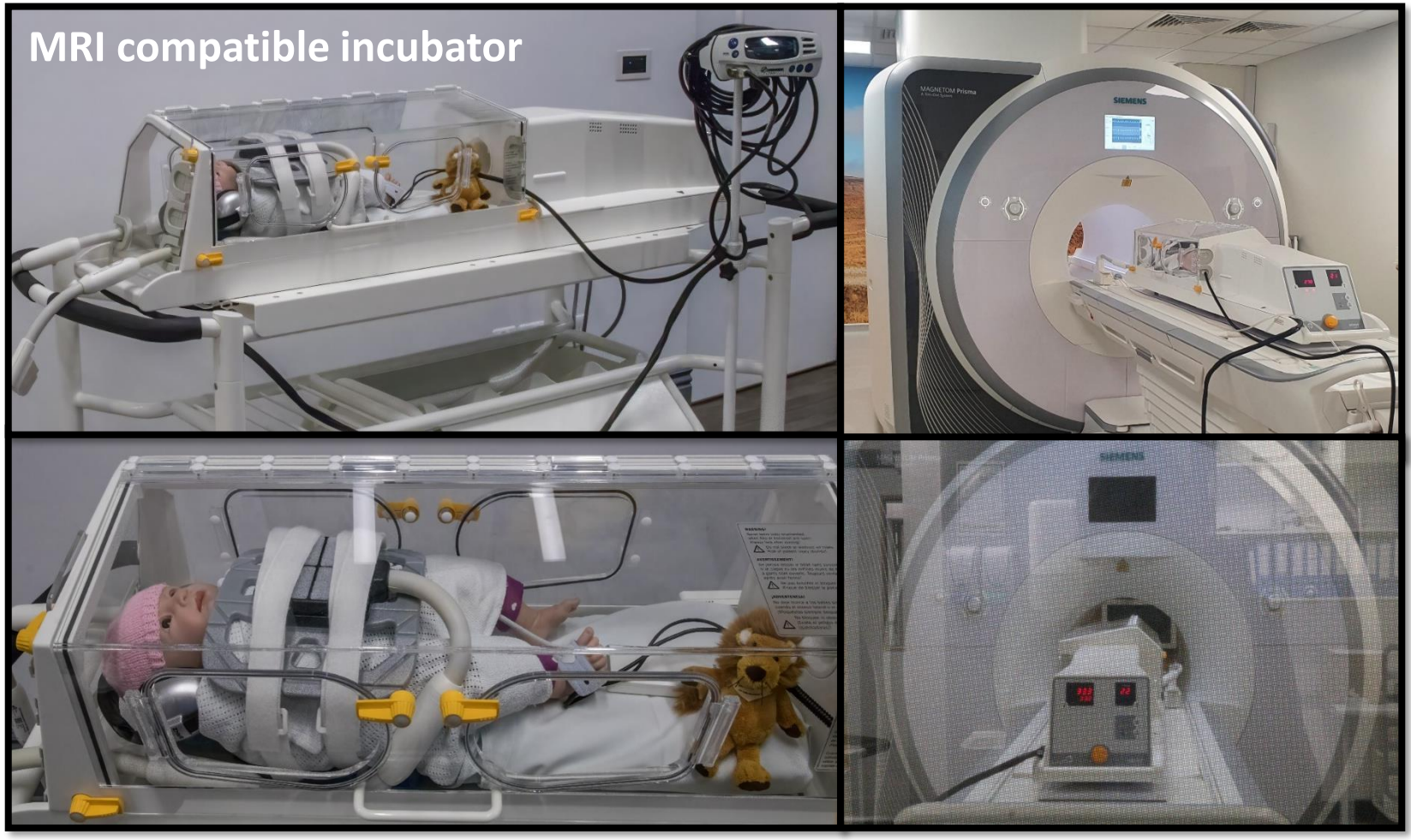
Neonatal cardiac feed and wrap free breathing 4D flow MRI is comparable to standard free breathing 2D flow assessment

Hannah Panayiotou, Lily Mills, David Broadbent, David Shelley, Jutta Scheffczik, Alexandra Olaru, Ning Jin, John Greenwood, Helen Michael, Sven Plein, Malenka Bissell

Background

- Feed and wrap is routinely used for neonatal clinical brain imaging.
- Cardiac imaging usually necessitates breath-holds and, therefore, a general anaesthetic.
- Advances in 4D flow MRI allow free-breathing cardiac assessment in 5-7 minutes.



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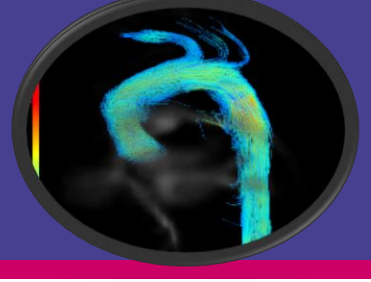
Methods



- A dedicated MRI compatible incubator with specialized small MRI coils within the incubator allowed transfer of the sleeping baby into the scanner
- 11 healthy babies were included (4 scanned in an open-top bassinet, and 7 in the incubator)

- Images were acquired on 3Tesla MRI scanner (MAGNETOM Prisma, Siemens Healthcare GmbH, Erlangen, Germany)
- The free breathing scan protocol included: Gradient echo single shot cross-sectional imaging; standard 2D phase contrast flow imaging of the ascending aorta; prototype compressed sensing accelerated 4D flow MRI, additional free breathing binning cine imaging if baby still asleep

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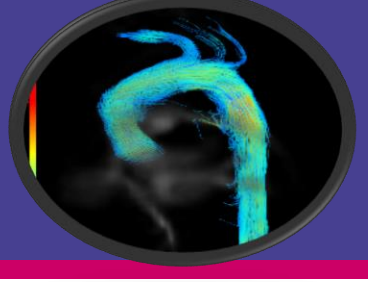
Results



4D MRI is feasible….

Median scan time:

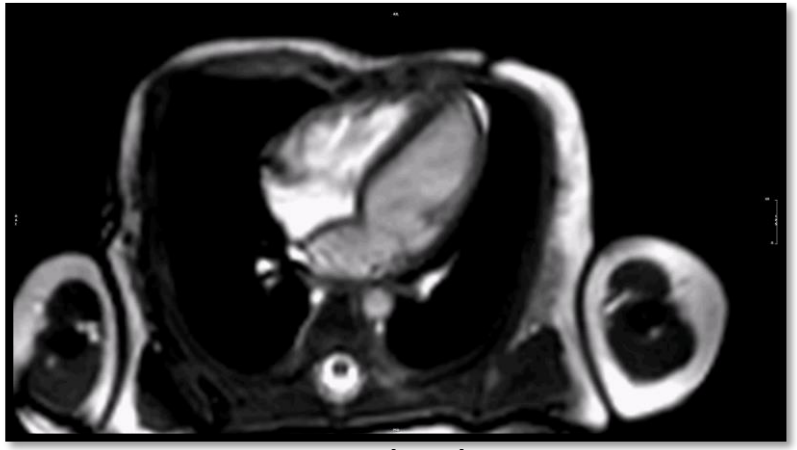
Bassinet 18min [14-30min] Vs Incubator 22min [18-25min]

Completion of protocol:

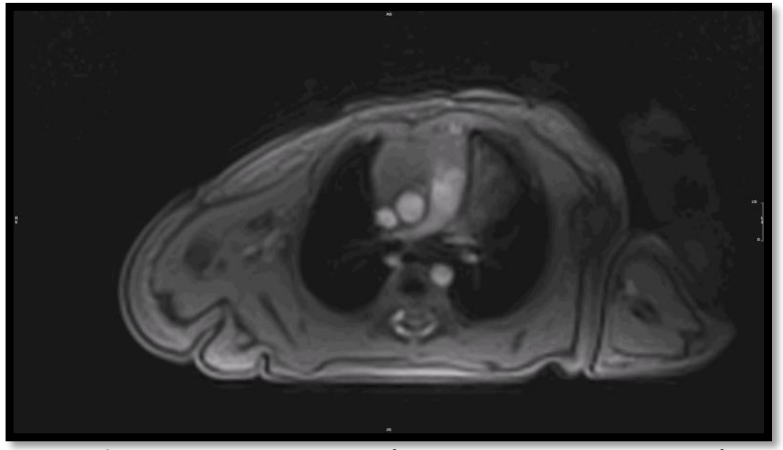
Bassinet, 2/4 babies (50%) Vs Incubator, 6/6 babies (100%)

Vs

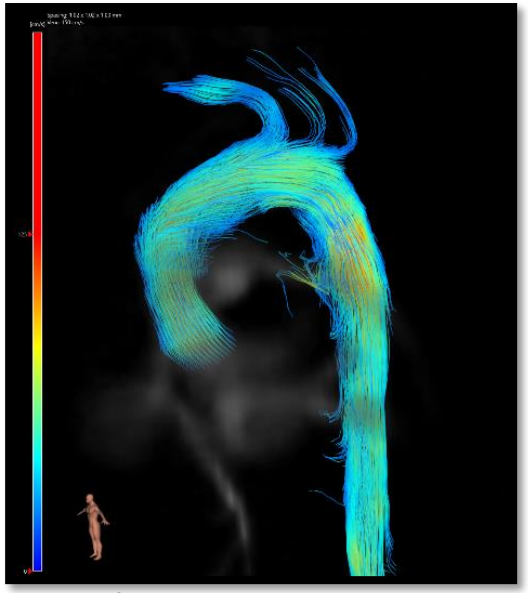
….Achievable…. 3 days of age, 2.7kg, awake, 3Tesla:



4 chamber view cine



2D flow MRI ascending aorta (at branch pulmonary arteries)



4D flow MRI anatomical aortic arch
3D reconstruction

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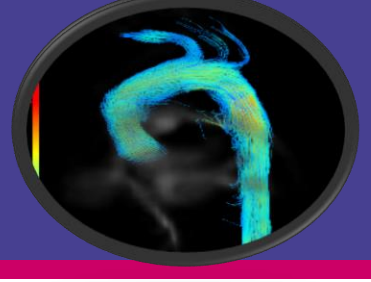
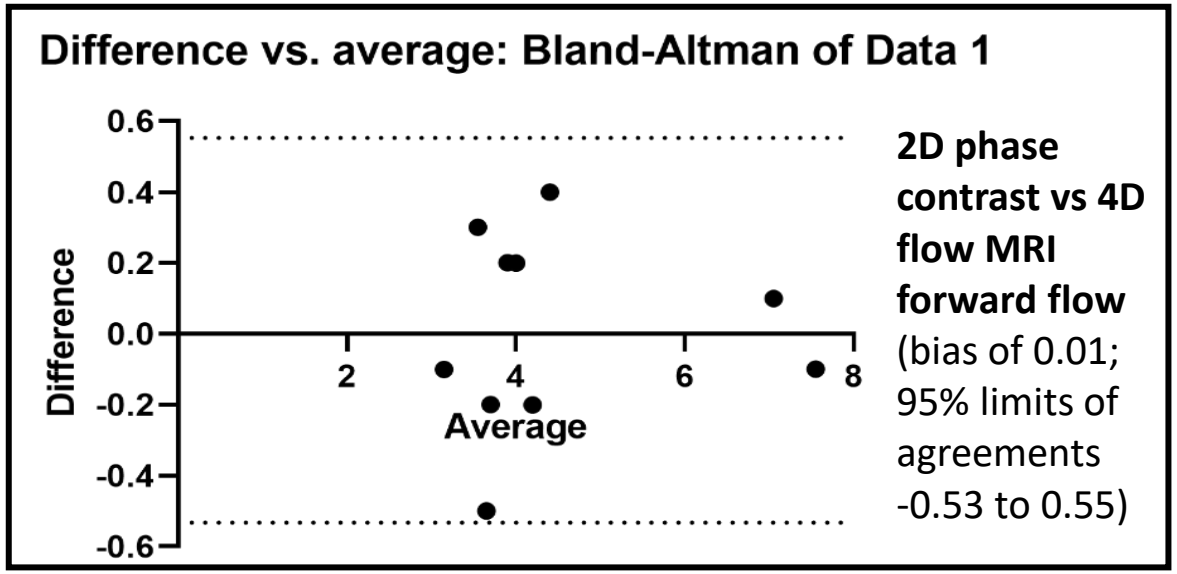
Results

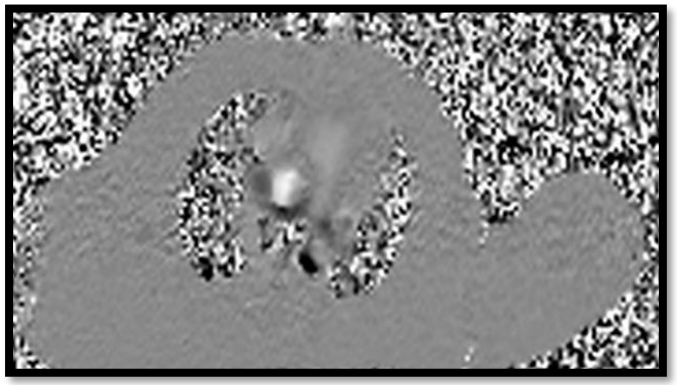


….Comparable….

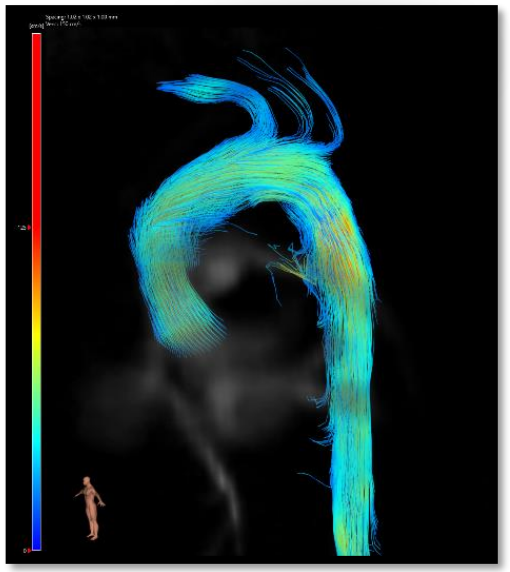
Forward flow in ascending aorta 2D phase Vs 4D flow Mean (SD)	
2D phase (mls)	**4D flow (mls)**
4.6 (±1.5)	4.5 (±1.5)



2D phase contrast vs 4D flow MRI forward flow (bias of 0.01; 95% limits of agreements -0.53 to 0.55)



2D flow MRI ascending aorta ↑



4D flow MRI anatomical aortic arch 3D reconstruction →

….And Reproducible

Ascending aorta 4D forward flow Mean (SD)	
Rater 1 (mls)	**Rater 2 (mls)**
4.5 (±1.5)	4.8 (±1.5)

Intraclass correlation coefficient = 0.98 (95%CI 0.92-0.99)

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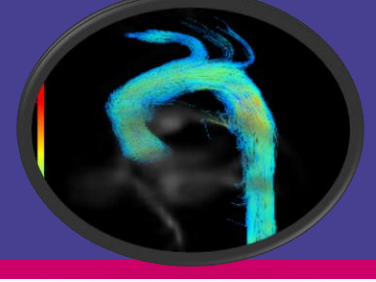
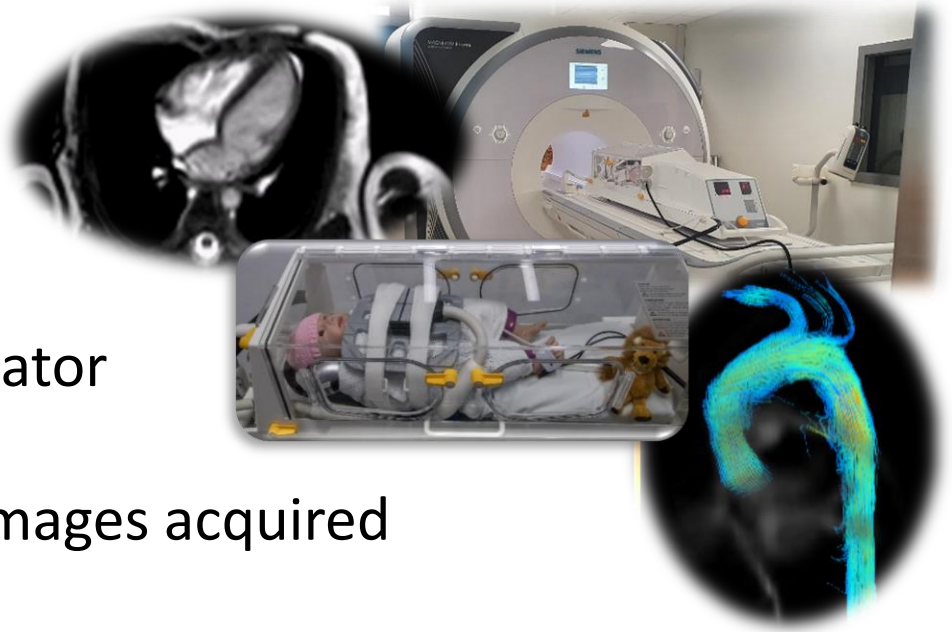
Conclusion





Neonatal feed and wrap cardiac MRI is:

- **Feasible**
  - 100% of babies completing the protocol in the incubator
- **Achievable**
  - Protocol completed in < 25 minutes and necessary images acquired
- **Comparable**
  - 4D flow quantification matches standard validated 2D flow free breathing imaging
- **Reproducible**
  - High levels of agreement between raters

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