Post Mortem CT Imaging: The Trials and tribulations of using off-site scanning – Is it worth having access to MRI?

Mr Simon Moretta
Mortuary Technical Co–ordinator
Background

- CT and radiography important method providing additional information to Post Mortem
- Currently at Forensic Science SA (FSSA) – no on site CT
- 2010–2013 – Investigating purchasing CT scanner for FSSA
  - Denied due to lack of funding
  - Cost of Machine
  - Maintenance of unit
- 2013 – In partnership with South Australian Health and Medical Research Institute (SAHMRI)
- Availability to utilise CT scanner and MRI at facility at Gilles Plains
- Access to MRI in addition to CT for PM imaging considered an unique and invaluable opportunity
Is it worthwhile??
SAHMRI Preclinical Services is a preclinical testing facility.
Located in Gilles Plains
It specialises in large animals studies,
  ◦ including MRI and other imaging modalities
Efficacy studies
Pharmacokinetic studies
  ◦ product safety testing
  ◦ implant and device testing
  ◦ small and large animal models
The Skyra 3T is a 48-channel XQ gradient MRI scanner with 70 cm wide bore. The scanner includes advanced imaging and analysis software.
CT Scanner
Chain of Events

- Select Case for scans for following day
- Liaise with Radiographer and conveyancer
- Following Day
- Transfer Body to SAHMRI
- Perform CT and/or MRI
- Transfer body back to FSSA
- Initially Approx. 5 Hr turnaround
Number of Transfers per Year
(from 16/4/2013 to 31/12/2018)

![Graph showing the number of transfers per year with lines for #times visited, CT, and MRI. The graph indicates an increasing trend for CT and MRI, with a peak in 2018 for CT and a steady decline for MRI.]
Cons

- Selective
- Conveyancing
- Time restraints – quicker just to do autopsy
30 mins
Travel time
(one way)
Cons

- Delay in PM being undertaken
- Staffing – 1 Mortuary staff to accompany deceased
- Download times, rendering times
- Cost
- No angiography available
- CT/MRI not working/available
  - used by other personnel – research commitment
  - being serviced
  - Lockdown of SAHMRI Facility
Pros

- Location of CT and MRI scanner at SAHMRI,
- Same site as our Emergency Mortuary Facility for DVI
- Maintenance and cost not provided by FSSA
- Provide additional information at autopsy
Advancement...

- MRI initially performed using a scanner with 1.5T magnetic field
- Replaced by scanner with 3T magnetic field in January 2018
  - Better quality images
  - Speed up scan time
Advancement…

- Can determine COD from imaging if possible and report to SCO
- April 2018 – Coroner agreed the Pathologist does not need to seek additional approval to conduct a CT/MRI
Increase # of Ct, external and toxicology
(from 16/4/2013 to 31/12/2018)
Number of Admissions, Post Mortems and Ct/External
(from 16/4/2013 to 31/12/2018)

# admissions
# postmortems
Ct and external
CT
An MRI is similar to a CT scan in that it produces cross-sectional images of the body.

CT scan
- uses X-rays to produce the images.

MRI
- uses a strong magnetic field and radio waves
Is it worth having access to MRI??

- MRI
  - uses a strong magnetic field to align nuclei of Hydrogen atoms
  - Introduce 2° Magnetic Field to move protons out of alignment
  - Capture energy released when protons flip back into alignment → produce Image

- Not imaging anything physical – Imaging how protons behave

- Environment
  - Temperature of bodies
  - Strength of Magnetic Field
MRI
MRI scanner

Helium fill and cold head
Casing
Outer vacuum shield
Shim coils
Main windings
Outer cold shield
Helium vessel
Inner cold shield
3D image

- CT
- x and y plane
- Table moves produce other plane

- MRI stationary
- Subtle varying magnetic field in one direction to produce other plane and location of image
- Computer interprets to produce image
MRI v CT

- MRI can provide imaging that cannot be achieved by CT
- However, obstacles in using MRI
Problems with MRI

- Most people believe the Magnetic field only issue with MRI relating to metal.
Problems with MRI

- Pacemaker
- Artificial joints
- Credit cards
- Bullet fragment
  - Metal heats up creates artefact
- Hearing Aids
- Metallic Objects
Cochlear Implants
Problems with MRI

- Magnetic Field
- Perform CT on deceased first – determine if any metallic objects, pacemakers, artificial joints etc in body
- Only then undertake MRI
Other Problems with MRI

- Tissue/ Air interface – edges effect
- Cost maintaining gases
  - Helium inner core expensive
- Artefacts imaging not perfect
  - Overlapping and chemical shift/ wrap around
- Venting of Gases
  - If gases heat up require to vent – $$
- Oxygen alarm sensor
- Cooling System
  - Energy to cool magnet
  - $$ – Equipment to support unit
  - Backup cooling and power supply
Arrival of new MRI and magnet is in imaging area

Varying Magnetic field
distorted by the presence of metal in pipes, wires, ducts, and structural beams in the immediate environment.

Fringe fields of nearby scanners may also affect the field of the newly installed magnet.

*Shimming* is the process by which the main magnetic field is made more homogenous.
Shimming the Coil

- Coils carrying a relatively small current that are used to provide auxiliary magnetic fields in order to compensate for inhomogeneities in the main magnetic field
- Reshim if new equipment added nearby – they may alter magnetic field of MRI
Other Problems with MRI

- Images difference in temperature shifts
  - Basal ganglia lighter in deceased
Benefits of MRI over CT

- Quality of images
- Aortic Dissection
- Septal Fibrosis
- Intracranial Haemorrhage
- Pulmonary Embolism
Haemopericardium
Pulmonary Embolism & DVT
Intracranial Haemorrhage
Septal Fibrosis

- Old myocardial infarction??
Diagnose Hidden Brain Injuries

- DTI isolates water movement within the brain, which allows doctors to isolate regions that are not functioning properly
- Only clinical thus far – still to be explored
Diffuse Tensor Imaging (DTI)
Summary

- CT and MRI scanning facilities have proven beneficial
- Do we benefit from using MRI – Yes
- Able to produce quality images
- Lack of Resources, cost and logistics
- Unable to scan all bodies
- Next step – Access to Onsite Scanning however will only be CT
Thankyou

Dr Neil Langlois
Forensic Science SA

Sunthara R Peruval
Preclinical Imaging and Research Laboratories & South Australian Health and Medical Research Institute (SAHMRI)