Nuclear Imaging in Cardiomyopathies

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Dilated cardiomyopathy (DCM)
Hypertrophic cardiomyopathy (HCM)
Restrictive cardiomyopathy (RCM)
Arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVC/D)
Unclassified cardiomyopathies
99mTc-3,3-diphosphono-1,2-propanodicarboxylic acid (99mTc DPD) scintigraphy
amyloidosis

(1) acquired monoclonal immunoglobulin light chain amyloidosis (AL), characterized by clonal plasma cells in the bone marrow which produce the immunoglobulin light chains of the fibrillary deposits;

(2) the hereditary, transthyretin-related form (ATTR), which can be caused by over 100 mutations of transthyretin (TTR), a transport protein mainly synthesized by the liver;

(3) wild-type (non-mutant) transthyretin-related amyloidosis (systemic “senile” amyloidosis, SSA), which mainly affects the hearts of elderly men.

Treatment of AL cardiac amyloidosis is twofold: treatment of the heart failure and treatment of the underlying plasma cell dyscrasia. This requires chemotherapy. TTR is primarily formed in the liver, orthotopic liver transplantation is a rational and effective treatment for ATTR.

Treatment of SSA is normally restricted to symptom relief with conventional heart failure therapy. However, some younger SSA patients may be eligible for heart transplantation.
(99mTc DPD) Retention

Imaging of cardiaca neurotransmission
neurotransmitters

Active on recettori adrenergic & muscarinic receptor with stimulating or inhibiting effects

ACETILCHOLINE (sistema parasimpatico)

NORADRENALINE (simpatico)
Imaging of cardiaca neurotransmission

- picomolar NA concentration in synaptic cleft

SPECT and PET are the only imaging modalities
<table>
<thead>
<tr>
<th>Tracer</th>
<th>SPECT/PET</th>
<th>Metabolized by MAO</th>
<th>Development Stage</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-123 metalodobenzylguanidine (MIBG)</td>
<td>SPECT</td>
<td>No</td>
<td>Clinical</td>
<td>Most extensively studied, wide potential clinical applications. Limitations from normal variants and attenuation as a SPECT agent</td>
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<tr>
<td>C-11 metahydroxyephedrine (HED)</td>
<td>PET</td>
<td>No</td>
<td>Clinical</td>
<td>Most widely used PET tracer. More homogenous uptake than MIBG, with fewer inferior defects in normal patients</td>
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<tr>
<td>C-11 epinephrine</td>
<td>PET</td>
<td>Yes</td>
<td>Clinical</td>
<td>A more physiologic tracer for evaluation of presynaptic function with respect to uptake, vesicular storage, and metabolism</td>
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<tr>
<td>C-11 phenylephrine</td>
<td>PET</td>
<td>Yes</td>
<td>Clinical</td>
<td>Vesicular storage necessary to protect from rapid metabolism by neuronal MAO. Potential use to assess function/impairment of vesicular storage function</td>
</tr>
<tr>
<td>F-18 6-fluorodopamine</td>
<td>PET</td>
<td>Yes</td>
<td>Clinical</td>
<td>Had been used mainly to identify cardiac involvement from neurologic diseases. Allows assessment of uptake and washout of NE. Difficult to produce</td>
</tr>
<tr>
<td>F-18 6-fluometaraminol</td>
<td>PET</td>
<td>Yes</td>
<td>Experimental</td>
<td>Low specific activity. Potent vasoactive properties</td>
</tr>
<tr>
<td>F-18 (-)-6-fluoronorepinephrine</td>
<td>PET</td>
<td>Yes</td>
<td>Experimental</td>
<td>High cardiac uptake and retention shown in baboons</td>
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<tr>
<td>F-18 para-fluorobenzylguanidine (PFBG)</td>
<td>PET</td>
<td>No</td>
<td>Experimental</td>
<td>PET analog of $^{123}$I-MIBG, with potential for quantitation. Considerable nonneuronal retention by uptake-2 mechanism. May depend less on flow for uptake</td>
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<tr>
<td>F-18 fluorobenzylguanidine</td>
<td>PET</td>
<td>No</td>
<td>Experimental</td>
<td>Greater lipophilicity than PFBG—more similar to MIBG</td>
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<tr>
<td>Br-76 metabromobenzylguanidine</td>
<td>PET</td>
<td>No</td>
<td>Experimental</td>
<td>Low uptake-1 selectivity</td>
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</table>
Metaiodobenzilguanidina (\(^{123}\text{I}-\text{MIBG}\))

(Wieland, University Michigan Medical Center 1980)

- False neurotransmitter
- Iodinated Analogue of guanetidene and of NA
- Share with NA reuptake mechanisms (uptake-1, uptake-2)

After i.v. MIBG injection diffuses in the sinaptyc cleft, then accumulates in vesicles (uptake 1) with a higher concentration than NA

Not metabolized by MAO system and/or Cathecolamine transferases

Correlation with cardiac density of cardiac innervation
**123I-MIBG Imaging Protocol**

**Patient preparation**

- fasting from midnight

*Parmacological interferences with.*

**Anti hypertensive drugs**

- Reserpine
- Guanetidine
- Labetalol
- Oppioids
- Cocaine
- *tricyclic antidepressant*

**Anti psycotics**

- fenothiazines, thioxantines
- butirrofenoni
- sympathomimetic inhalators: anphetamine, dopamine
**Tracer injection**

- Thyroid uptake block 30 min before injection  
  \((KCl)\) (ADMIRE-HF clinical trial optional)

- Patient at rest for 15'

- Slow injection (1-2 min). 185-370 Mbq (±10%) \(^{123}\text{I}\)-MIBG  
  (ADMIRE-HF = 370±10%MBq). Flush with 10 ml saline
Planar acquisition:

- 15-20 min and 4 hours planar acquisition (10 min)
- SPECT (20 min) after planar
Which parameter are useful?

**4h CARDIAC GLOBAL UPTAKE (planar ant)**
Distribution of cardiac sympathetic nervous fibers and uptake-1 function

H/M ratio 1.9-2.8 (<1.6 negative prognostic impact)

**4h CARDIAC GLOBAL WASHOUT (planar ant)**
Measure of myocardium capacity to retain MIBG (10%±9%)
(>27% poor prognosis)

**REGIONAL CARDIAC UPTAKE (SPECT)**
Heterogeneous uptake may indicate arrhythmia risk (no normal limits available)
H/M ratio

different methods, similar results

normal values (1.9-2.8)
media di circa 2.2

heart ROI – ROI mediastinum / ROI mediastinum)
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<td>late acquisition time</td>
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<th>late heart</th>
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<th>method 3</th>
<th>early heart</th>
<th>mediastinum</th>
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<td>107306</td>
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<td>322</td>
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<td>446</td>
<td>420</td>
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<th>method 1</th>
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<th>mediastinum</th>
<th>late heart</th>
<th>mediastinum</th>
<th>method 3</th>
<th>early heart</th>
<th>mediastinum</th>
<th>late heart</th>
<th>mediastinum</th>
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<tbody>
<tr>
<td>CD/MBq</td>
<td>1,74</td>
<td>1,00</td>
<td>1,15</td>
<td>0,85</td>
<td>CD/MBq</td>
<td>1,45</td>
<td>1,00</td>
<td>1,03</td>
<td>0,85</td>
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<tr>
<th>Cardiac I-123 MIBG</th>
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<table>
<thead>
<tr>
<th>parameter</th>
<th>method 1</th>
<th>Media ± SD</th>
<th>method 3</th>
<th>Media ± SD</th>
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<tbody>
<tr>
<td>Washout</td>
<td>33,6%</td>
<td>23,0 ± 6,4</td>
<td>28,9%</td>
<td>22,3 ± 8,1</td>
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<tr>
<td>H</td>
<td>early</td>
<td>1,74</td>
<td>1,48 ± 0,29</td>
<td>1,45</td>
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<tr>
<td>H</td>
<td>late</td>
<td>1,15</td>
<td>0,93 ± 0,22</td>
<td>1,03</td>
</tr>
<tr>
<td>M</td>
<td>early</td>
<td>1,00</td>
<td>0,77 ± 0,12</td>
<td>1,00</td>
</tr>
<tr>
<td>M</td>
<td>late</td>
<td>0,85</td>
<td>0,47 ± 0,10</td>
<td>0,85</td>
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<tr>
<td>H/M</td>
<td>early</td>
<td>1,73</td>
<td>1,89 ± 0,14</td>
<td>1,45</td>
</tr>
<tr>
<td>H/M</td>
<td>late</td>
<td>1,36</td>
<td>1,93 ± 0,16</td>
<td>1,22</td>
</tr>
</tbody>
</table>

[carlo.rodella@spedalicivili.brescia.it]
$^{123}$I-MIBG planar

NORMAL
H/M = 2.47

CHF
H/M = 1.56

(4h imaging)
$^{123}$I-MIBG SPECT

Imaging after 4h

NORMAL

CHF
$^{123}\text{I-MIBG}$ & CHF
Cardiac function impairment

SAS Activation

RAS Activation

release of vasoactive mediators: Endotheline, vasopressine, citochrome

Downregulation Remodelling Fibrosis Apoptosis Necrosis
At cellular level?

- **Early phases:** NA release in the synaptic cleft and increased NET1 uptake

- **Late:** down-regulation of NET1, further increase of NA synaptic concentration

- **End stage:** reduction of synaptic function (intact presynaptic fibers, dysfunctional) Low MIBG uptake (low H/M ratio and increased washout rate)

*Chen et al; J Nucl Cardiol 2005*
A) Late H/M rate = 2.2
   WR = 15%

Normale

B) Late H/M rate = 1.7
   WR = 25%

NYHA II

C) Late H/M rate = 1.1
   WR = 40%

NYHA IV
Ogita et al; Heart 2001

20 NC  WR 9.6±8.5  2SD=27%

79 pts CHF  LVEF < 40%

Group 1 (WR ≥ 27%)
Group 2 (WR < 27%)

$^{123}$I-MIBG washout rate
prognostic value
I-123-\textit{m}IBG myocardial imaging for assessment of risk for a major cardiac event in heart failure patients: insights from a retrospective European multicenter study

Dataset multicentrico (6 centri)

- 290 pts HF; NYHA II-IV

LVEF ≤35%
NYHA II-III
N=182

13% of ICD candidates
New risk stratification evidence from the ADMIRE-HF study

Adreview Myocardial Imaging for Risk Evaluation in Heart Failure
ADMIRE-HF objective\textsuperscript{18}

**Primary objective**

• To demonstrate the prognostic value of the H/M ratio of 123I-MIBG for identifying subjects at higher risk of an adverse cardiac event

**Secondary objectives**

• To quantify the risks for adverse cardiac events due to heart failure and arrhythmias
• To assess myocardial sympathetic innervation H/M ratio as a continuous variable
ADMIRE-HF endpoints\textsuperscript{18}

**Composite primary endpoint**

- Occurrence of any of the following 3 categories of adverse cardiac events
  - Heart failure progression,
  - arrhythmia and
  - cardiac death

  Defined by the time to first event in relation to the H/M ratio

**Secondary endpoint**

- Any secondary event following a first event of heart failure progression or arrhythmia
- Defined by the time to secondary event for all unique events in relation to H/M ratio
ADMIRE-HF adverse cardiac events

Heart failure progression

- Progression of heart failure stage from one NYHA class to the other
- NYHA II to III or IV – NYHA III to IV

Life threatening arrhythmia

- Sustained ventricular tachyarrhythmia
- Appropriate ICD discharge
- Aborted cardiac arrest

Terminal cardiac death

- Sudden Cardiac Death
- Progressive heart failure death
- Myocardial Infarction
- Cardiac surgery complication
<table>
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<tr>
<th>Variable</th>
<th>Data</th>
<th>Range</th>
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<tbody>
<tr>
<td>Mean Age (yr)</td>
<td>62.4</td>
<td>20-90</td>
</tr>
<tr>
<td>Gender (M/F) (%)</td>
<td>80/20</td>
<td>-</td>
</tr>
<tr>
<td>Race (White/Black/Other) (%)</td>
<td>75/14/11</td>
<td>-</td>
</tr>
<tr>
<td>NYHA II/III (%)</td>
<td>83/17</td>
<td>-</td>
</tr>
<tr>
<td>HF Etiology (I/NI) (%)</td>
<td>66/34</td>
<td>-</td>
</tr>
<tr>
<td>Mean LVEF (%)</td>
<td>27</td>
<td>5-35</td>
</tr>
<tr>
<td>Median Follow-up (mo)</td>
<td>17</td>
<td>0.1-27</td>
</tr>
<tr>
<td>ACE Inhibitor*/ARB** (%)</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Beta Blocker (%)</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>ARA*** (%)</td>
<td>35</td>
<td>-</td>
</tr>
<tr>
<td>2-year mortality rate (%)</td>
<td>12.8</td>
<td>-</td>
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</tbody>
</table>

*ACE inhibitors: Angiotensin Converting Enzyme Inhibitors
**ARB: Angiotensin Receptor Blockers
***ARA: Aldosterone Receptor Antagonist
ADMIRE-HF finding\textsuperscript{18}

ADMIRE-HF supports a cut-off value for stratifying the risk of an adverse cardiac event

H/M ratio $\geq 1.6$ – low risk
H/M ratio $< 1.6$ – high risk
237 subjects had an adverse cardiac event on primary analysis

Kaplan-Meier estimates of ACE free probability

H/M ratio

*\(p=0.0001\) vs H/M ratio ≥1.60

H/M ratio <1.60; ACE free probability = 63%

H/M ratio ≥1.60; ACE free probability = 85%

Separation from groups is evident within the first two months

35\%^{21} greater probability of not experiencing an adverse cardiac event for patients with an H/M ratio ≥1.6 vs. those with H/M ratio <1.6.
Kaplan-Meier estimates of arrhythmia free probability

H/M ratio

64 patients had an arrhythmia on secondary analysis

*\( p=0.002 \) vs H/M ratio ≥1.60

H/M ratio ≥1.60: 2-year event-free survival 96%

NPV 96% for arrhythmias

Greater arrhythmia-free survival at 2 years for patients with H/M ratio ≥1.6 vs. those with H/M ratio of <1.6
Kaplan-Meier estimates of ACE incidence

LVEF

LVEF 30% MADIT II threshold on ACE

<table>
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<tr>
<th>Months</th>
<th>LVEF&lt;30%</th>
<th>LVEF≥30%</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>490 subjects 154 events</td>
<td>471 subjects 83 events</td>
</tr>
<tr>
<td>6</td>
<td>p&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
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</tr>
</tbody>
</table>

LVEF 30% threshold does risk-stratify...as known and expected
Kaplan-Meier estimates of ACE incidence\(^{21}\)

H/M ratio vs. LVEF

H/M ratio 1.6 ADMIRE-HF threshold vs. LVEF 30\% MADIT II threshold on ACE

H/M ratio 1.6 threshold provides additional prognostic information over EF 30\% threshold\(^{21}\)
Kaplan-Meier estimates of ACE incidence

H/M ratio vs. BNP

H/M ratio 1.6 ADMIRE-HF threshold vs. BNP 140 ng/l threshold on ACE

H/M ratio 1.6 threshold provides additional prognostic information over BNP 140 ng/l threshold.

* p = 0.004
† p = 0.041
Cardiac autonomic neuropathy in patients with diabetes and no symptoms of coronary artery disease: comparison of $^{123}$I-metaiodobenzylguanidine myocardial scintigraphy and heart rate variability

A composite endpoint (HMR <1.8, WR >25%, or TDS >13) was used to define an abnormal $^{123}$I-mIBG study.

Results The prevalence of CAN in patients asymptomatic for CAD with type 2 diabetes and normal myocardial perfusion assessed by HRV and $^{123}$I-mIBG scintigraphy was respectively, 27% and 58%. Furthermore, in almost half of

Fig. 6 Agreement and disagreement between HRV and $^{123}$I-mIBG scintigraphy for the assessment of CAN

Fig. 1 Pie chart showing the location of the innervation defects on $^{123}$I-mIBG myocardial scintigraphy
$^{123}$I-MIBG and therapy monitoring
Efficacy of Beta-blockers on Cardiac Function and Cardiac Sympathetic Nerve Activity in Patients with Dilated Cardiomyopathy

Effects of carvedilol on myocardial sympathetic innervation in patients with chronic heart failure

multicenter study
- 64 CHF pts
- before and after 6 month therapy with carvedilol v.s. placebo

Results: $>^{123}\text{I-MIBG uptake (planar & SPECT)}$ $<\text{EDV}$ $>\text{LVEF}$

Effect of Carvedilol on Cardiac 123I-MIBG Uptake in Patients with Dilated CM

22 patients Class II, III, IV CHF

Figure 3. Patient with cardiomegaly and relatively advanced baseline impairment of cardiac sympathetic nerve function, as demonstrated by a 4-hour heart-mediastinum ratio of I-123 MIBG activity of 1.38 (A). Subjectively, I-123 heart activity is similar to adjacent lung activity. Improvement in the 4-hour heart-mediastinum I-123 MIBG ratio to 1.67 with carvedilol treatment (B). Subjectively, the heart is less dilated and I-123 myocardial activity is now more clearly greater than adjacent lung activity.

Gerson et al. J Nucl Cardiol 2002
effective Pharmaceuticals on MIBG uptake

- **Takeishi et al (J Nucl Med 1997)**
  19 pts; NYHA II-III class; under enalapril
  > H/M r; < WR

- **Toyama et al (J Nucl Med 1999)**
  - 24 pts with dilative CM under ACE-I
  - > H/M r

  - ACE-I + sartanid
    > uptake 123I-mIBG (H/Mr; WR)
    > della LVEF
    > NYHA
Cardiac sympathetic activity pre and post resynchronization therapy evaluated by 123I-MIBG myocardial scintigraphy

- 30 pts CHF
- NYHA III-IV
- medical Tx
- candidability a CRT

H/M \( r > 1.36 \)

sensitivity 75%
specificity 71%

D’Orio Nishioka et al; J Nucl Cardiol 2007
Identificazione dei pts a rischio di morte improvvisa che necessitano di un ICD
Sudden cardiac death: key points

- Sudden cardiac death (SCD) is a major cause of death in the growing population of patients with heart failure.
- Ventricular arrhythmias have been documented in up to 85% of patients with severe congestive heart failure.
- Patients with severe left ventricular (LV) systolic dysfunction are among those at greatest risk for SCD.
- To date, no single test reliably predicts arrhythmic risk in patients with heart failure.
- Optimal medical treatment will improve prognosis and reduce the risk of SCD in heart failure patients.
- The implantable cardioverter-defibrillator (ICD) effectively treats malignant ventricular arrhythmias and is indicated for the secondary prevention of SCD.
- There is growing evidence for the use of the ICD for the primary prevention of SCD.

Cardiac Sympathetic Denervation Assessed With 123-Iodine Metaiodobenzylguanidine Imaging Predicts Ventricular Arrhythmias in Implantable Cardioverter-Defibrillator Patients

Mark J. Boogens, MD,* † C. Jan Willem Borleffs, MD,* Maureen M. Henneman, MD,* Rutger J. van Bommel, MD,* Jan van Rijnhorst, MD,* Eric Boersma, MD,* Petra Dibbits-Schneider, MSC,* † Marcel P. Stokkel, MD, PhD,* Ernst E. van der Wall, MD, PhD,* Martin J. Schalij, MD, PhD,* Jeroen J. Bax, MD, PhD*
Leiden, Utrecht, and Rotterdam, the Netherlands

Discussion

The main findings of the study can be summarized as follows. Late 123-I MIBG SPECT defect score was an independent predictor for ventricular arrhythmias causing appropriate ICD therapy (primary end point) as well as the composite of appropriate ICD therapy or cardiac death (secondary end point). In addition, cumulative event rates for appropriate ICD therapy (52% vs. 5%, p < 0.01) and appropriate ICD therapy or cardiac death (57% vs. 16%, p < 0.01) were significantly higher in patients with a large late 123-I MIBG SPECT defect (summed score >26) as compared with patients with a small late 123-I MIBG SPECT defect (summed score ≤26) at 3-year follow-up. Importantly, only 2 (3%) patients with a small late 123-I MIBG SPECT defect received appropriate ICD therapy during follow-up.

Figure 2 Kaplan-Meier Analysis for Patients With Large or Small 123-I MIBG SPECT Defect

Kaplan-Meier curve analysis showing the difference in appropriate implantable cardioverter-defibrillator therapy (primary end point) between patients with a large (summed score >26) or small (summed score ≤26) late 123-Iodo metaiodobenzylguanidine single-photon emission computed tomography (123I MIBG SPECT) defect.
Increase in the Use of Implantable Cardioverter-Defibrillators (ICDs) in the United States

Age and sex standardised ratios of implantable cardioverter defibrillator (ICD) use and standardised mortality ratios for ischaemic heart disease (IHD SMR) in English health regions, 1998-2000

The crude rate of implantation of new ICD in UK rose from 12.4 per million in 1998 to 30 per million in 2002.

Significant regional differences in standardized rates of implantation (p=0.005).

Differences between implantation and need in five out of eight Regions suggested inequity.
- 17 pts CHF;
- ICD
- NYHA IV

- H/M r < 1.54

- VPP 71%
- VPN 17%

Fig. 3. ¹²³I-MIBG results in relation to the occurrence of ICD discharges in 17 patients who had ICDs and 2 control patients who did not have heart disease. Compared with patients who did not have ICD discharge (ICD −), patients with a discharge (ICD +) had a lower mean HMR, a higher mean neuronal tracer defect score, and a higher mean neuronal tracer uptake/perfusion tracer mismatch score. (Data from Arora R, Ferrick KJ, Nakata T, et al. I-123 MIBG imaging and heart rate variability analysis to predict the need for an implantable cardioverter defibrillator. J Nucl Cardiol 2003;10:121–31.)
123-MIBG imaging and heart rate variability analysis to predict the need for an implantable cardioverter defibrillator

Denervazione in aree di miocardio vitale

Different imaging techniques (predominantly myocardial perfusion imaging) have been used to provide information on the underlying substrate. Borger van der Burg et al. (18) evaluated the occurrence of ventricular arrhythmia and cardiac death in relation to ischemia, viability, and scar tissue in 156 survivors of sudden arrhythmic death. Extent of scar tissue and reduced LV function (LVEF ≤30%) were significantly associated with occurrence of ventricular arrhythmias and cardiac death in univariable and multivariable analysis. In the present study, ischemia (summed perfusion difference score) was significantly associated with appropriate ICD therapy in univariable analysis. However, myocardial infarction (resting perfusion defect score) and ischemia were not significantly associated with both end points in multivariable analysis. One of the potential explanations for these findings is the fact that the current study included patients with nonischemic cardiomyopathy, whereas in the study performed by Borger van der Burg et al. (18), all patients were diagnosed with significant coronary artery disease. In the present study, a small amount of myocardial ischemia was observed, which can be explained by the fact that these patients received optimal pharmacologic and revascularization therapy prior to ICD implantation.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Met. 3</th>
<th>Aver. ± SD</th>
<th>Met. 1</th>
<th>Aver. ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washout</td>
<td>23.5%</td>
<td>23.0 ± 6.4</td>
<td>23.0%</td>
<td>22.3 ± 8.1</td>
</tr>
<tr>
<td>H Early</td>
<td>0.75</td>
<td>1.48 ± 0.29</td>
<td>0.74</td>
<td>2.01 ± 0.43</td>
</tr>
<tr>
<td>H Late</td>
<td>0.57</td>
<td>0.93 ± 0.22</td>
<td>0.57</td>
<td>1.30 ± 0.30</td>
</tr>
<tr>
<td>M Early</td>
<td>0.63</td>
<td>0.77 ± 0.12</td>
<td>0.63</td>
<td>0.91 ± 0.15</td>
</tr>
<tr>
<td>M Late</td>
<td>0.50</td>
<td>0.47 ± 0.10</td>
<td>0.50</td>
<td>0.58 ± 0.10</td>
</tr>
<tr>
<td>H/M Early</td>
<td>1.20</td>
<td>1.89 ± 0.14</td>
<td>1.18</td>
<td>2.15 ± 0.30</td>
</tr>
<tr>
<td>H/M Late</td>
<td>1.15</td>
<td>1.93 ± 0.16</td>
<td>1.14</td>
<td>2.16 ± 0.17</td>
</tr>
</tbody>
</table>
$^{123}$I-MIBG and ischemic cardiac disease
ischemic heart disease causes impairment of sympathetic innervation and $^{123}$I-MIBG uptake
Mismatch perfusion/innervation

Fallavollita J et al; J Nucl Cardiol 2010

areas at risk of malignant arrhythmias
Presence of sympathetically denervated but viable myocardium and its electrophysiologic correlates after early revascularised, acute myocardial infarction.

67 pts (14 after AMI)
- 123I-MIBG
- ²⁰¹Tl

Results
- 90% MIBG/Tl mismatch
- prolonged QTc interval

? prognostic impact?

Simoes et al; Eur Heart J 2004
$^{123}\text{I-MIBG}$ and Primary arrhythmias
Cardiac autonomic dysfunction in Brugada syndrome

- 17 pts (Brugada S.) + 10 NC
  - MIBG-SPECT

**Results**

- < regional MIBG uptake in 8/17 (47%) pts Brugada, but not in normal uptake in control group

- < regional uptake in inferior and infero-septal wall in comparison to control group (p<0.05)

Wichter T et al; Circulation 2002
Cardiac autonomic dysfunction in Brugada syndrome

Wichter T et al; Circulation 2002
CONCLUSION

- **1^{23}I-MIBG scintigraphy**
  - Indicated in cardiomyopathies
  - high prognostic value maybe > (LVEF; BPN) with very high NPV
  - can guide medical Tx
  - can indicate alternative TX (CRT, transplant)
  - indication ICD implant

- Need of clinical guidelines
- only one large MC trial