

## An MR/CT compatible neonatal incubator

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### INTRODUCTION

Neonatal imaging is of growing importance as the effects of premature birth are becoming better controlled and babies are surviving from earlier gestational ages. Prematurity can often lead to consequences for the CNS and other parts of the body and MR is highly relevant for imaging this population as it is non-invasive and so allows follow up scanning. There have been two main approaches to imaging neonates who require monitoring and preservation of temperature away from the care unit:

- a dedicated MR system on the intensive care unit where care and support can be easily provided.
- a neonatal incubator with full support equipment to transport the baby to a central hospital based MR system.

A number of prototype incubators and a commercial system have previously been reported but all these systems have one or more disadvantages in terms of cost, complexity and patient visibility during imaging. We report here recent progress on developing a simple neonatal transport MR and CT compatible incubator and monitoring system which aims to overcome some of these limitations.

### METHODS

A lightweight neonatal transport incubator routinely used for inter-hospital transfers and emergency service evacuation procedures with full CE marking and with no metallic components (Babypod, UK) was tested for MR compatibility using a 1.5T HDx MR (GE, Milwaukee, USA) and a 3T Achieva MR (Philips, Best, NL) and also on a 64 slice CT system (GE Milwaukee, USA). The pod with transparent cover for high visibility of the neonate in the magnet accepts standard knee sized coils. Temperature is maintained using disposable heat pads which are widely used during transport of neonates and temperature is monitored using an MR compatible 15m fluoroptic probe (PalmSense, CN) accurate to 0.1C and logged to a PC in the control room. The baby can also be monitored visually using a small wireless (2.4GHz) colour 'spy' camera and receiver system digitized onto the control room PC. Vital signs monitoring is provided using an MR compatible Maglife Light system (Schiller, DE).

### RESULTS



Fig. 1

Figure 1 (left) shows the MR and CT compatible incubator. Figure 2 below shows the CT cross section of the pod with the MR phantom in place (left) showing no streaking or flaring artifacts and figure 3 shows an MR spin echo sequence (TR/TE 640/10ms, 1mm in plane, 4mm SLT, NEX=1) acquired from a resolution and slice test phantom at 3T showing no artifacts. The pod is strapped to a standard MR compatible trolley for intra-hospital transfers and is ambulance compatible for inter-hospital transfers. MR-compatible support gas cylinders and pumps can be transported on the trolley when needed. Figure 4 shows an Axial T2 FRFSE sequence acquired at 1.5T from a neonate with 1mm in-plane resolution, 4mm SLT, NEX=1, TR/TE= 3640/85ms. Transport time for the baby from the NICU back to the NICU was less than 1 hour for this study.

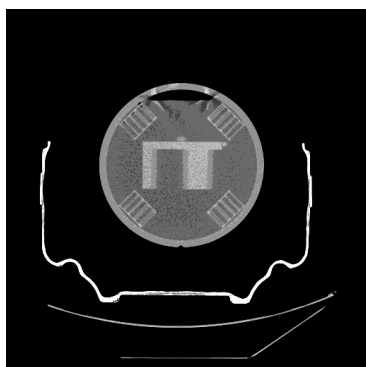


Fig. 2

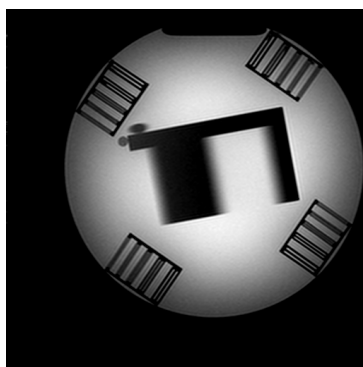


Fig. 3

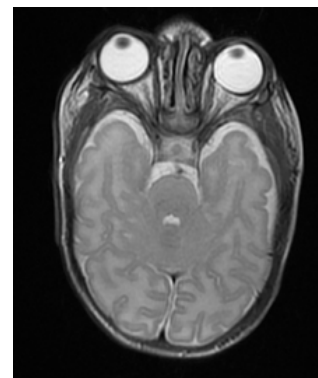


Fig 4.

### DISCUSSION

The pod is compatible with knee sized coils from all the major MR manufacturers providing flexibility and can be used in CT scanners also. It is easily cleanable with removable pads. The incubator provides a simple and cost effective solution for transporting babies from the neonatal unit to a remote MR or CT system, has an MR compatible temperature maintenance and monitoring system, is light enough to be moved onto the MR table by a single operator and produces high quality neonatal MR imaging studies.