%)    | 0.062 |
| Prior CAB               | 0 (0%)                      | 11 (66%)    | <0.001 |

**SPECT MPI Findings**

| Quantitative TID         | 1.22 (1.33, 1.31)           | 1.39 (1.34, 1.26) | 0.592 |
| Post-stress EDV, indexed (mL/m²) | 50 (40, 65) | 59 (45, 74) | 0.090 |
| Post-stress ESV, indexed (mL/m²) | 34 (20, 22) | 19 (13, 27) | 0.088 |
| Pre-stress ejection fraction (%) | 70 (65, 79) | 68 (55, 71) | 0.133 |
| Post-stress ejection fraction (%) | 70 (64, 75) | 66 (60, 71) | 0.062 |

**Total stress defect size**\(^2\) = 0.004

| None                    | 14 (42%)                    | 2 (7.1%)     |
| Small                   | 7 (21%)                     | 7 (29%)      |
| Moderate                | 6 (18%)                     | 4 (14%)      |
| Large                   | 6 (18%)                     | 15 (54%)     |

\(^*\) Severe = Stenosis ≥70% for LAD, LCX, RCA and ≥50% for LMCA

323-02

**CORRELATION OF QUALITATIVE TRANSIENT ISCHEMIC DILATION ON STRESS SPECT MPI WITH CORONARY ANGIOGRAPHY**

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**Introduction:** Quantitative transient ischemic dilation (TID) on stress single-photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI) has been considered a potential high-risk finding associated with significant obstructive coronary artery disease (CAD). However, there are little data regarding the significance of qualitative, or visual, TID with or without quantitatively significant TID. We assessed the incidence of significant CAD in stress SPECT MPI with visual TID.

**Methods:** We conducted a single-center retrospective study of patients who underwent a stress SPECT MPI from January 1 through December 31, 2021 on our GE Discovery NM 530c CZT nuclear camera demonstrating visual TID with subsequent invasive coronary angiography within 6 months. 61 patients met this inclusion criteria and were divided into those with and without significant CAD, which was defined as ≥ 70% in multivessel distribution or proximal left anterior descending or ≥ 50% left main stenosis. Baseline characteristics and stress test findings were compared between the 2 groups to assess for any potential predictors of significant CAD (Table 1).

**Results:** Of the 61 patients with visual TID, only 46% had significant CAD without any significant difference in patient characteristics between the groups. However, those with any stress perfusion defects were more likely to have significant CAD than those without (OR 9.58, P = .006), which was observed with small (OR 7.0, P = .036) as well as large (OR 17.5, P = .001) stress defect sizes. The mean values of quantitative TID between those with and without significant CAD were not statistically significant (1.22 vs 1.19, P = .592).

**Conclusion:** Visual TID did not predict significant obstructive CAD, especially in the absence of any stress perfusion defects. Even though visual TID did not correlate with quantitative TID measures, it may provide incremental value with abnormal perfusion defects to detect significant obstructive CAD.

**Table:** Association of Regional Stress MBF, MPI and Odds of Severe CAD* by Regional Coronary Artery

| Odds of Severe CAD | p-value |
|--------------------|---------|
| LAD-MFR            | 0.20 (0.05-0.76) | 0.02 |
| LAD Stress MBF     | 0.30 (0.10-1.23) | 0.20 |
| LCX-MFR            | 0.18 (0.04-0.85) | 0.03 |
| LCX Stress MBF     | 0.24 (0.05-1.23) | 0.09 |
| RCA-MFR            | 0.45 (0.85-1.32) | 0.35 |
| RCA Stress MBF     | 0.84 (0.07-7.75) | 0.20 |

\(*\) Severe = Stenosis ≥70% for LAD, LCX, RCA and ≥50% for LMCA
323-03

ATRIAL UPTAKE: PREDICTOR OF ATRIAL FIBRILLATION IN PATIENTS WITH SUSPECTED CARDIAC AMYLOIDOSIS
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Introduction: Atrial fibrillation (AF) is a common arrhythmia in patients with cardiac amyloidosis (CA). Technetium (Tc)-pyrophosphate (PYP) single-photon emission computerized tomography (SPECT) cardiac scintigraphy is an essential diagnostic tool for the workup of transthyretin (ATTR) CA. The aim of this study was to assess the association of PYP atrial uptake (AU) and incident and prevalent AF in patients undergoing cardiac scintigraphy for suspected transthyretin CA.

Methods: A retrospective cohort from an institutional registry of consecutive patients undergoing 99mTc-PYP radiotracer cardiac scintigraphy between January 2020 and October 2021 was analyzed. Atrial uptake was assessed visually on fused SPECT-CT imaging obtained 3 hour post PYP injection. Transthyretin (ATTR) CA diagnosis was based on results of cardiac scintigraphy following standard guidelines. Prevalent and incident of AF were determined based on recorded electrocardiograms (ECG).

Results: A total of 365 patients (42%) had prevalent atrial fibrillation at the time of imaging and 54 patients (20%) had scans consistent with ATTR-CA. A total 68 patients (26%) had atrial uptake. Patients with AU had higher odds of prevalent AF (OR 6.6, 95% CI [3.5-12.4], \( P < 0.001 \)). After a median follow-up of 10 months (IQR 5-14), atrial uptake was associated with an increased risk of developing new-onset AF (HR 22, 95% CI [6.7-72], \( P < .001 \)), regardless of ATTR-CA status (Figure 1). Similarly, atrial uptake was associated with higher event rates (Incident heart failure admissions (HR 3.6, 95% CI [2.1-6.2] \( P < .001 \)) and all-cause mortality (HR 5.1, 95% CI [1.6-16], \( P = .005 \)).

Conclusion: Our analysis showed that atrial uptake on Tc-PYP was strongly associated with prevalent and incident atrial fibrillation. The mechanism of this observation needs to be further investigated.

323-04

CORONARY RESERVE (CR) ASSESSED BY CONVENTIONAL 99MTc-TETROFOSMIN SPECT, WITHOUT FIRST-PASS, IS AN ADDED VALUE, IMPROVING THE INTERPRETATION OF THE REPORT.
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Introduction: Diagnosis of Coronary Artery Disease (CAD) is usually performed by computed tomography coronary angiography (CTCA). Because the images are calibrated to the maximum pixel uptake, they look normal when a global decreased uptake is present, as for 3 vessel CAD, leading to false negative. Assessment of myocardial flow, by means of a Coronary Reserve Index (CRI), allows an absolute analysis of the myocardial uptake.

Methods: Fifty patients referred to our institution for suspicion of CAD underwent routine 99mTc-Tc-ICA with a one-day stress/rest protocol on a classical GE gamma-camera NM/670 (29 dipyridamole, 17 exercise tests, 4 Regadenoson). Invasive Coronary Angiography (ICA) considered as gold standard for CAD was performed within 4 months. Stenosis < 50% was considered as normal. Patients with previous revascularization (CABG, PTCA) were excluded. The counts ratio stress/rest needs to be adapted for accurate results. The counts ratio stress/rest is corrected by 5 factors in order to provide equivalent acquisitions conditions: 1- residual activity of stress injection. 2- Time duration acquisitions. 3- injected tracer activity. 4- Non linear myocardial flow dependent extraction. 5- Normalization of the central ventricular pixel counts (background). Myocardial extraction is difficult to appreciate. We use the formula derived from Glover experiment \( T_{tetro} = 1.60 \times 99.7/X \), and/or a polynomial formula \( Y = 0.02X^3 - 0.25X^2 + 1.222X + 0.012 \). The best results were obtained using the mean of the 2 equations.

Results: Using a 3.0 cutoff for the CRI (normal/abnormal), we observed 8 FN, 33 TP, 6 TN3 FP, corresponding to 81% Sensitivity, 67% Specificity, 92% PPV, and 43% NPV. Among the 8 normal perfusion SPECT with abnormal CRI and abnormal ICA, we find 2 patients with 1-vessel CAD, 2 with 2-vessel CAD, 4 with 3-vessel CAD. These patients were neglected with the standard SPECT and recaptured by the CRI. A CRI of 3 should indicate a 1-vessel CAD.

Conclusion: The patients with normal SPECT and abnormal CRI represent 16% (8/50) of our population. This justifies the CRI added value for the CAD diagnostic. Furthermore, this method is fully automatic without additional time, and without additional injected dose.
29.8 ± 5.6%. Mean global MFR was 2.27 ± 1.03. 31 patients had impaired MFR (using a threshold of 2); among them, 3 patients had normal ICA, but had history of diabetes with potential microvascular dysfunction. 34 patients had preserved MFR: 17 with normal ICA, 17 with history of revascularization and/or optimal medical therapy. Considering patients with 1-vessel disease successfully revascularized before SPECT as “normal,” Area Under ROC Curve was 0.92 for global MFR. Using the same threshold of 2, sensitivity and specificity were respectively 100% and 85.71%.

Conclusions: Global MFR measured during dynamic SPECT is significantly correlated to ICA results. This parameter significantly enhances SPECT diagnostic performances and could help physician decision to perform ICA.

323-06
REGIONAL SOCIOECONOMIC DIFFERENCES AMONG RACIAL SUBGROUPS OF PATIENTS WITH ATTR CARDIAC AMYLOIDOSIS
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Introduction: The outcome of ATTR CA patients is influenced by race. However, the interplay between race and SE factors is unknown. We sought to determine the regional variation in SE factors and their relative effect on racial subgroups among patients from three regions in the US.

Methods: Cross-sectional analysis of clinical and SE data on ATTR-CA patients, diagnosed at hospitals in Allegheny, Cook and Erie counties, was performed. Zip-code level SE data were obtained from the 2019 American family survey. Social Vulnerability index (SVI; lower = less social vulnerability; Range 0-1) was obtained from the CDC.

Results: Data from 208 ATTR-CA patients were evaluated (mean age = 78 years; 78% males; 39% blacks). The mean age at diagnosis (75 vs. 79 vs. 85 years, P = .0003) and left ventricular ejection fraction (43% vs. 50% vs. 55%, P = .005) were significantly different between Allegheny (PA), Cook (IL) and Erie (NY) counties, respectively. Among black patients, those belonging to Cook county had significantly worse SE features when compared to the rest (Figure A). Among non-black patients, significant differences among SE features were not seen, except for a greater prevalence of uninsured patients in Cook county (Figure B). Among black patients, SVI was significantly greater among patients from Cook (0.31) county (P = .004). Similarly, SVI was significantly greater among non-black patients from Cook (0.63), as compared to Allegheny (0.31) and Erie (0.52) county (P = .0001). Black patients in Cook and Allegheny counties had significantly greater SVI as compared to non-blacks (P = .008, P < .0001, respectively), but not in Erie county (P = .22).

Conclusions: Regional differences in SE factors exist among ATTR-CA patients, which are more prominent among black patients. Knowledge of racial disparities may inform targeted outreach to enhance awareness and diagnosis in at-risk populations.
**323-07**

EFFECT OF TAFAMIDIS TREATMENT ON TC99M PYP REGIONAL UPTAKE IN PATIENTS WITH ATTR CARDIAC AMYLOIDOSIS

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**Introduction:** Tc-99 m pyrophosphate (PYP) imaging is a commonly used diagnostic imaging study for transthyretin cardiac amyloidosis (ATTR). There are little data on the use of repeat imaging to assess the response to treatment with tafamidis and no description of the pattern of change in the distribution of myocardial tracer uptake.

**Methods:** This was a prospective, single-center cohort study comparing Tc-99 m PYP uptake before and after patients with ATTR cardiac amyloidosis were treated with tafamidis. Quantification of SPECT tracer uptake (counts per mCi administered) was assessed utilizing a 17 segment model using commercially available software. Pre-treatment and post-treatment counts were then compared.

**Results:** 19 patients with clinically diagnosed ATTR cardiac amyloid were included with an average age of 75 ± 9 years and 84.2% male. All patients were treated with tafamidis 61 mg daily; however, 5 patients were also treated with tafamidis meglumine 80 mg daily for a portion of the study due to insurance. The median time from initial imaging to initiation of tafamidis was 49 days (range of 1-49). The mean treatment duration prior to repeat imaging was 400 days ± 153. All 17 segments saw on average a 61.9% reduction in counts per mCi during therapy with some heterogeneity in individual segments. The greatest reductions were seen in the mid septal, apical septal, and apical segments. Comparing basal (−7.0 ± 4.3) to mid (−7.9 ± 5.1) to apical (−8.7 ± 5.8) segments, there was significant variation in count reduction (P = .0004). Comparing anterior (−7.5 ± 5.0) to septal (−8.6 ± 5.5) to inferior (−7.5 ± 4.5) to lateral (−7.1 ± 4.6) segments also saw a significant regional difference in count reduction (P = .001).

**Conclusions:** There is a significant decrease in Tc-99 m PYP uptake in patients with ATTR cardiac amyloid after treatment with tafamidis, and this reduction appears to be heterogenous with greater reductions in the apical and septal regions.

**323-08**

COMPARING THE USE OF LOW-DOSE CT AND GD-153 LINE SOURCE FOR ATTENUATION CORRECTION

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**Introduction:** Attenuation correction (AC) has been shown to increase the sensitivity, specificity, and predictive value of SPECT MPI studies. We compared two types of AC, low-dose CT and Gd-153 line source, to determine if there were differences in rates of downstream coronary angiography.

**Methods:** We retrospectively reviewed all patients undergoing Tc-99 m stress SPECT MPI studies with AC from 2016 to 2020 at Hartford Hospital. Patients’ demographics, risk factors, stress test results, cardiac catheterization within 90 days, and revascularization were obtained. The two attenuation types were compared based on the recorded data.

**Results:** A total of 6185 non-randomized patients were reviewed, 3292 had a low-dose CT and 2893 used a Gd-153 line source (table). While most patient characteristics except BMI were similar between groups, there was a higher proportion of abnormal MPI results in the CT cohort (43.7% vs 55.2%, P < .001). Downstream angiography was greater in the CT group (9.8% vs 7.4%, P = .001), but the proportion of patients with obstructive disease (63.2% vs 75.7%, P = .003) along with subsequent revascularization (38.0% vs 45.8%, P = .09) was lower in the CT cohort. In a logistic regression analysis, the odds ratio of a subsequent coronary angiogram in the CT cohort compared to line source group was 1.4 (95% CI 1.1-1.6, P = .001) in the univariate model, but was not statistically different in the multivariable model (OR 1.1, 95% CI 0.93-1.4, P = .20).

**Conclusion:** While low-dose CT had no clinically significant differences in patient characteristics aside from a higher BMI, it was associated with more downstream coronary angiography and less obstructive disease compared to Gd-153 line source AC. However, with multivariate analysis, this difference between the AC types was no longer statistically significant, suggesting comparable results regardless of AC method.

| BASELINE CHARACTERISTICS | CT ATTENUATION (N = 3,292) | LINE SOURCE ATTENUATION (N = 2,893) | P-VALUE |
|--------------------------|-----------------------------|-----------------------------------|---------|
| Age (years)              | 64.4 ± 12.5                 | 64.5 ± 13.2                       | 0.73    |
| Gender                   |                             |                                   | 0.86    |
| Male                     | 1,738 (52.8%)               | 1,534 (53.0%)                     |         |
| Female                   | 1,564 (47.2%)               | 1,359 (47.0%)                     |         |
| BMI (kg/m²)              | 32.2 ± 8.3                  | 28.8 ± 5.8                        | <0.001  |
| Cardiovascular Risk Factors |                            |                                   |         |
| Diabetes                 | 1,255 (38.1%)               | 987 (34.1%)                       | 0.003   |
| Hypertension             | 2,214 (71.6%)               | 2,174 (71.5%)                     | 0.54    |
| Hypothyroidism           | 2,289 (69.5%)               | 1,976 (68.3%)                     | 0.13    |
| Smoking                  | 1,807 (55.5%)               | 1,616 (55.8%)                     | 0.25    |
| Family History           | 1,451 (45.0%)               | 1,197 (42.5%)                     | 0.06    |
| Known Coronal Disease    | 800 (28.8%)                 | 865 (29.9%)                       | 0.008   |
| SPECT MPI                |                             |                                   |         |
| Symptomatic              | 2,471 (75.1%)               | 2,045 (70.7%)                     |         |
| Exercise Stress          | 810 (24.6%)                 | 833 (28.3%)                       |         |
| Rest Stress              | 2,160 (65.6%)               | 2,337 (80.8%)                     | <0.001  |
| Stress Test              | 499 (14.9%)                 | 180 (6.2%)                        | <0.001  |
| ECG Response             | 638 (19.4%)                 | 370 (12.8%)                       | <0.001  |
| Negative                 | 2,591 (78.0%)               | 2,116 (73.7%)                     | 0.031   |
| Positive                 | 327 (9.9%)                  | 284 (9.8%)                        |         |
| Non-Diagnostic Results   | 388 (11.8%)                 | 410 (14.2%)                       | <0.001  |
| Abnormal                 | 1,649 (48.3%)               | 1,874 (64.8%)                     |         |
| LVFP (%)                 | 66.3 ± 15.3                 | 64.4 ± 15.4                       | <0.001  |

**CORONARY ANGIOGRAM**

| Coronary angiogram (within 90 days) | CT ATTENUATION (N = 3,292) | LINE SOURCE ATTENUATION (N = 2,893) | P-VALUE |
|-----------------------------------|-----------------------------|-----------------------------------|---------|
| Obstructive Disease               | 321 (9.8%)                  | 214 (7.4%)                        | <0.001  |
| (of those having angiogram)       | 203 (63.2%)                 | 162 (75.7%)                       |         |
| Revascularization (within 90 days)| 122 (38.0%)                 | 98 (45.8%)                        | 0.09    |
| (of those having angiogram)       |                             |                                   |         |
| Revascularization (within 90 days)|                             |                                   |         |
| (of those with obstructive CAD)   | 60.1%                       | 60.5%                             | 0.94    |
323-09  
CZT MYOCARDIAL BLOOD FLOW INCREASES ACCURACY FOR CORONARY ARTERY DISEASE DETECTION  
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**Introduction:** CZT cameras have higher sensitivity for photon detection, as well as higher temporal and spatial resolution. These have enabled non-invasive quantification of myocardial flow reserve (MFR), which may increase the accuracy of myocardial perfusion SPECT (MPS) for the detection of obstructive coronary artery disease (CAD). This study aimed to compare the accuracy of CZT MPS and of MFR for the detection of obstructive CAD.  
**Methods:** 48 patients with CAD (> 50% obstruction) detected at invasive coronary angiography or CT angiography underwent dipyridamole MPS and MFR evaluation within 30 days. A 1-day protocol (rest-stress) was used to quantify MFR. The acquisition of dynamic rest and stress images was initiated simultaneously to 99mTc sestamibi injection (10 mCi ± 3 mCi, respectively), both lasting for 11 min, followed by 5-min imaging. Pharmacologic stress with dipyridamole (0.56 mg/kg for 4 min) was performed with the patient positioned in the CZT camera. The images were processed, and time-activity curves were generated, calculating local and regional MFR in a semiautomatic software. A global or regional MFR < 2.0 was considered abnormal. The MPS perfusion images were classified as normal or abnormal and perfusion scores were calculated. The images were interpreted by experienced physicians blinded to the results of MFR and coronary angiography/CT.  
**Results:** Mean age of the population was 61 ± 9 years, 54.2% female. Hypertension, hypercholesterolemia, and diabetes were the most frequent risk factors (81.3%, 45.8%, and 43.8%, respectively). Twenty patients (41.7%) had single-vessel CAD, 22 (45.8%) 2-vessel CAD, and 6 (12.5%) triple-vessel CAD. Among the 82 vessels with obstruction, 48 had perfusion abnormalities in MPS and 60 had reduced MFR, while among the normal vessels, 54 normal MPS and 52 had preserved MFR. The sensitivity of MFR (69%) was higher than that of MPS (55.2%), without significant changes in specificity (86 vs 83.7%).  
**Conclusions:** MFR in the CZT camera is an absolute, physiologic, quantifiable measure which is more sensitive for the detection of CAD than perfusion abnormalities in MPS, especially in patients with multi-vessel CAD.

323-10  
THE PROGNOSTIC VALUE OF HIBERNATING MYOCARDIUM, VENTRICULAR REMODELING, AND LEFT VENTRICULAR MECHANICAL DYSSYNCHRONY IN PATIENTS WITH ISCHEMIC HEART FAILURE: A COMPARATIVE STUDY OF MEDICAL AND REVASCULARIZATION THERAPY.  
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**Objective** We aimed to assess the prognostic value of hibernating myocardium (HM), left ventricular (LV) remodeling, and LV mechanical dyssynchrony (LVMD) in patients with ischemic heart failure (IHF), and to guide clinical decision-making.  
**Methods** Three-hundred and thirty-five (age, 59 (52, 66) y, 289 men and 46 women) consecutive IHF patients (LVESPECT ≤ 35%, LVEF-SPECT 23% (18%, 29%), ESVI 84% ml/m² (23 ml/m², 232 ml/m²) who underwent g99mTc-sestamibi SPECT (GESPECT) and gated 18F-FDG PET(GPET) imaging were followed up for a median of 3.4 y (range 0.1-5.7 y). Patients were classified into 4 subgroups according to HM ± (HMPET > 10% LV), combined with LV remodeling ± (ESV/DPET > 70 ml/m²) or LVMD ± (BW/PECT > 120%) information. All-cause survival served as the only endpoint. The estimated survival curve was analyzed and compared with the log-rank test. Cox proportional hazards regression analysis identified the independent predictors for all-cause death.  
**Results** A total of 74 patients (22.1%) suffered all-cause death. In comparison with other subgroups, the survival was significantly lower in patients with HM ±, LV remodeling + (n = 128) (62.1% ± 6.6%, P = 0.006) (Figure 1) and also in patients with HM +, LVMD + (n = 83) (56.5% ± 9.5%, P = 0.01) (Figure 2). In patients with HM + (n = 197), the survival in patients treated by revascularization (n = 102) was significantly higher than that in patients treated by medical therapy (n = 95) (90.1% ± 4.5% vs. 40.5% ± 7.3%, P < .001). Similarly, in patients with LV + and LV remodeling (n = 61) significantly improved their survival in comparison with medical therapy (n = 67) (94.8% ± 2.9% vs. 42.0% ± 7.8%, P < .001). The survival in patients with HM + and LVMD ± treated surgically was significantly higher than that treated medically (88.9% ± 5.2% vs. 41.3% ± 10.9%, P = .002; 91.0% ± 5.9% vs. 52.0% ± 7.5%, P = .026, P < .001). Multivariate Cox regression analysis showed that age (HR 1.033, 95% CI 1.005-1.062, P = .019), revascularization (HR 0.185, 95% CI 0.091-0.374, P < .001), and HM score (HR 1.022, 95% CI 1.002-1.041, P = .029) were independent predictors of all-cause death in patients with IHF.  
**Conclusion** HM in patients with IHF was negative predictors of survival. Compared with medical therapy, coronary revascularization was significantly associated with improved long-term survival in patients with HM, also accompanied with LV remodeling or with LVMD.

323-11  
INCREMENTAL PROGNOSTIC VALUE OF POST STRESS LEFT VENTRICULAR EJECTION FRACTION AND VOLUME BY GATED SESTAMIBI MYOCARDIAL PERFUSION SPECT IN ANGIOGRAPHICALLY PROVEN CAD PATIENTS WITH MYOCARDIAL INFARCTION.  
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**Introduction** Although LVEF and LV volume are major determinants of long-term survival in CAD patients, their incremental prognostic combined value over perfusion in Indian population is not investigated much.  
**Methods** Electronic medical records of 2215 consecutive patients (M: F, 1440: 775) between 2014 and 2019 who underwent same day stress-rest gated Tc-99 m sestamibi perfusion SPECT in a tertiary hospital were analyzed for invasive angiography details. 443 patients were found to have angiographically significant (> 50% luminal stenosis) & 244 patients with proximal LAD / Triple vessel disease (123: 121 patients). All patients were followed up for a mean period of 2 years + 9 months. 34% of patients were subjected to pharmacological stress MPI and rest underwent symptom limited treadmill exercise. Images were visually and quantitatively analyzed by 2 NM physicians. The presence of significant ischemia (> 3 segments showing reversible perfusion defects) was noted in 199 patients. Receiver-operator characteristics analysis was done. Kaplan–Meier cumulative survival analysis with stratification by LVEF thresholds, yielding moderate sensitivity and high specificity for the cardiac death prediction. Patients with an EF ≥ 42% had mortality rates < 1% per year, despite severe perfusion abnormalities, whereas patients with an EF < 42% had high mortality rates, even with only mild/moderate perfusion abnormalities (11.2% per year; P < 0.0001). Similarly, an ESV ≤ 75 ml was related to a low cardiac death rate (< 1.6% per year), even for patients with severe perfusion abnormalities, whereas patients with an ESV > 75 ml and only mild/moderate perfusion abnormalities had high death rates (7.9% per year; P < 0.0001). Patients with an EF < 42% and an ESV ≤ 75 ml had low cardiac death rates (1.5% per year); those with an EF < 42% but an ESV > 75 ml had high death rates (7.1% per year; P < .002). Multivariate Cox proportional hazards regression showed that perfusion variables and ESV were independent predictors of overall coronary events, whereas LVEF and
Conclusion: Our data show that the criteria of LV EF < 42% and ESV > 75 mL, derived from ROC analysis, efficiently stratify CAD patients into low- and high-risk groups. Post-stress LVEF and ESV by gated-SPECT have incremental prognostic values in predicting cardiac death and help in risk stratification in patients with physiologically significant LAD / Triple vessel stenosis.

323-12

QUANTITATIVE PET PERFUSION IMAGING: ADDITIVE VALUE OF CORONARY FLOW RESERVE AND CORONARY FLOW CAPACITY IN THE DIAGNOSIS OF OBSTRUCTIVE CORONARY ARTERY DISEASE

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Background: Quantitative PET perfusion imaging includes coronary flow reserve (CFR) and can also include coronary flow capacity (CFC) which incorporates absolute stress flow and CFR regionally. While coronary flow reserve is widely used, the additive benefit of CFC in clinical decision-making has not been studied.

Methods: This was a retrospective, single-center study pilot study of consecutive patients who had a Rb-82 regadenoson stress PET MPI study who subsequently had a coronary angiogram within 6 months. Patients without complete data or with a history of CABG were excluded. Two nuclear board-certified cardiologists reviewed images of the PET perfusion, CFR, and CFC blinded to the patient’s clinical history. The perfusion images were interpreted first, followed by CFR, then CFC. Quantitative measures of perfusion and coronary flow were recorded. After each stage in the study, the readers were asked to select if cardiac catheterization should be recommended.

Results: A total of 25 patients (64 ± 11 years, 72% male, 80% with a history of CAD) were chosen from a pool of 100 patients (80% abnormal studies, 68% obstructive CAD) for the pilot study. Analysis of the overall accuracy found an increase from 64% with perfusion alone, to 72% with CFR included and back down to 68% with the addition of CFC (Figure). The test statistics of the methods of interpretation found myocardial perfusion had a higher sensitivity than the flow measures (CFR/CFC), both of which had higher specificity and PPV with similar NPV. Analysis of quantitative measures found that the summed stress score and total perfusion defect provided the best overall accuracy, compared to both flow measures and clinical assessment (Figure).

Conclusion: In this pilot study, the addition of CFR to perfusion imaging improved overall accuracy by improving specificity with only a small reduction in sensitivity. We found no particular impact of adding CFC to myocardial perfusion with CFR.
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