IMAGING WITH MIBG: Utility in Patients with CHF
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INTRODUCTION
- The heart is densely innervated with autonomic fibers, sympathetic and parasympathetic.
- Autonomic innervation plays a crucial role in regulating cardiac function.
- Cardiac pathology from a variety of diseases upsets normal autonomic function.
- Nuclear imaging allows visualization of cardiac neuronal condition: can help with risk stratification and therapy.

I-MIBG IMAGING: UPTAKE OF TRACER
- I-MIBG (metaiodobenzylguanidine) is a norepinephrine analog, similar to guanethidine (a false neurotransmitter).
- Uptake is not completely understood. Shares same uptake, storage, and release as norepinephrine. Enters neuron by active transport through high-affinity uptake-1 system. Not metabolized, concentrates in sympathetic nerve terminals.
- There may also be some non-neuronal uptake-2 (carrier facilitated transport and diffusion), but minimal in humans.

I-MIBG IMAGING: PROCEDURES AND IMAGE ANALYSIS
- I-MIBG can assess both global and regional sympathetic innervation. Parameters assessed:
  - Global uptake (planar imaging): Heart mediastinal (H/M) ratio. Normal 2.5 ± 0.3. Poor prognosis if H/M ratio < 1.2.
  - Global washout. Normal 10% ± 9%. Poor prognosis if WO > 27% (2SD above mean).
  - Regional uptake: SPECT defects. Innervation perfusion mismatch.

I-MIBG IMAGING TO EVALUATE POTENTIAL FOR ARRYTHMIAS IN PATIENTS WITH CHF
- 50% of all CV deaths are sudden: 300,000-400,000/year, most VT/VF. Techniques to identify patients are inadequate.
- Autonomic abnormalities may be a common end-pathway for SCD in a variety of cardiac diseases that result in CHF.
- Denervated local areas with preserved perfusion may be at greatest risk.
- Numerous studies have shown correlation between MIBG abnormalities and arrhythmias.
- I-MIBG could screen CHF patients who would benefit from ICD. Can be coupled to other measure of autonomic function, e.g., HRV (heart rate variability). Recent study (Arora et al. JNC 2003) showed that a combination of MIBG and HRV variables could separate patients with ICD who had shock from those who did not. Needs larger trial.
- MIBG imaging is helping to elucidate the mechanisms of primary arrhythmic diseases (e.g., Brugada syndrome).

I-MIBG IMAGING TO EVALUATE ISCHEMIC HEART DISEASE
- Sympathetic nervous tissue is more sensitive to ischemia than myocytes.
- Transmural MI: produces autonomic dysfunction in infarct territory and in distal regions. Predisposition to arrhythmias.
- Non-ST elevation MI and unstable angina: defects more often localized to area of injury.
- Neuronal imaging may detect early stages of CAD.

I-MIBG IMAGING TO EVALUATE HEART FAILURE: Prognosis and Management
- There is increased adrenergic activity in setting of CHF. Initially favorable, but eventually deleterious.
- Patients with CHF commonly have MIBG abnormalities: global and focal decreased uptake, increased washout.
- Patients with heart mediastinal ratio (HMR) <1.2 are at significantly increased risk of death. By multivariate analysis, HMR has been shown to be more significant predictor of death than LVEF (Merlet JNM 1992).
- HMR predicts death in patients with both ischemic and non-ischemic cardiomyopathies.
- MIBG imaging may both help guide therapy in CHF and follow the effects of therapy that is being given.
- MIBG imaging could play a role in selecting CHF patients best referred for cardiac transplant.

I-MIBG IMAGING TO EVALUATE PATIENTS AFTER HEART TRANSPLANT
- MIBG imaging can be used to follow cardiac innervation after transplant.
- Restoration of sympathetic function correlates with improved cardiac response to exercise.

I-MIBG IMAGING IN DIABETIC PATIENTS
- Diabetes is a systemic disease that affects the autonomic nervous system.
- Morbidity and morality are increased by DAN (diabetic autonomic neuropathy).
- Cardiac imaging with MIBG can assess potential problems with sympathetic function.
- Many patients without clinical evidence of autonomic pathology have abnormal cardiac MIBG uptake.
- Clinical DAN increases mortality/morbidity. Prognostic significance of MIBG abnormalities in diabetics is not known.

CHEMOTHERAPY CARDIOTOXICITY
- I-MIBG may help identify patients becoming toxic from chemotherapeutic agents.

LARGE MULTICENTER TRIAL
- Cardiac I-MIBG imaging is currently investigational in US, with many unanswered questions. Has great potential utility in a variety of cardiac diseases.
  - Patients with Class II-III CHF, LVEF ≤ 35% will undergo planar and SPECT MIBG imaging.
  - Image results will be correlated with worsening CHF, cardiac arrhythmias and cardiac death.
  - Will evaluate the safety profile of MIBG.

FUTURE TRACERS
- PET: 11C-HED, 11C-EPI, 11C-phenylephrine
- Post-synaptic receptor tracers.
REFERENCES


Baliga RR, Narula J, Dec GW. The MIBG tarot: is it possible to predict the efficacy of β-blockers in congestive heart failure? *J Nucl Cardiol* 2001;8:107-9


