

Micro-CT for human fetal⁺ imaging



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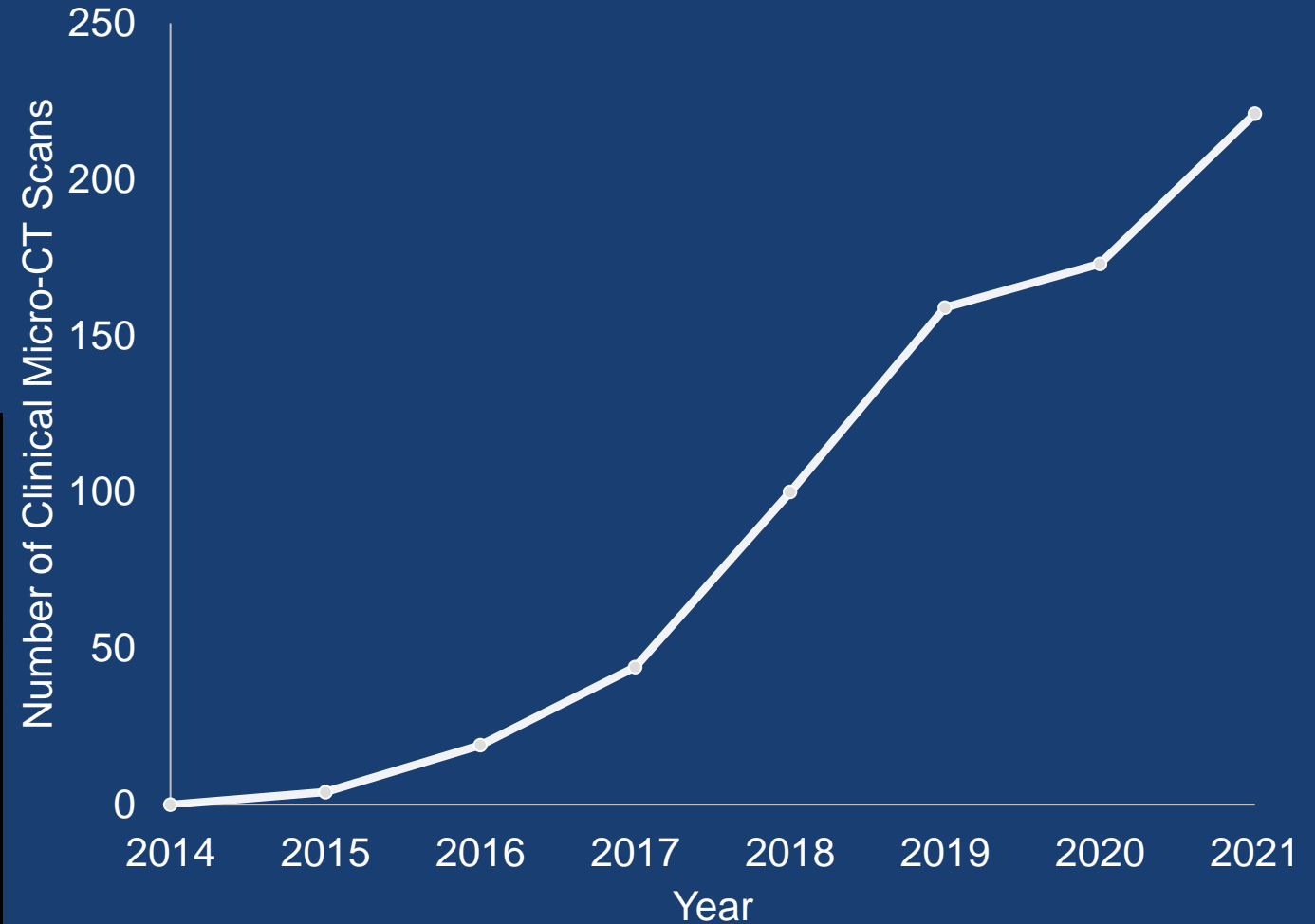


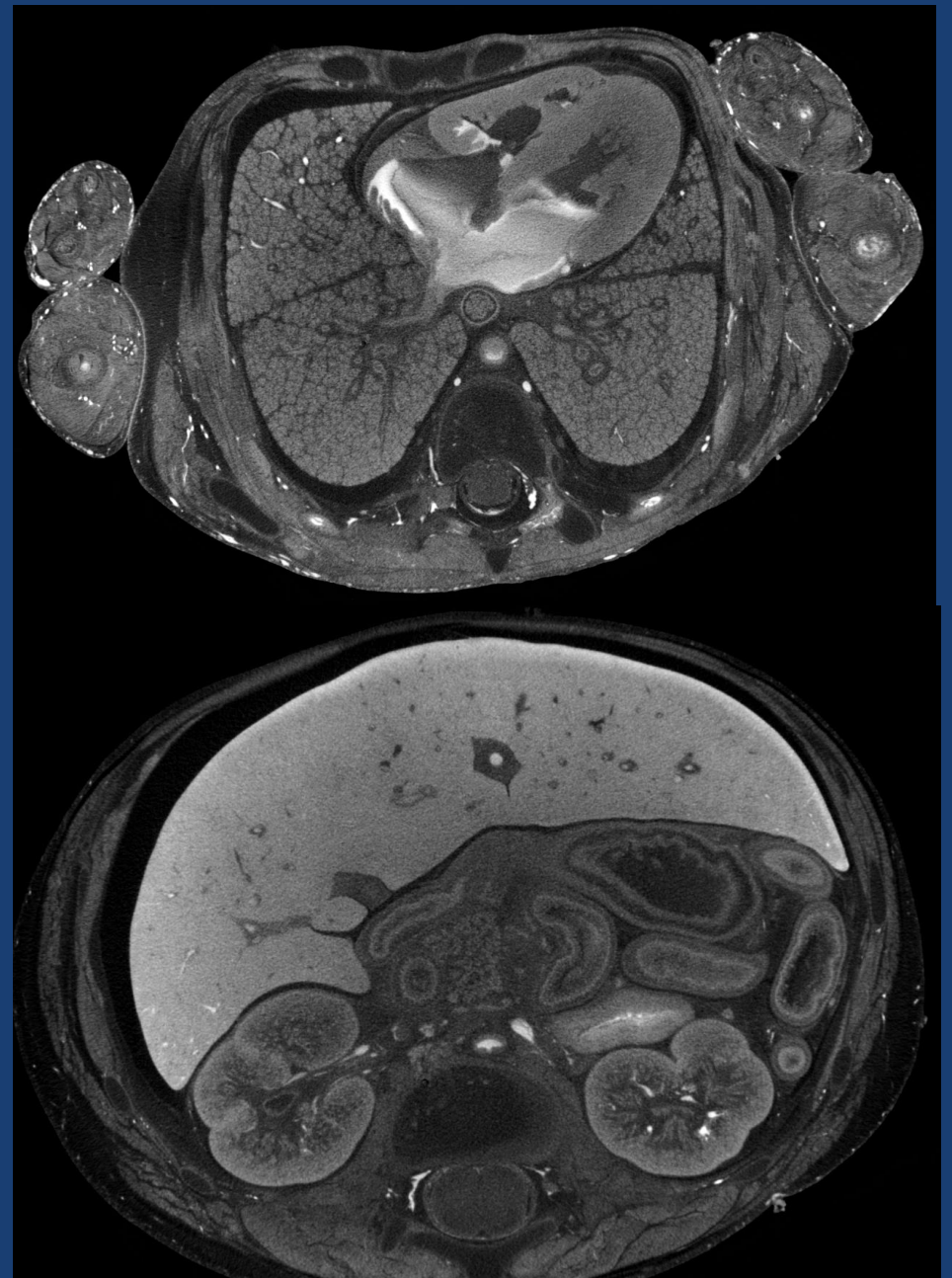
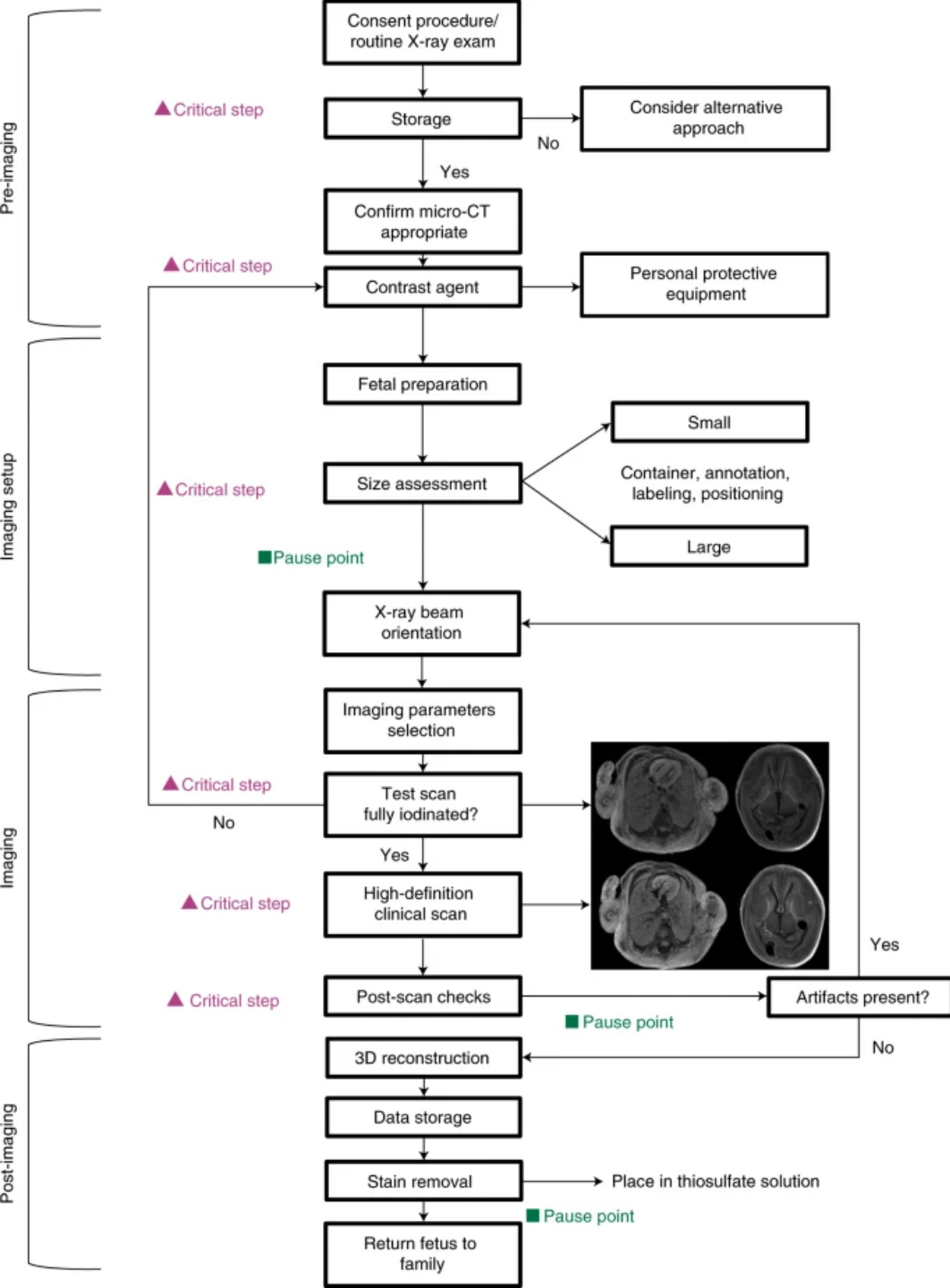
Clinical micro-CT service

- Over 900 clinical cases at GOSH
- Eligible micro-CT cases increased from 74% (2019) to 96% (2021)

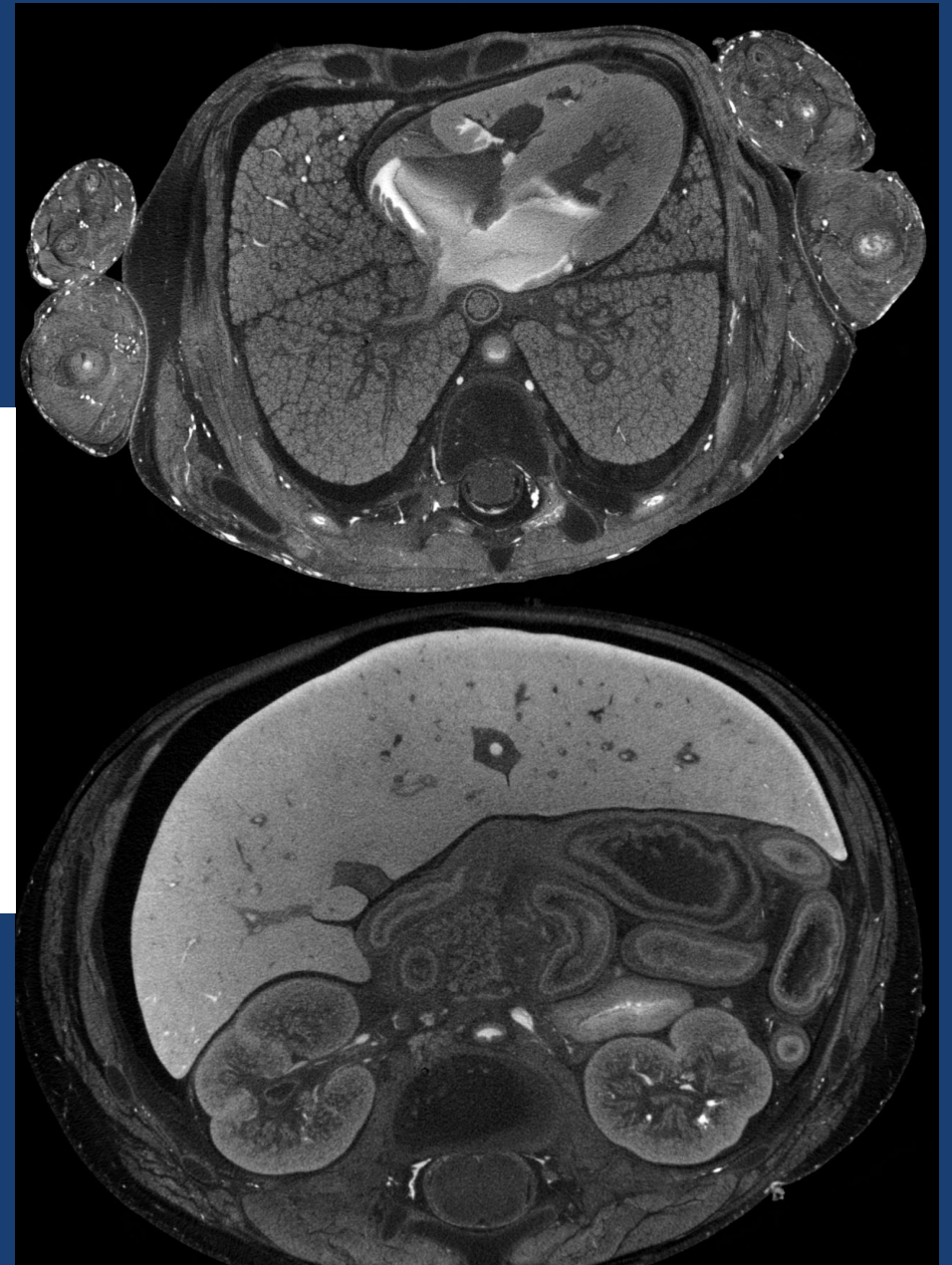
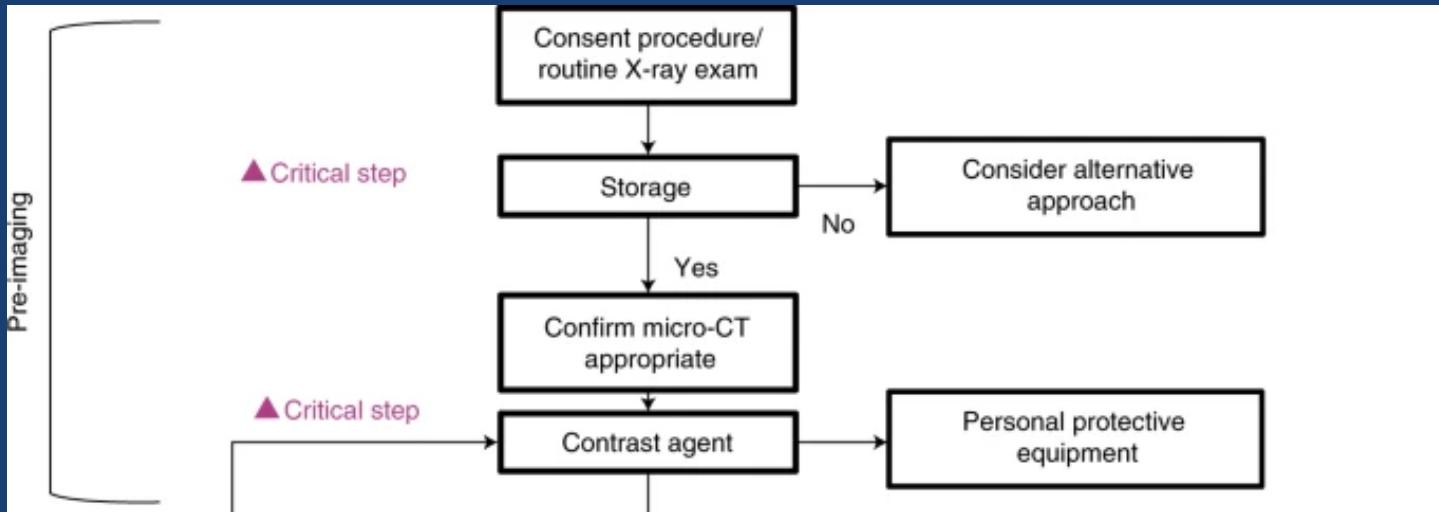


Micro-CT Clinical Cases at GOSH





Pre-imaging



Contrast enhancement

- Iodination essential for soft tissue identification
- Potassium tri-iodine 2.5%
 - 100g KI and 50g I₂ dissolved in 1 litre of H₂O
 - Dilute 1:1 with 10% formalin
- Consent - Darkening of the skin



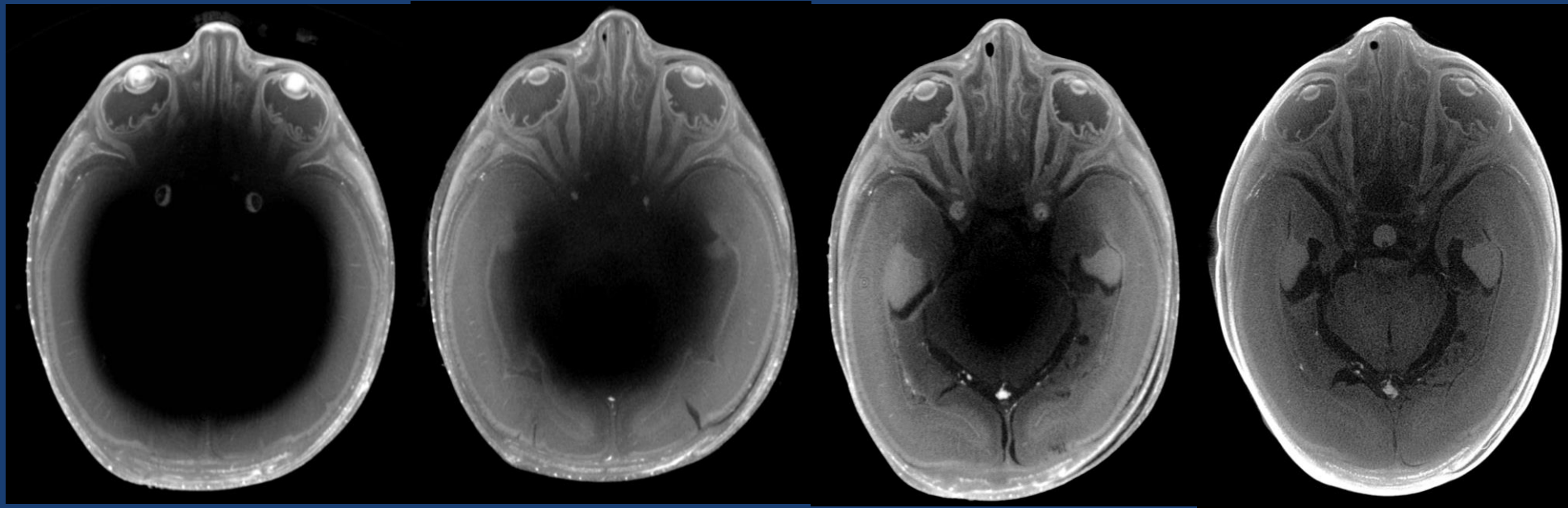
Iodination of fetus

- Relationship – iodination time and body weight

- Immersion time (days) = $0.03 \times \text{weight (g)} + 2.2$

For example

- 50g - 4 days
- 100g - 5 days
- 200g - 8 days
- 300g - 11 days



Time/days

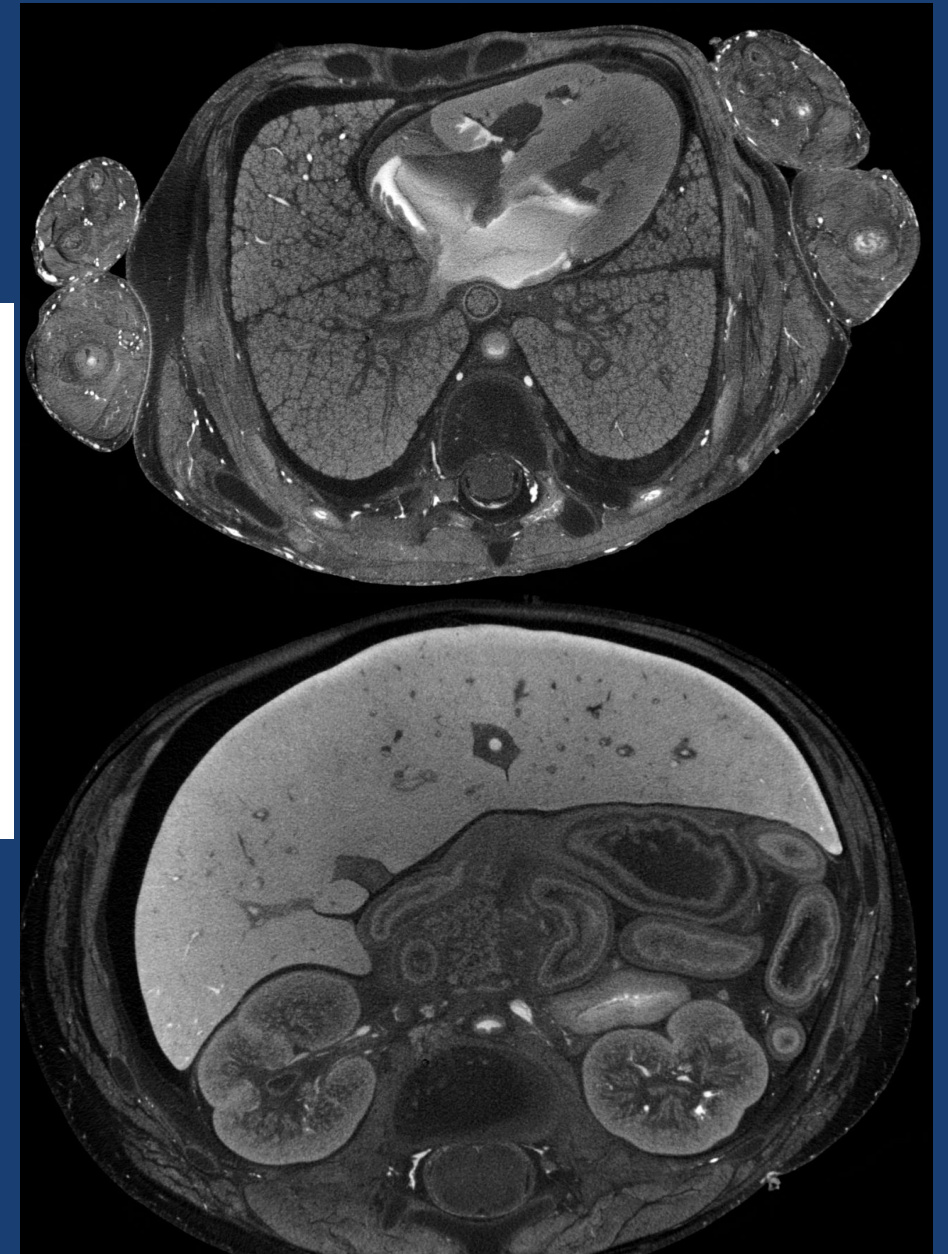
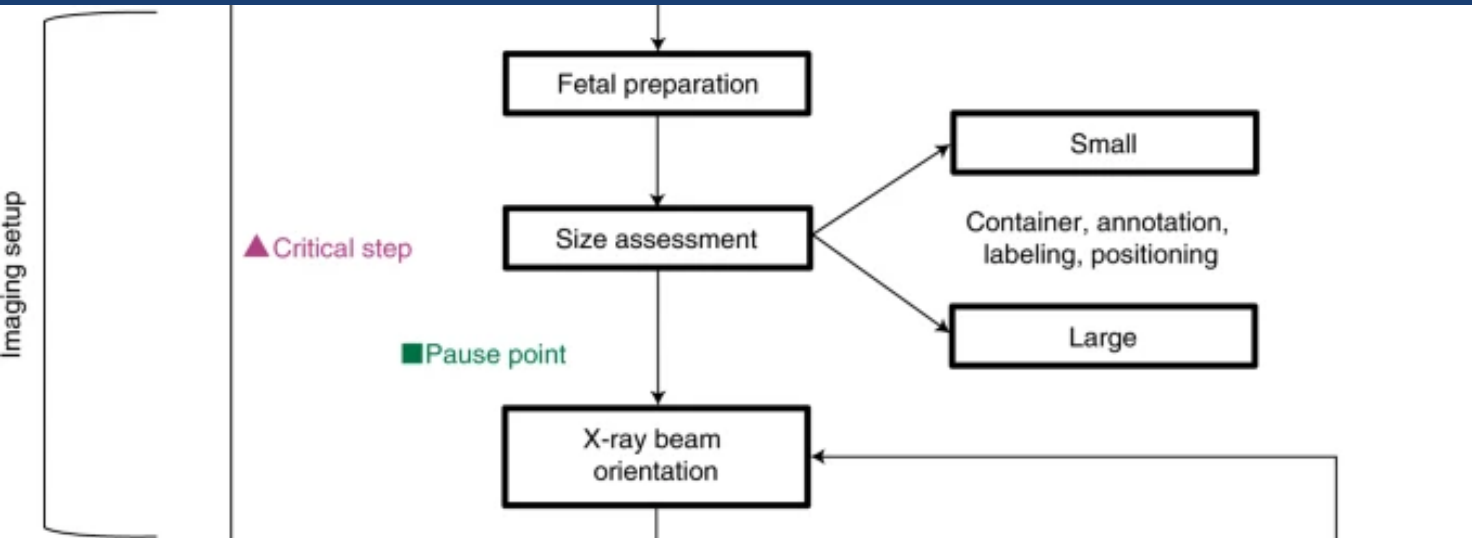
1

2

3

4

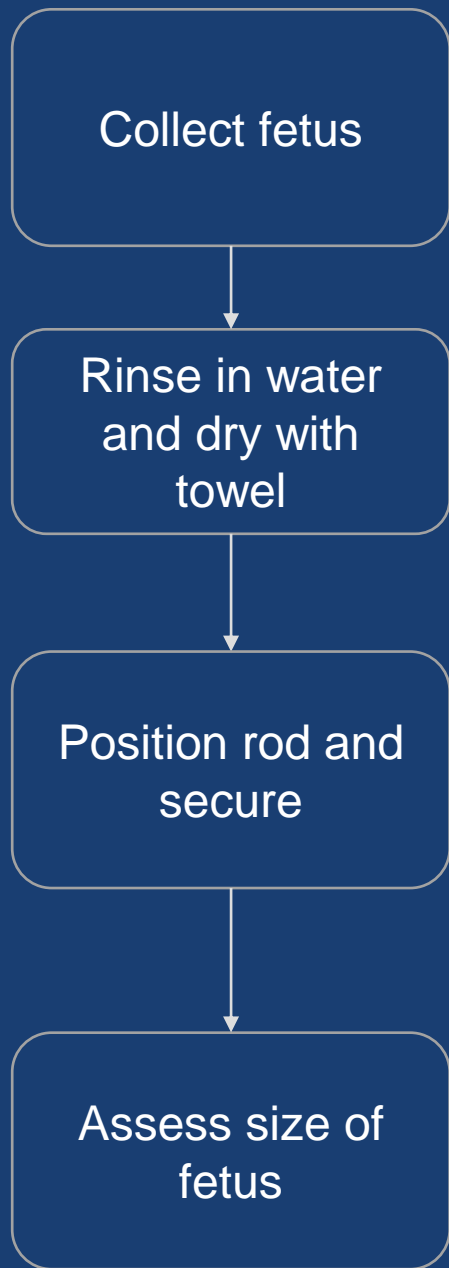
Imaging setup



Equipment required

- Protective equipment
- Parafilm
- Suitable container
- Carbon fibre mounting
- Carbon fibre rod
- Incopads
- Towels
- IPA for spillages





Length <10 cm

Small fetus positioning

Length >10 cm

Large fetus positioning

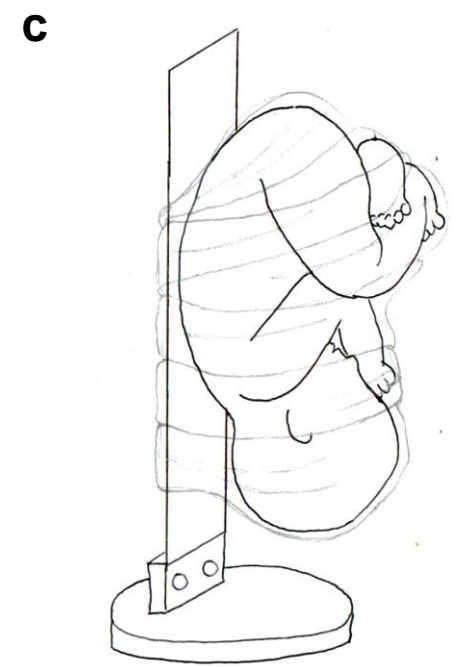


Note temporary darkening of skin tone

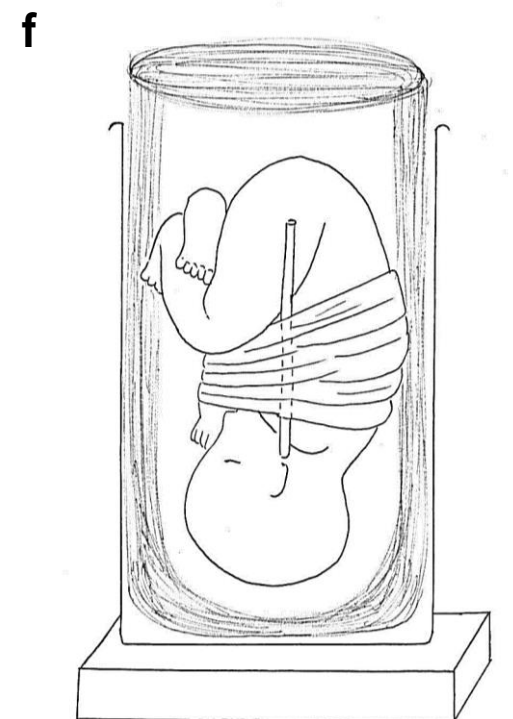
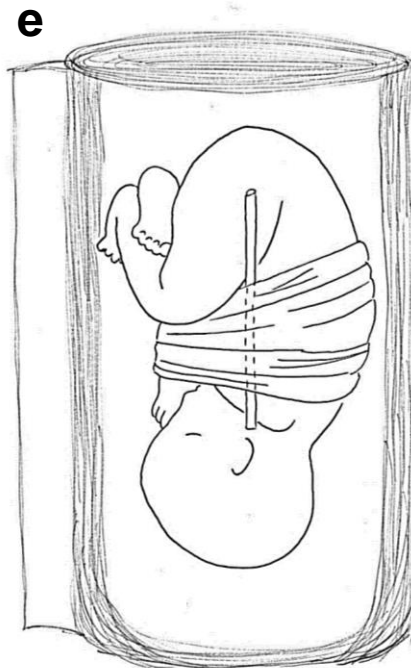


Position and secure rod on right side

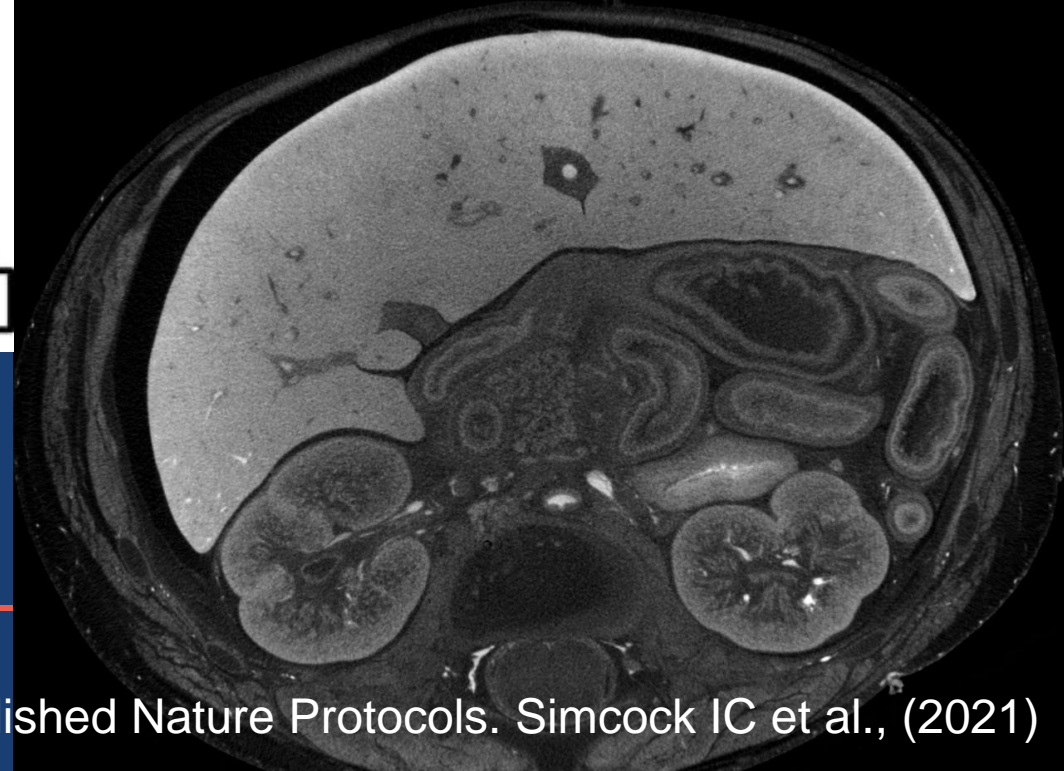
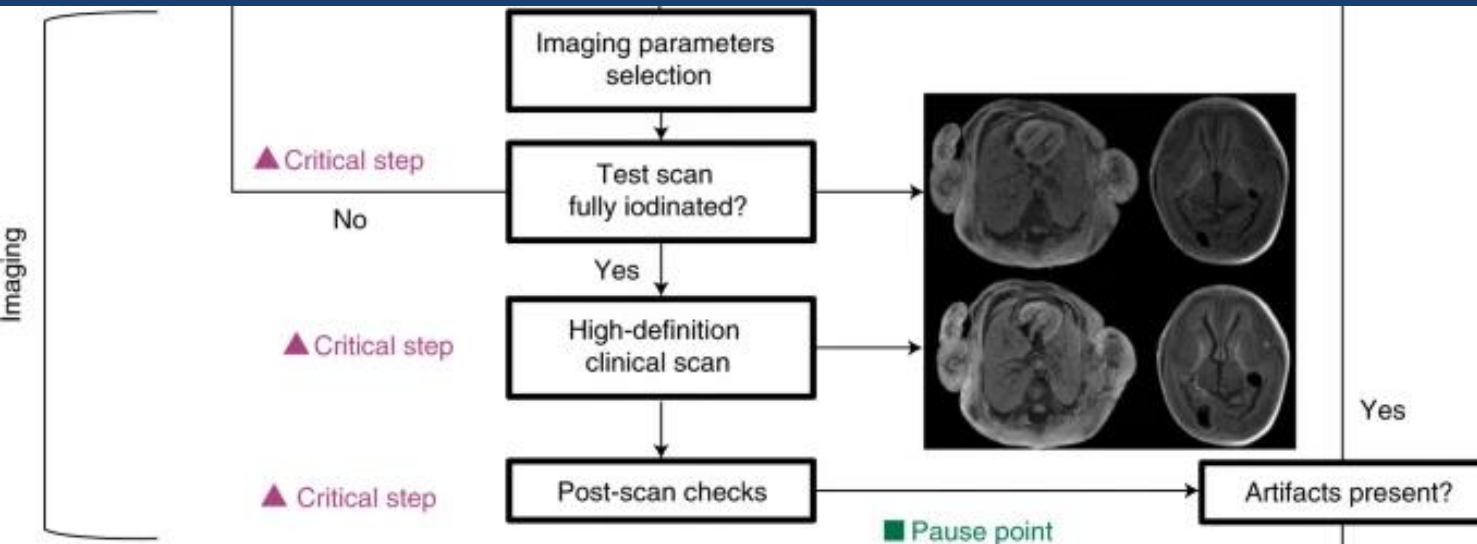
- Small fetus positioning
 - Parafilm and incopad
 - Carbon fibre rod



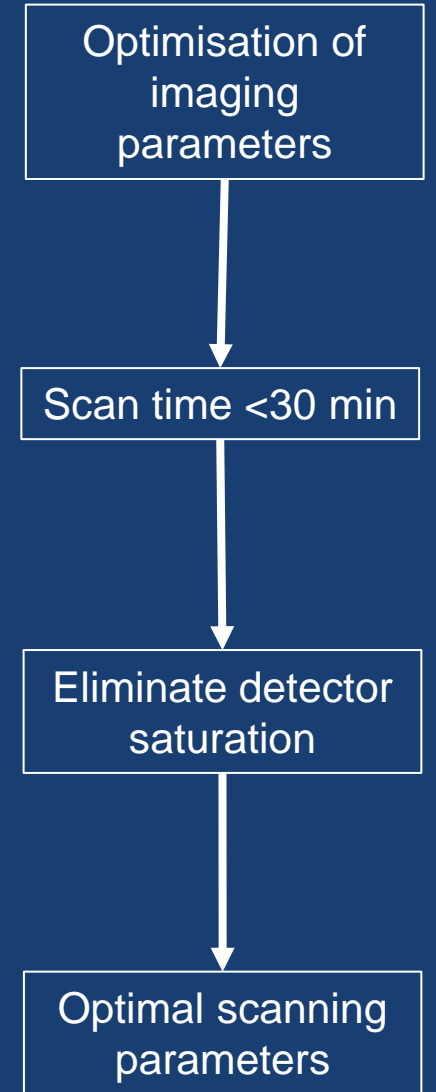
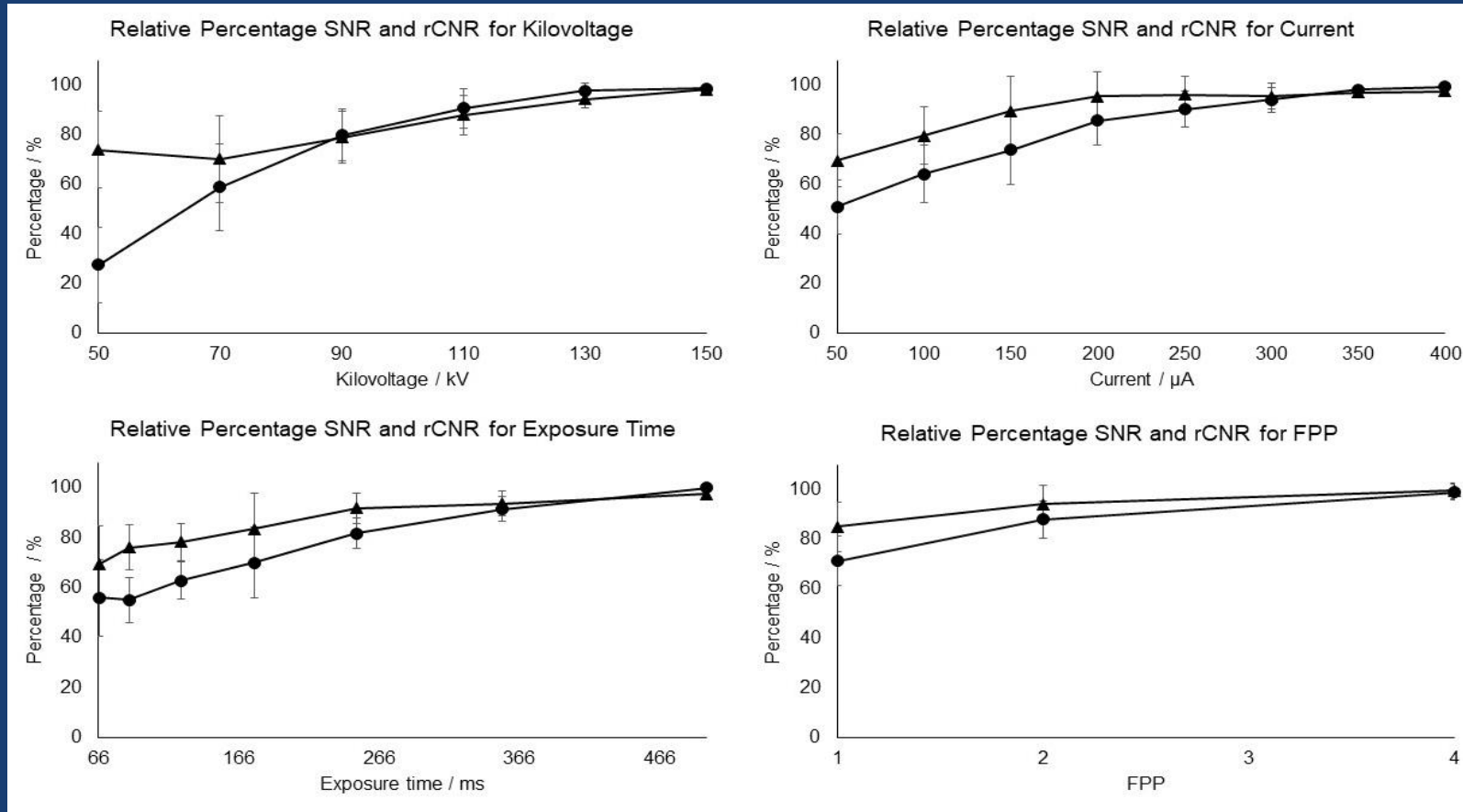
- Large fetus positioning
 - Incopad cushioning
 - Suitable container



Imaging



Optimal imaging parameters for clinical usage



	Kilovoltage	Current	Exposure time	FPP	Scan time
Optimal imaging parameters	130	140	250	2	25

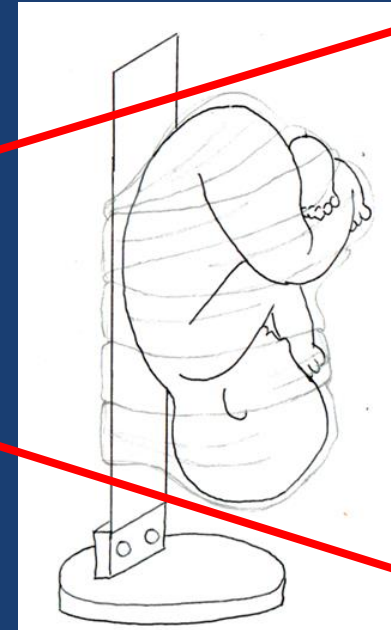
Imaging parameters

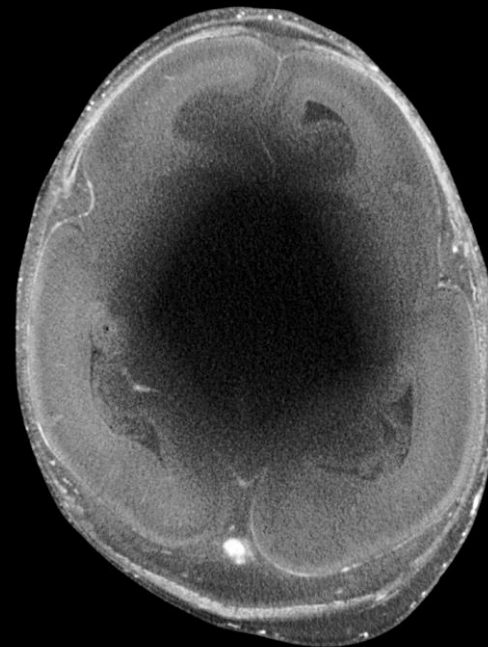
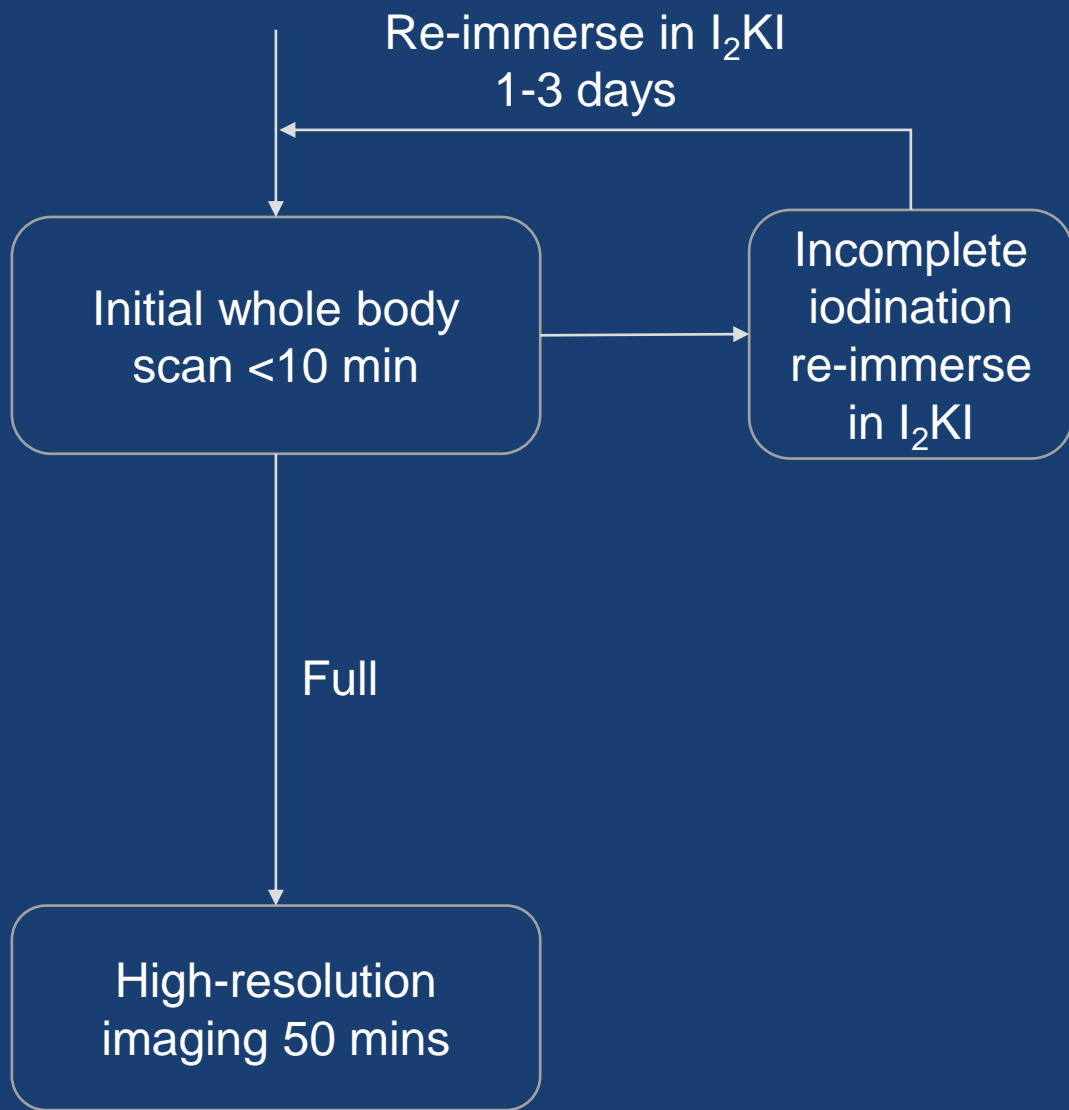
	Kilovoltage	Current / μA	Exposure Time / ms	Frames per projection	Individual scan duration / minutes
Test scan	130	140	250	1	< 10
High resolution parameters	130	140	250	2	2 x 25

Whole body positioning

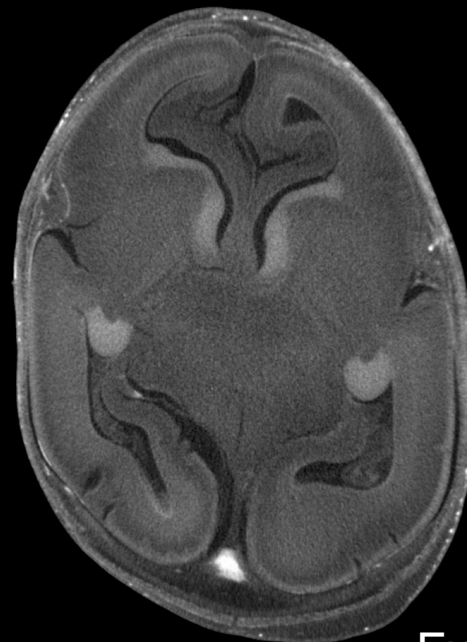
- Position to include whole body
- Still maximise resolution

X-ray
source





Incomplete iodination



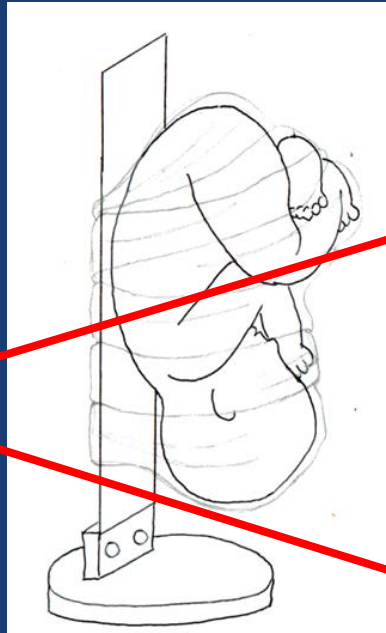
Full iodination



Head and torso positioning

- Position to include individual head and torso
- Higher resolution for head and torso

X-ray source



Head scan

X-ray source



Torso scan

Artefacts

- Important to reduce
 - Over-iodination
 - Distortion
 - Deformation
 - Movement

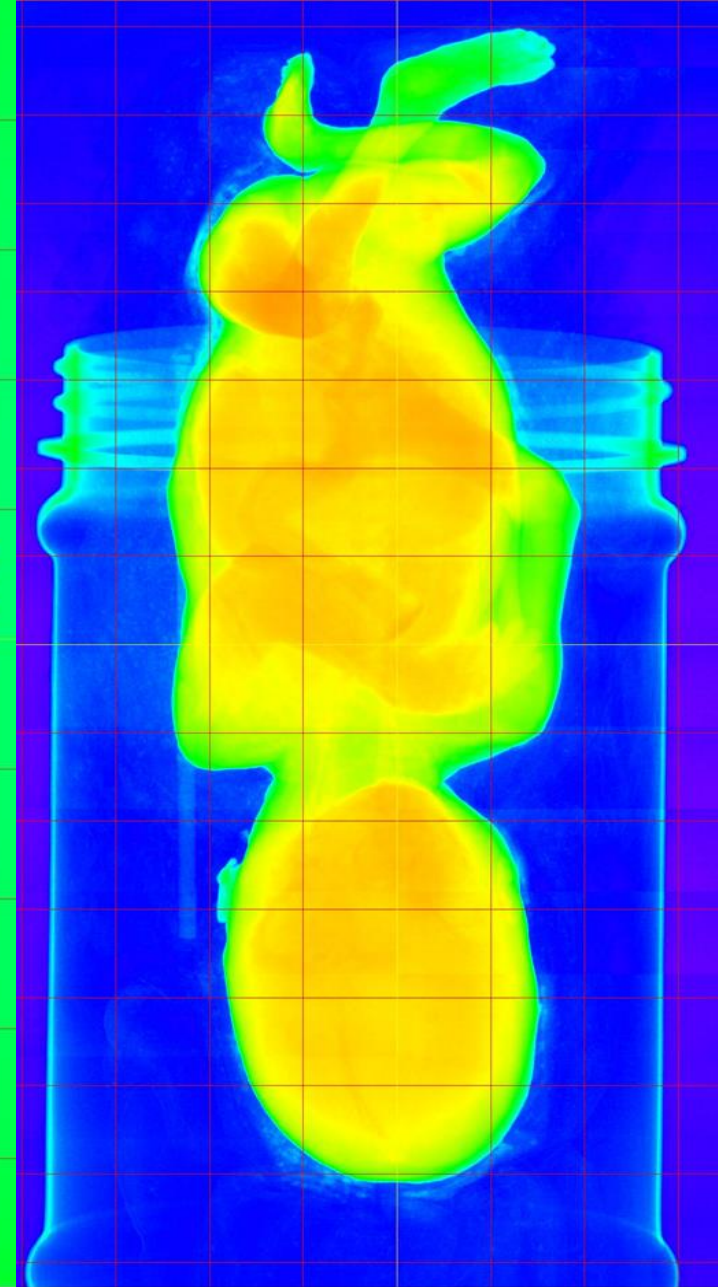


Over-iodination

- Differential attenuation required
- Minimise tissue distortion



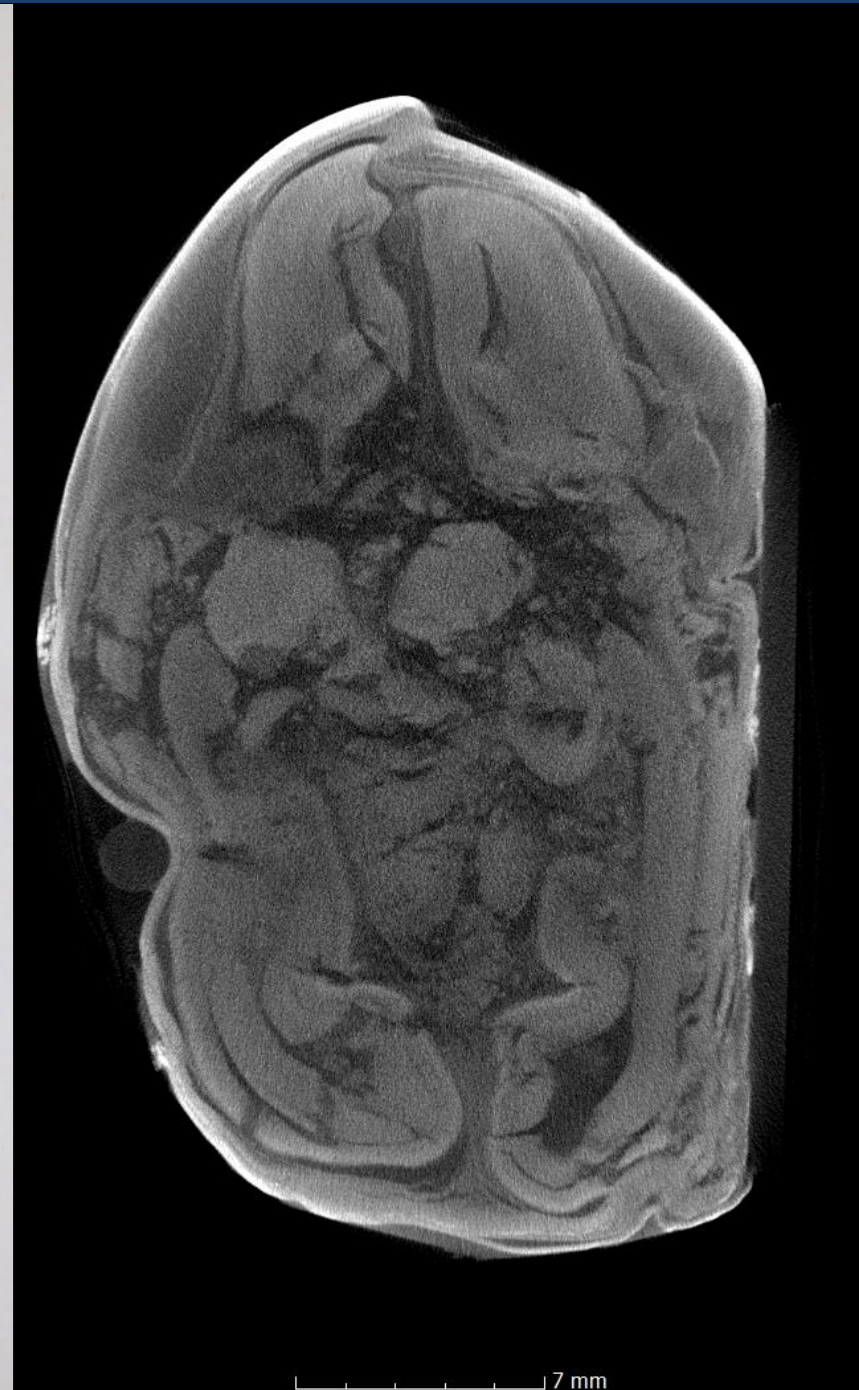
Over-iodination



Suitable iodination

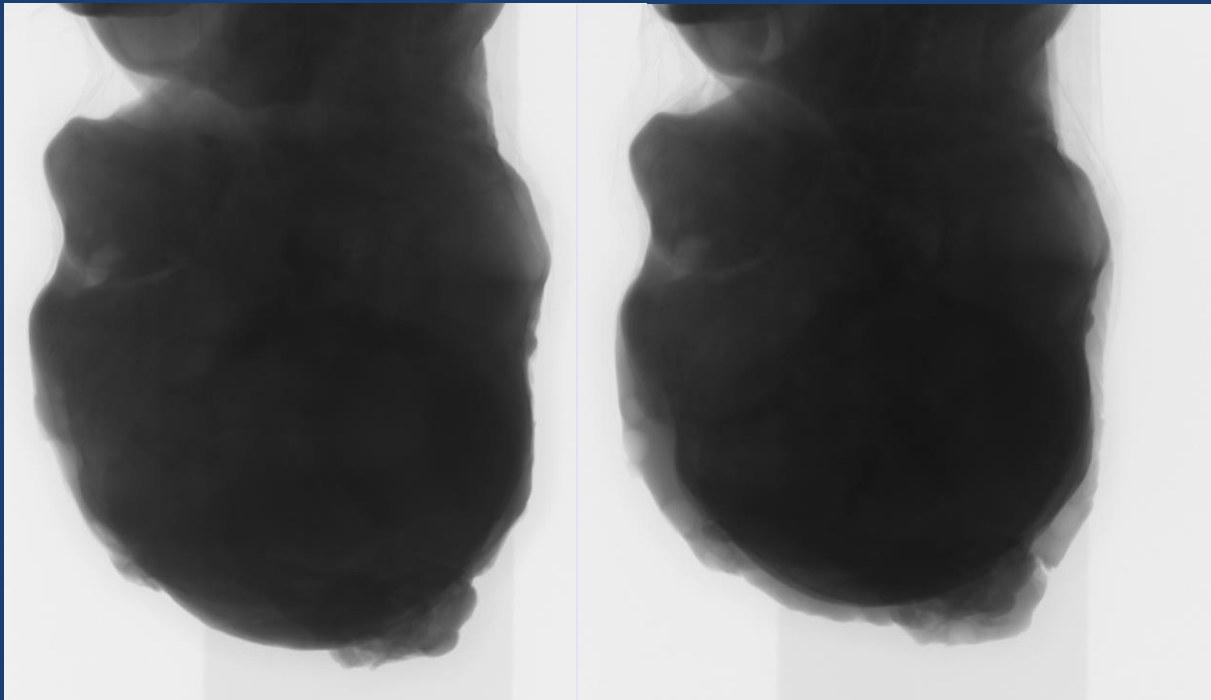
Deformation / movement

- Padding eliminates mechanical distortion
- Retain anatomical integrity



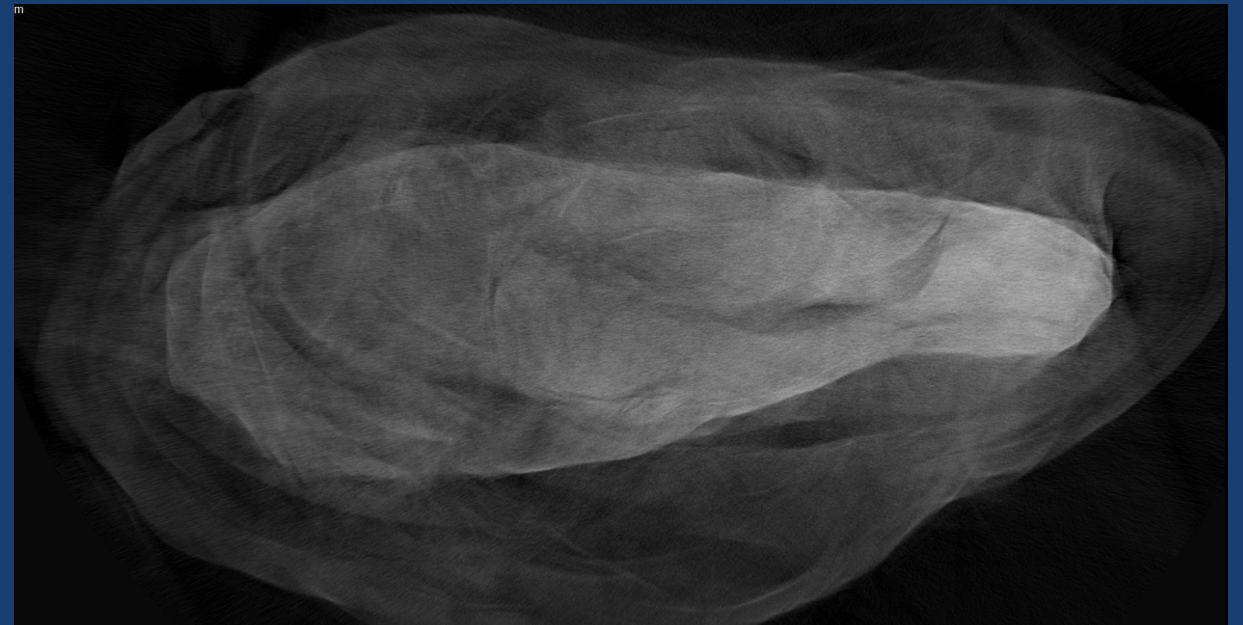
Correct volume calculation

- Reduce pooling of I_2KI solution
- Maintain integrity of original and final volume



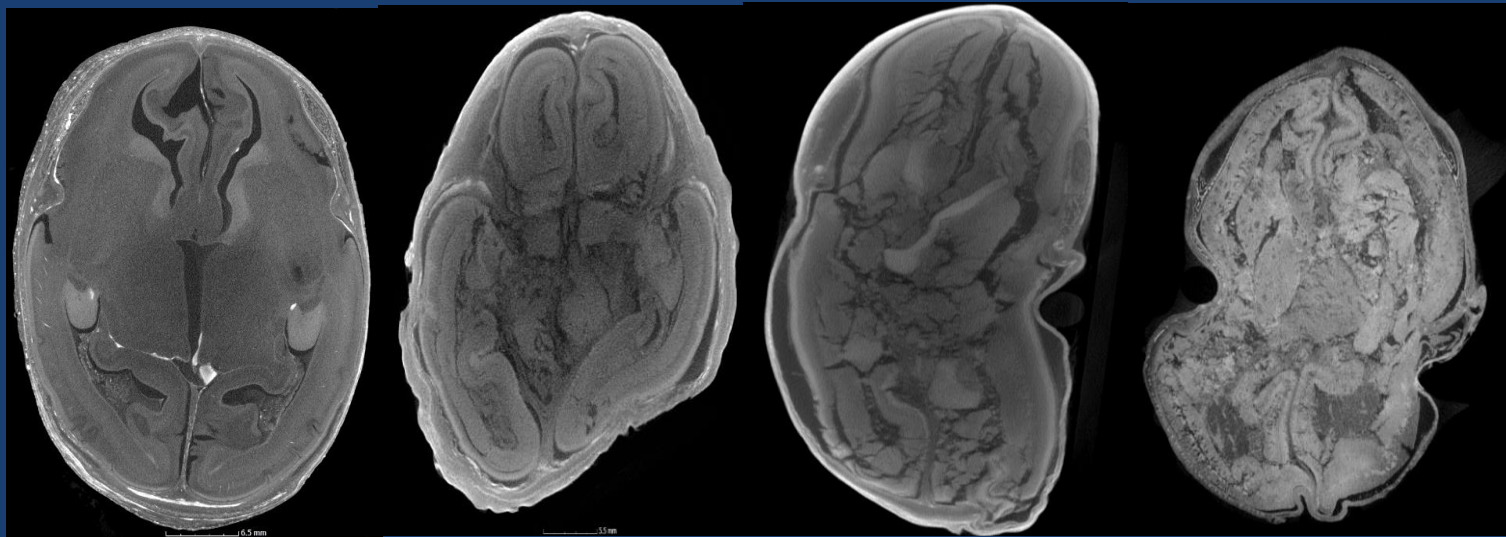
Initial

Final



Data unable to be calculated

Image quality prediction



0

1

2

3

Maceration

Aim – To identify strongest determinants for fetal post-mortem imaging

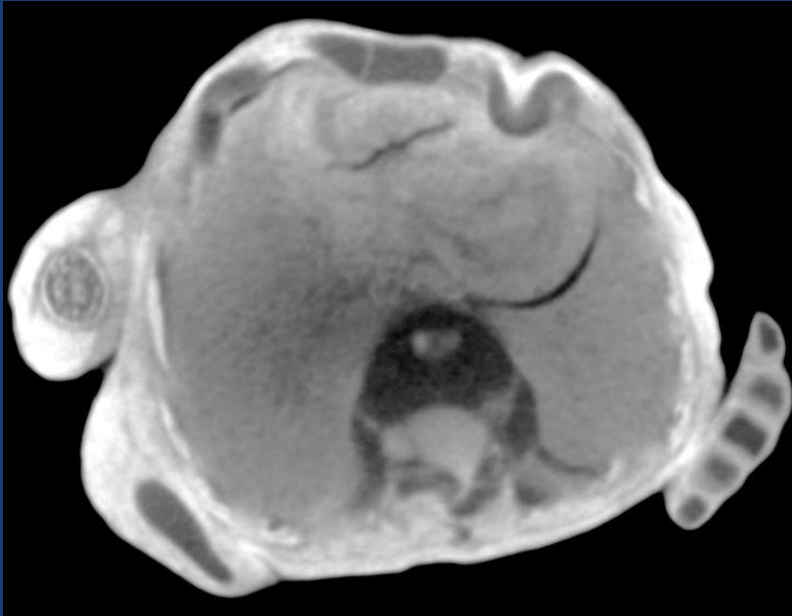
Methods

258 fetuses compared for I₂KI contrast, maceration and image quality.

Results

Strongest predictors – Maceration and body weight

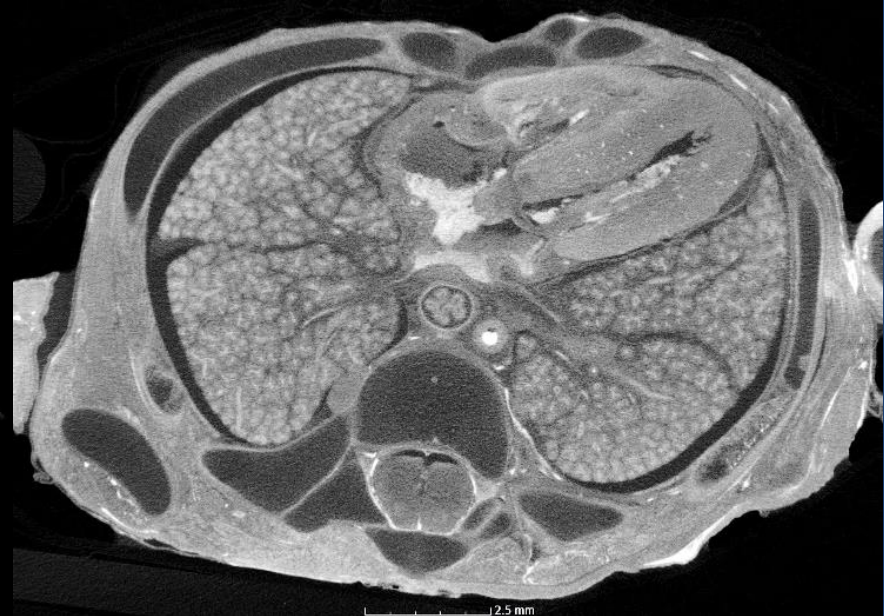
Image quality prediction



Poor



Moderate



High

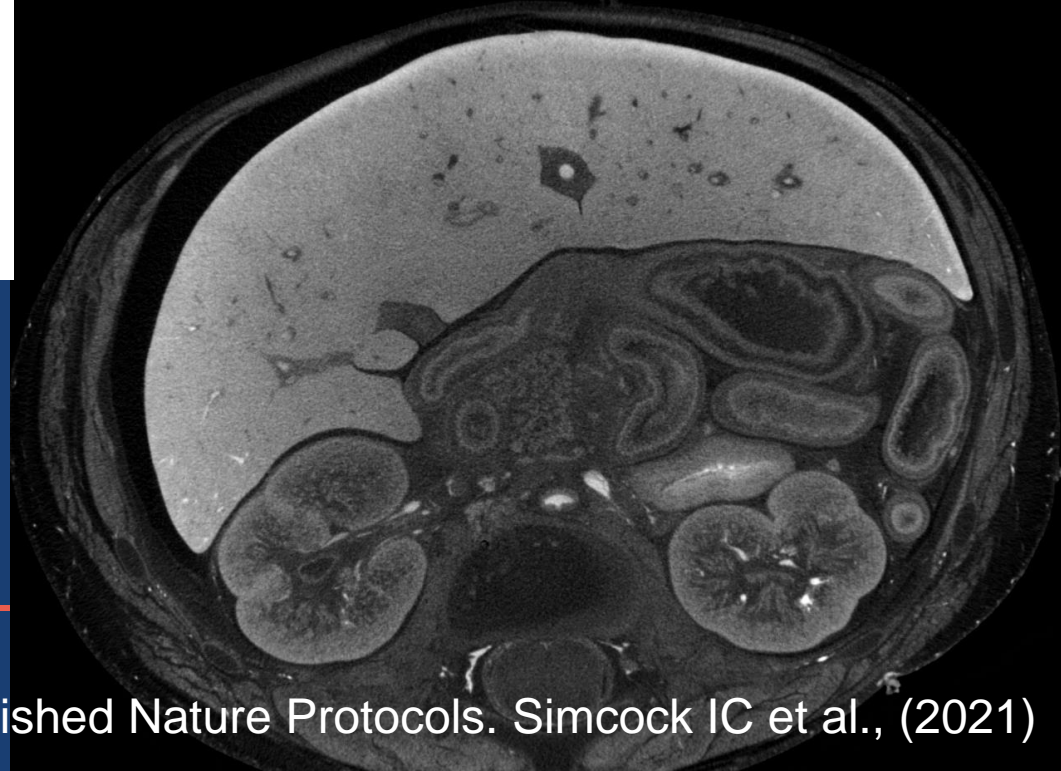
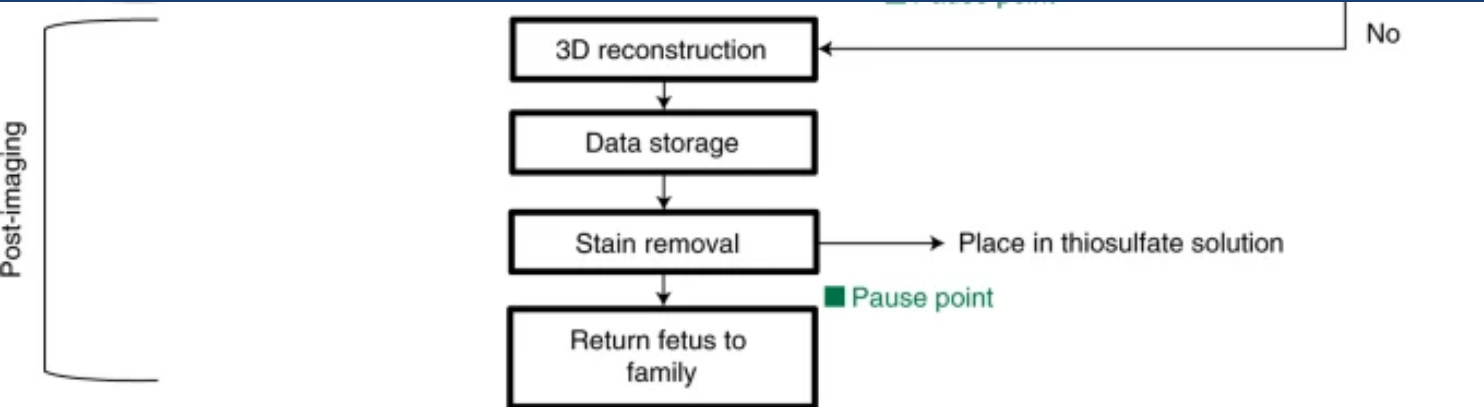
Results

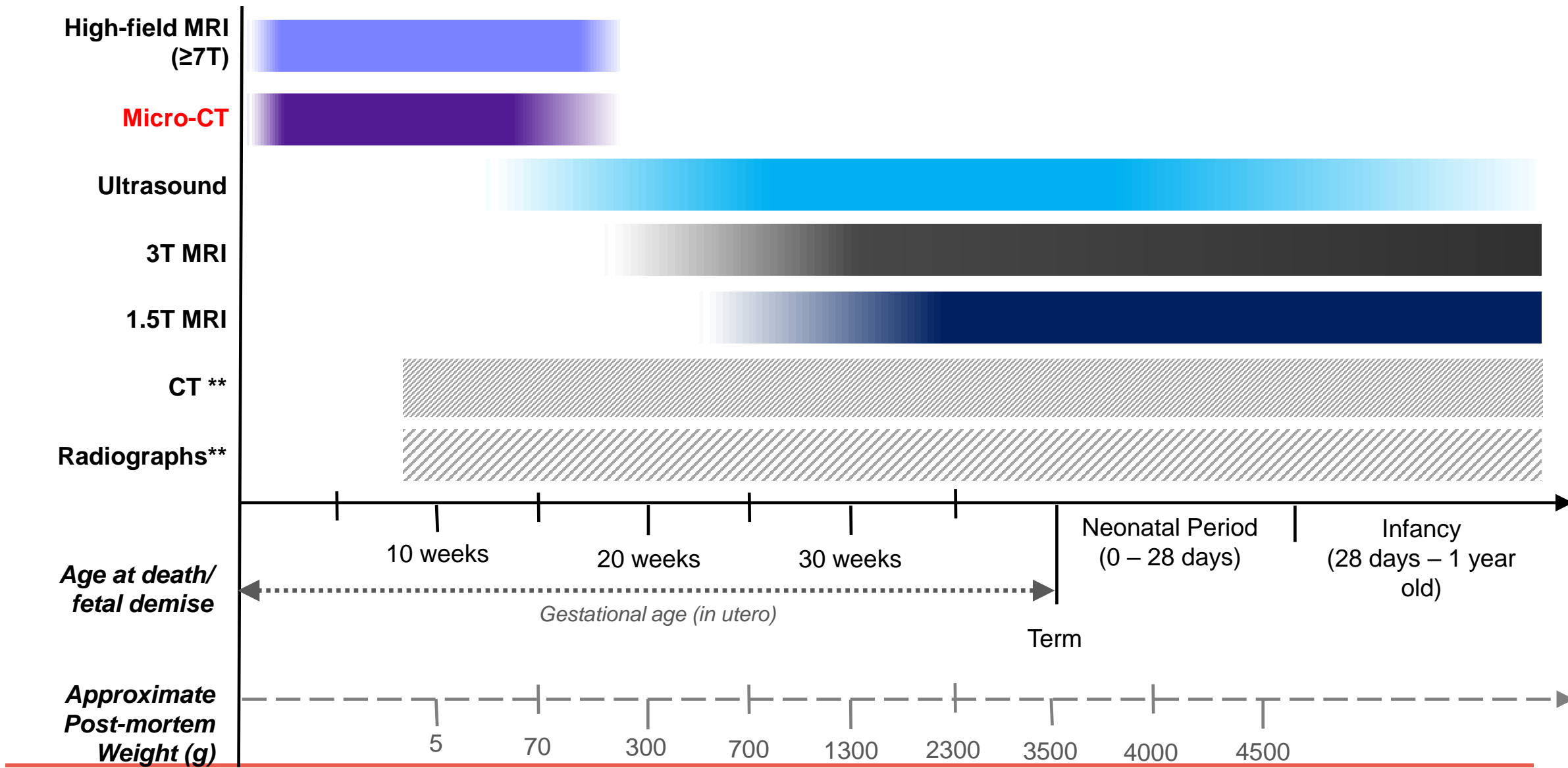
Image quality – high >95% of cases

Conclusion

Micro-CT provides high image quality even with maceration

Post-imaging

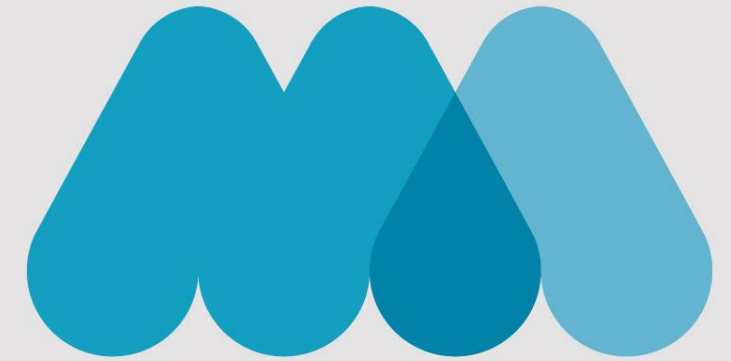




Parental perceptions of micro-CT

- Focus group
- Parents experienced miscarriage
- Miscarriage Association
- Identify barriers and benefits

NIHR | Research Design
Service London



**MISCARRIAGE
ASSOCIATION**

The knowledge to help

Focus Group Findings – Parental feedback on micro-CT imaging following miscarriage

Simcock I. C., Lewis, C., Shelmerdine S. C., Sebire N. J., Arthurs O. J.



Protection

“You don’t necessarily want any more harm done because you’re still quite protective of the baby.”

Hope for the future

“Knowing the answers gives you hope moving forward.”

Research

“We need more information, we want to know why it happens really.”

Positive implications for parental mental health

Almost gives you hope moving forward.”

Clear high resolution imaging

“It is so impressive how detailed the images are, when the babies are so tiny.”

Ability to image early gestation babies

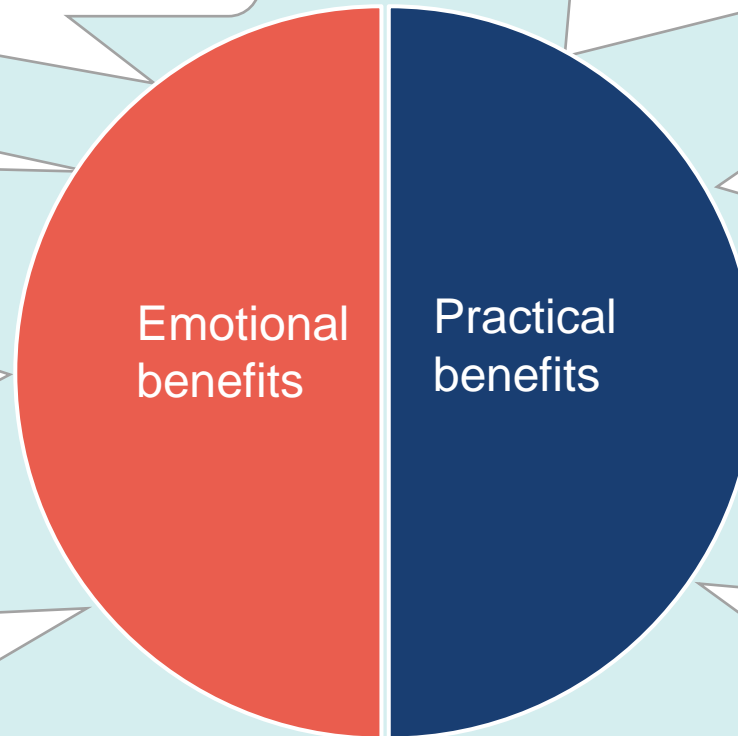
“To see it was actually a baby... you don’t feel crazy anymore”

Ability to provide answers

“I just wanted to know answers.”

Non-invasive imaging

“I just couldn’t bear the thought of him being cut open, but if something like this was available, I would have jumped at the chance



Personally I would have chosen micro-CT imaging

“I think it’s really amazing, I think it can help a lot of women and men!”

Published Simcock IC et al., NIHR conference 2021, Leeds, UK

- Truly clinical service at GOSH
- Key partners co-designed service
- Ongoing research, development and investment
- Parents at the heart of the service



6.5 mm

