A method for structural MRI scanning of non-sedated infants

Sarah J. Paterson, Nino Badridze, Judy F. Flax, Wen-Ching Liu & April A. Benasich
Infancy Studies Laboratory, Center for Molecular and Behavioral Neuroscience, Rutgers University.

Abstract

Structural MRI scans of healthy infant's brains promise to tell us a great deal about brain development, however it is ethically inappropriate to sedate such infants to prevent movement during scanning. A special infant MRI protocol has been developed in our laboratory that enables healthy infants to be scanned during normal sleep without sedation. These infants are scanned as part of a longitudinal study relating brain structure to various aspects of cognitive development. The protocol takes into account the stringent constraints on scheduling imposed by using a scanner primarily in a doctor's office complex. Scans are conducted after regular patient hours.

The research setting

A clinically active MRI suite in a doctor's office complex. Scans are conducted after regular patient hours.

The scanner: GE 1.5T Echo Speed Scanner.

The headcoil: GE Adult headcoil.

Aims

• To reduce vibration
• To attenuate scanner sound
• To alleviate parent anxiety

I. Prior to the scan

• Parents are given an MRI information sheet
• Parents report on infant’s nap schedule and sleep patterns
• Parents are provided with a CD of the scanner sounds for all sequences and asked to play it while the infant is awake and during sleep for several days before the scan so that the infant becomes desensitized to the sound.

Section I: Communicating with parents prior to the scan and providing them with clear and appropriate information. Parents have many concerns and it is vital to address them fully. We have found that caregiver comfort has a marked effect on the ease with which infants fall asleep.

Section II: Description of our protocol for running the scanning session, including attempts to make the environment as conducive to sleep as possible as well as description of the technical aspects of our sound attenuation system.

Section III: Detailed information is provided about our sound attenuation system, including the construction of our sound attenuating helmet. The system not only reduces noise levels but also considerably reduces the vibration during scanning.

II. Putting the infant to sleep

Environment

• Lights in the reception and scanner room are dimmed
• A rocking chair and crib with no metal parts are provided

Bedtime routine

• Earplugs and helmet are placed on the infant, if baby can feed with them in place
• Parents follow the infants normal bedtime routine.
• Parent (if they wish) and/or researcher place the infant on the scanner bed
• Parents signal researcher when they feel their infant is sleeping soundly

III. Comfort and sound attenuation

Our scanning set-up has three components for sound attenuation as well as comfort.

• Foam mattress
  • 2 inch thick visco-elastic (memory) foam 2.5 b/sq. inch density
  • Molded to infant’s body
  • Open cell - reduces vibration, draws heat from body

• Earplugs and ear muffs
• Sound attenuating helmet

Sound attenuation cap

Cap to reduce vibration and attenuate sound during scanning.

• Ear plug 30dB
• Extra foam in muffs 20dB
• Ear Muffs 20dB
• Foam cap

Masking system

Music is used to mask some of the variations in the scanner noise

• Holes were drilled into the ear muffs and 50mm diameter silicon tubing was inserted into the muff.
• Tubes were attached to an MRI compatible music system in the control room
• Parents bring child’s preferred music with them

Efficacy of sound attenuation

The frequency of sounds emitted during different scanning sequences range from 400-22,000 Hz at levels from 87 to 120dBs

We have been unable to measure cumulative sound reduction in a standardized manner. However, when babies fall asleep they tend to do so for a full sleep cycle and do not seem disturbed by the scanner noise.

Summary

We are using a combination of tools and methods to successfully acquire MRIs from 3, 6 and 12 month old infants. These include:

• Simulation of normal bedtime routine
• Ear plugs and ear muffs to provide attenuation of 30 and 20 dB respectively
• Visco-elastic foam cap to reduce bone conductance and vibration

Scanning non-sedated infants is an ongoing challenge and we continue to refine our methods. We plan to take standardized measures of the cumulative sound attenuation provided by our protocol in the near future.

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