A HISTORY OF NUCLEAR CARDIOLOGY

Joel Culver, C.N.M.T.
Annual Meeting SWCSNM

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Nuclear Cardiology

Myocardial Perfusion Imaging
- Radiochemistry
- Instrumentation
1920’s : Radon gas in solution injected.
1940’s: Radiolabeled bovine albumin, soon replaced with the labeling of human serum albumin. Both with I-131.
1960’s: Technetium 99m commercially available.
1970’s: Thallium-201 for myocardial perfusion imaging.
1989:  Rb-82
1990’s: Tc- labeled isonitrile (Cardiolite)
1990’s: 15-O(Water), 13-N (ammonia)
1927: Radon gas in solution injected: Dr. George Blumgart
G-M tube placed above heart to measure velocity of circulation from distal vein to the heart.
1929: First heart catheterization: Dr. Werner Forssmann
1951: Rectilinear scanner: Dr. Benedict Cassen
1954: Holter monitor: Jeff Holter
1958: Scintillation camera: Hal Anger
1976: SPECT camera: John Keys, Ronald Jaszczak
1984: PET perfusion images of the heart with Rb-82
1985: PET images of the heart with FDG and ammonia
Drs. Blumgard and Weiss inject soluble radon gas in one arm of a patient, and detect the arrival in the opposing arm using a cloud chamber. The technique is not favorable with children due to the potential poisonous effect of daughter radionuclides (Pb).
Cardiology Resident Dr. Werner Forssmann performs the first cardiac catheterization on himself!
1930’s  Tracer technology improved:
P-32 labeled RBC’s for red cell volume.
Fe-59 RBC’s for total-body hematocrit.
S-35 for plasma proteins.

1940’s  Radiolabeled bovine albumin, soon replaced with the labeling of human serum albumin. Both techniques accomplished with I-131.
1950’s The Imaging Revolution
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1954 The Society of Nuclear Medicine chartered, Seattle, WA
Techentium become commercially available

- Labeled Human Serum Albumin for ventricular wall motion.
- Labeled MAA for pulmonary perfusion and shunt evaluation.
- Labeled PYP for MI
Advent of the Brattle gate made blood pool imaging a useful tool for defining ventricular ejection fraction.
MAA for Shunt Evaluation

A: Sequential frames showing the progression of a bolus injection.
B: SVC ROI (Reference Obj) with FP:Kist.
C: Bolus FWHM = 1.18 (3.21-4.39).
D: Curve showing QP:QS = 1.00 (Negligible shunt area).
PYP Imaging for Myocardial Infarction
1972

Thallium-201 Chloride
Sodium-Potassium Pump
ANT

RCA
PDA
LCx
LAD
Anterolateral
Septal
Inferior
Apical

LAO

RCA
LAD
LCx
Septal
Pseudorotolateral
Infereospical

LL

RCA
LAD
LCx
Anterior
Posteronasal
Apical
Inferior

Images of heart views in ANT, LAO, and LL projections with labeled anatomy.
Berman D, Garcia E, Maddahi J; et al. Quantitative analysis of thallium-201 distribution and washout for comparison of multiple pinhole tomography with planar imaging (abstr), Circulation 62 (suppl III) 1980 III-103
<table>
<thead>
<tr>
<th>1. basal anterior</th>
<th>7. mid-anterior</th>
<th>13. apical anterior</th>
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<tbody>
<tr>
<td>2. basal anteroseptal</td>
<td>8. mid-antero septal</td>
<td>14. apical septal</td>
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<tr>
<td>3. basal inferoseptal</td>
<td>9. mid-infere septal</td>
<td>15. apical inferior</td>
</tr>
<tr>
<td>4. basal inferior</td>
<td>10. mid-inferior</td>
<td>16. lateral</td>
</tr>
<tr>
<td>5. basal inferolateral</td>
<td>11. mid-inferolateral</td>
<td>17. apex</td>
</tr>
<tr>
<td>6. basal anterolateral</td>
<td>12. mid-antero lateral</td>
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1980s

Uptake of Hexakis(t-Butylisonitrile) Technetium (I) and Hexakis (Isopropylisonitrile)Technetium (I) by Neonatal Rat Myocytes and Human Erythrocytes
Howard Sands, Margaret L. Delano, and Brian M. Gallagher

Methoxyisobutyl isonitrile (RP30) for quantification of myocardial ischemia and reperfusion in dogs.

Li QS, Frank TL, Franceschi D, Wagner HN, Becker LC
Comparison of $^{99m}$Tc- MIBI and $^{201}$Tl

<table>
<thead>
<tr>
<th>Item</th>
<th>$^{99m}$Tc- MIBI</th>
<th>$^{201}$Tl</th>
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<tbody>
<tr>
<td>Energy</td>
<td>140 kev</td>
<td>72 kev</td>
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<tr>
<td>Dosage</td>
<td>10-30 mC</td>
<td>4 mCi</td>
</tr>
<tr>
<td>Image time</td>
<td>4 hrs</td>
<td>Immed, 2 hrs</td>
</tr>
<tr>
<td>Origin</td>
<td>Mo generator</td>
<td>Cyclotron</td>
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Multi-head detectors improve image time and quality.
1990’s

Improvement in pharmacologic stressor agents:

Dipyridamole I.V.

Adenosine I.V.

Lexiscan (2010)
CZT Solid State Detectors

2000’s

Reduced patient dose, improved image quality
2008- Medicare approves PET imaging for limited studies in oncology. Soon, cardiac PET is approved.
2000’s

Fusion Imaging
The Future?
Nanotechnology to create new imaging agents

“Closing the gap between the fabrication of nanoparticles for preclinical research and the agents suitable for human trials will be the completion of the Nanomedicine Fabrication Center. The Cyclotron/Radiochemistry lab will be the breeding ground for new nuclear medicine tracers that can fully exploit the functional imaging capabilities of positron emission tomography (PET). This core will be on the forefront of personalized medicine.”

Dr. Gang Zhen, Ontario Cancer Institute
Space based Imaging and therapeutic technology

Over the years, NASA can claim at least partial credit for a wide variety of medical innovations, from ear thermometers and automatic insulin pumps to implantable heart defibrillators and improvements in digital mammography technology.

Here are a few of the many other medical advances that came at least in part from NASA:

- Digital imaging breast biopsy system, developed from Hubble Space Telescope technology
- Tiny transmitters to monitor the fetus inside the womb
- Laser angioplasty, using fiber-optic catheters
- Forceps with fiber optics that let doctors measure the pressure applied to a baby's head during delivery
- Cool suit to lower body temperature in treatment of various conditions
- Voice-controlled wheelchairs
- Light-emitting diodes (LED) for help in brain cancer surgery
- Foam used to insulate space shuttle external tanks for less expensive, better molds for artificial arms and legs
- Programmable pacemakers
- Tools for cataract surgery
Summary