The use of Resolution Recovery software in nuclear medicine from an ALARA perspective

– is it possible to reduce patient doses?

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Nuclear medicine imaging

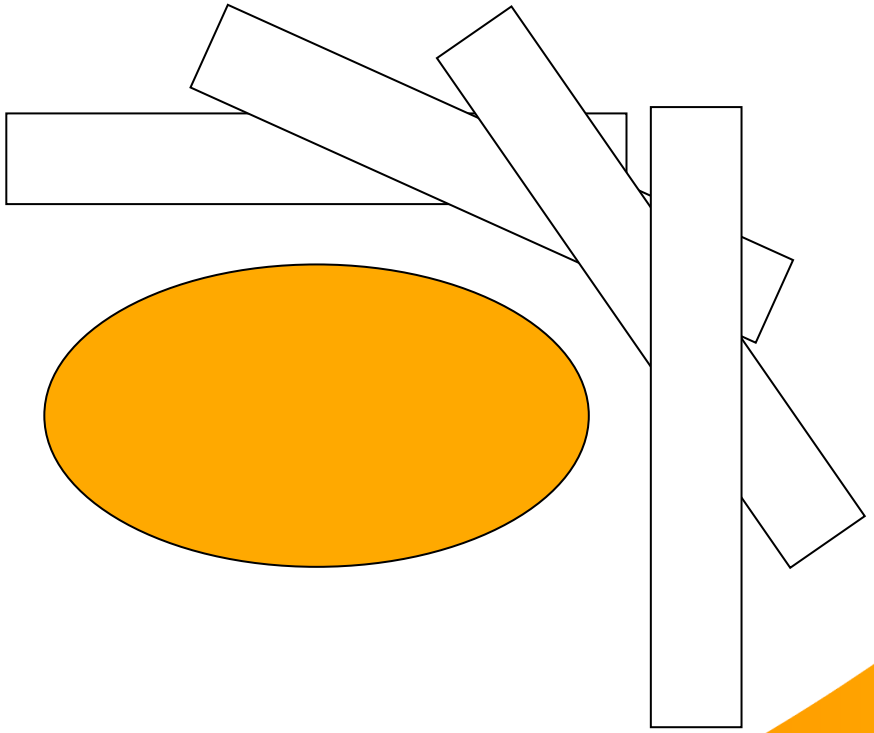
- relies on tracer principle established in 1913 (de Hevesy)
- provides functional information
- gamma camera is primary tool
- planar and cross-sectional images are produced
- technetium is the most commonly used radioisotope
- doses are not trivial (15mSv for cardiac studies)

SPECT Imaging

Acquire planar images from many different angles (projections)

Use these projections to reconstruct the full 3D distribution

Similar to CT



Problems with all SPECT Reconstruction techniques

Attenuation

Many gamma rays are lost due to absorption in the patient

Scatter

Some gamma rays are scattered in the patient before detection

Poor resolution

Gets worse with increasing distance from the camera

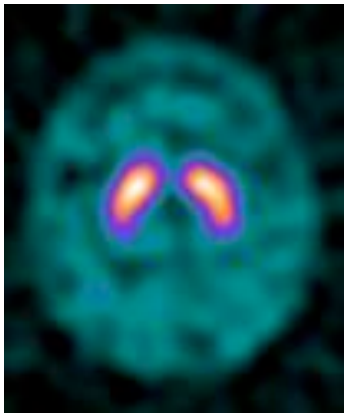
Noise

Due to low counts

Computation time

Accurate methods need a lot of computing power

SPECT reconstruction methods



Filtered Back Projection (FBP)

- Standard for many years
- Fast but amplifies noise
- Attenuation corrections (AC) and scatter corrections (SC) produce errors

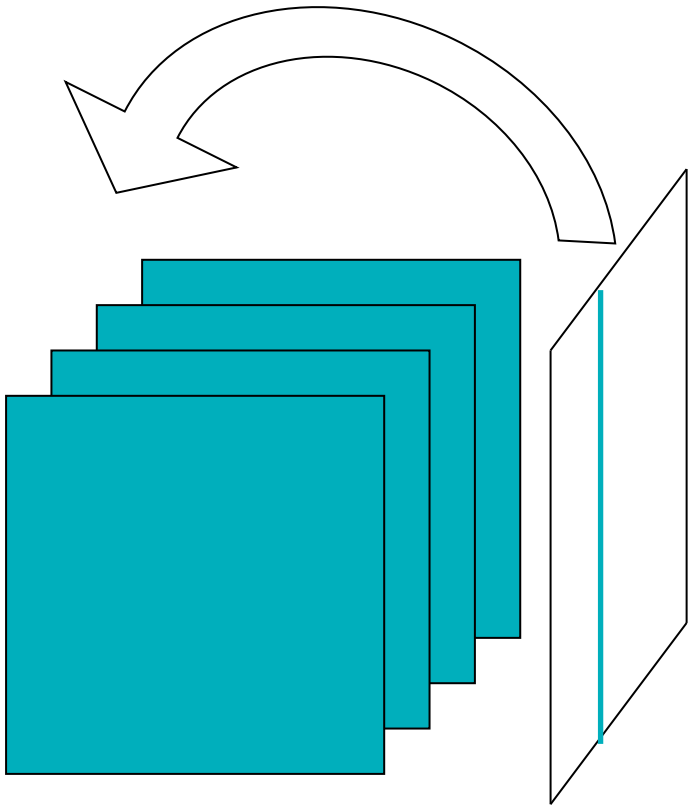
2D Iterative Reconstruction (IR)

- Now widely used – as sufficient computer power is now available
- Slower
- Deals well with noise but only works one slice at a time

3D Iterative Reconstruction

- Now available
- Even slower!
- Deals well with noise and works on all slices at once

2D Iterative Reconstruction



One Transaxial slice
at a time

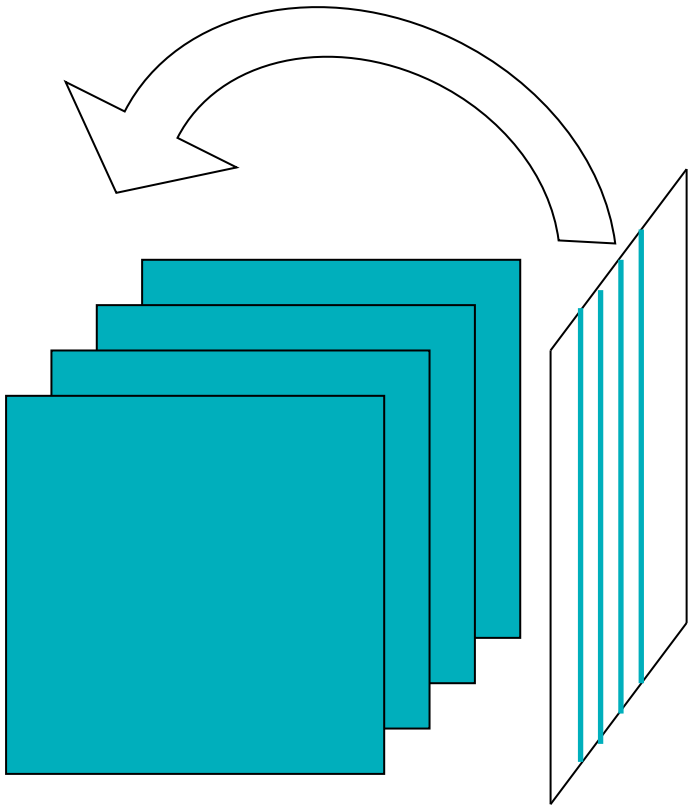
Each slice reconstructed separately

Attenuation correction ✓

Scatter correction ✓

Resolution recovery ✗

3D Iterative Reconstruction



All Transaxial slices

All slices reconstructed together

Attenuation correction ✓

Scatter correction ✓

Resolution Recovery ✓

Resolution Recovery

Originally designed to reduce acquisition time

- All major manufacturers have RR packages
- Camera/collimator specific
- Study specific e.g. bone, cardiac
- Generic packages

Only be possible to validate RR software for the applications for which they have been designed

Why not use RR to reduce administered activity rather than time?

RR software validation

Published patient studies showing that RR software can produce good clinical results from half-count data

most use half time instead of half counts

Variation in imaging protocols across centres requires local validation

- Different acquisition protocols

administered activity, acquisition matrix, angles, time per angle etc

- Different reconstruction protocols

filters, AC, SC etc

Choice of RR software may be restricted depending on equipment

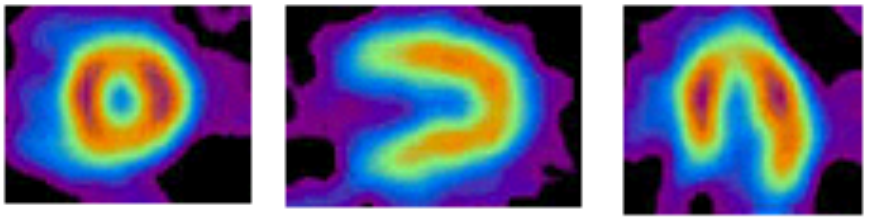
Myocardial Perfusion Imaging (MPI)

2nd most common NM investigation in UK

DRL = 1600MBq ^{99m}Tc (Stress + Rest)

Significant use of ^{99m}Tc

All manufacturers have RR software that can be applied to MPI



Pilot study

Aims

Half count data (RR software) ⟺ Full count data (standard IR)

Investigate effect on quantitative parameters

Use a range of software packages

Pilot Study

Carried out at Central Manchester Nuclear Medicine Centre

- GE Evolution for Cardiac
- Stress and rest data from 44 patients
- GE Infinia Hawkeye 4

Full results published in ARSAC report www.arsac.org.uk

Double reporting

- Half count (RR) vs Full count (std recon)

Quantitative LV function analysis

Conclusions from pilot study

Significant role for RR software when making the best use of available ^{99m}Tc

Data relates to one system only - further work is required using other software packages

Appendix A of ARSAC report proposes methodology for a multicentre evaluation of RR software

Summary

Resolution Recovery software was developed to reduce imaging time.

New focus on using this software to reduce administered activity and hence patient dose

Initial results show that MPI images produced with half the administered activity and processed using resolution recovery software, give same image quality as standard protocol

More work required – but promising