

First Experiences with Magnetic Resonance Imaging of Neonates Using a Magnetic-Resonance- Compatible Incubator with a Built-in Coil



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BACKGROUND

Magnetic resonance (MR) imaging of the neonate is a non-invasive, clinically important tool, because for certain pathologies it is clearly superior to ultrasound. However, high resolution ultrasound is nowadays a bed-side technology without burden on the infant, whereas imaging by MR necessitates movement of the neonate from the intensive care unit to the MR-site with the need for controlling body homeostasis.

Lammers Medical Technology has produced a MR-compatible incubator with a built-in head coil, which can also be used as a transport incubator with independent supply and control of temperature, humidity and oxygen.

OBJECTIVE

To evaluate a half a year experience on MR-examinations using a MR-compatible incubator at 1,5 Tesla.

METHODS

The infants were examined inside the incubator at 1,5 Tesla (Philips Intera). An MR-compatible incubator of LMT Lübeck with built-in coil, temperature and humidity control, and an integrated ventilator was used. Sedation was done with chloral hydrate in a dosage of 2 x 25mg/kg. The temperature inside the incubator was maintained according to the needs of the infant on the ward. Humidity was not added so far to the air. Oxygenation was monitored by integrated or external pulseoximetry. Body temperature was measured before and after imaging. Ventilation during imaging was not used until now.

RESULTS

23 newborn infants were examined ranging from 23 to 41 weeks gestational age and birthweight from 730 to 4350 g, at the age of 1 day to 4 months. Details are given in Table 1. All patients were stable in terms of oxygenation, pulse frequency and body temperature. All infants were under sedation and without relevant movement during the examination. One examination had to be terminated because of technical problems of the scan.

Tab. 1: Infants with incubator MR-imaging and their diagnosis

Pat.Nr.	GA	BW	Diagnosis
1	39+0	3720	Encephalocele
2	38+5	3265	Prenatal hydrocephalus
3	34+6	2030	Pierre Robin Sequence
4	23+5	730	GA 23 4/7 wks, IVH 3 left
5	29+4	2145	GA 29 wks, FETS, IVH 1 l/r.
6	31+2	1780	GA 31 wks, Joubert-Syndrom
7	41+3	4350	Multiple, huge cutaneous hemangioma, CNS normal
8	38+4	3300	Agensis of Corpus callosum
9	39+2	3714	Hydrocephalus occlusus (prenatal)
10	39+6	2430	Arthrogryposis multiplex
11	37+3	2620	Pierre Robin Sequenz, fits
12	36+3	2380	GA 36 wks, Microcephalus, Schizencephaly
13	40+3	2430	Agensis of corpus callosum.
14	35+1	1980	Tris 21, GA 35 wks, severe asphyxia, HIE
15	38+3	3070	Severe malformation, retardation
16	38+0	3910	Cleft palate, multiple ass. malf.
17	37+5	2750	Lymphangioma colli
18	38+4	3170	Dandy Walker Variant
19	33+2	1600	GA 33 wks, Asphyxia, PVL
20	31+4	1140	Part. Tris 9, Infarction in Corona Radiata left
21	35+2	2550	Cleft palate, palsy of n. facialis and vagus
22	33+5	1470	GA 33 wks, Agensis of septum pellucidum
23	40+0	3450	Sturge Weber Syndrome, CNS: no hemangioma

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RESULTS



Figure 1:
LMT MR-compatible incubator

The quality of the images is of excellent resolution and distinctively better than previous scans (see fig.2a-f).

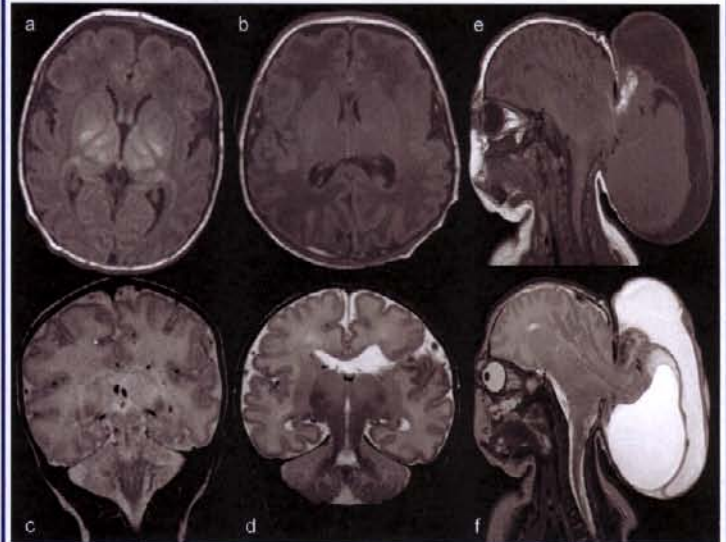


Figure 2: Conventional T1w (a), T2w (c) with a standard circularly polarized head coil, in contrast incubator images T1w (b), T2w (d). In (a) and (c) a case of severe hypoxia with hyperintensities in the basal ganglia on both T1w and T2w is depicted, whereas the incubator images (b) and (d) show a case of closed lip shizencephaly with polymicrogyria. Note the significant better image quality in (b) and (d), due to increased signal to noise ratio (pat. no. 12).

Sagittal T1w (e), T2w (f) incubator images of a big occipital cephalocele. Different cystic, solid and hemorrhagic parts of the cele can clearly be differentiated (pat. no. 1).

Infant handling:

Preparing the infant for the MR imaging is beginning on the ward a sufficient time period before the examination: During the last nursing round before starting clothing with any metal (zip, press button etc.) and also ECG-Electrodes have to be removed, followed by placing a thin gastric tube. About half an hour before leaving last feeding must be finished, 25 mg/kg chloral hydrate is given through the gastric tube, ear-pads are fixed protecting against MR-noise, and the infant is placed in the MR-incubator where he falls asleep. As of now the infant must not be touched any more. Pulse frequency and oxygen saturation is monitored by pulseoximetry. Another 25 mg/kg chloral hydrate is given about 5-10 minutes before imaging. 9 of 23 infants needed additional dosing up to 90 mg/kg if scan time took longer than 40 minutes.

DISCUSSION

An MR-compatible incubator with built-in coil allows imaging of excellent quality better than our techniques used before. The incubator is safe and allows to avoid risks associated with transporting and MR-imaging. In cooperation with LMT former technical solutions could be actually improved concerning especially the algorithm of pulseoximetry (Masimo will be used), the controlling of battery charging and positioning of the head by flexible gap keeping devices.

SUMMARY

An MR-compatible incubator allows safe and excellent MR examinations.