Easy and effective acoustic noise protection in neonatal MRI

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Introduction

The effect of acoustic noise during MRI is unclear and difficult to study in neonatal individuals. Studies have shown that newborns are likely to be more sensitive to acoustic noise than adults [1, 6]. High acoustic noise levels during MRI can lead to anxiety, motion artifacts, and incomplete examinations due to newborns waking up. Since hearing protection is difficult to fit properly on newborns there is also a risk of hearing loss. The acoustic noise is clearly a risk factor in MRI and hearing protection must be used [2, 3, 4, 5]. Usually, three passive attenuators are used: (1) a moldable dental putty, reducing more than 20dB and showing small image artifacts in our tests, (2) Natus minimuffs, reducing 7dB and (3) regular earmuffs, reducing 15-32dB, if fitted properly which is difficult on the small neonate. In addition, we have developed a new simple, safe and reliable method for reducing the acoustic noise.

Methods

An acoustic hood of dampening material was built (figure 1). The acoustic hood is placed inside the MR-scanner tunnel. The acoustic noise was measured inside the MR-scanner tunnel using a microphone unit (type 4189, Brüel & Kjaer, Nærum, Dennmark) and a laptop with a soundcard (VX Pocket v2, Digigram, Montbonnot, France). The DSSF3 software (Yoshimasa Electronic Inc., Tokyo, Japan) and Matlab 7.0 (Mathworks, Novi, Michigan) was used to record and analyze data. The measurement chain was calibrated with the TES-1356 Sound Level Calibrator (ISO-Tech, Taipei, Taiwan). The MR-scanner (Philips Intera 1.5T, Best, Holland) was tested for acoustic noise levels during 12 common pulse sequences. Different combinations of materials were tested and several hoods were built to achieve a substantial dampening effect. The acoustic hoods were constructed of acoustic foam rubber, 38-104mm, combined with a 4mm isolating mat and a closed exit in the back of the MR-scanner.

Figure 1. The acoustic hood reducing noise for a neonatal patient during MRI examination.

Results

Using different acoustic hoods the acoustic noise levels were reduced by 6-24dB on the A-weighted scale (figure 2); a 38mm small flexible hood reducing 6dB and a 104mm hood with isolating mat reducing 24dB. The sound pressure recordings show a substantial dampening effect when using an acoustic hood (figure 3). All hoods left at least 50mm of space outside the Philips SENSE Head coil. Acoustic noise levels during our neonatal MRI studies ranged from 80-112dB (A-weighted); earlier publications report similar acoustic noise levels of 81-117dB [3, 4, 5]. The acoustic hood was used in neonatal MRI without affecting the image quality and it was easily inserted from the back of the MR-scanner without interfering with the examination (figure 1).

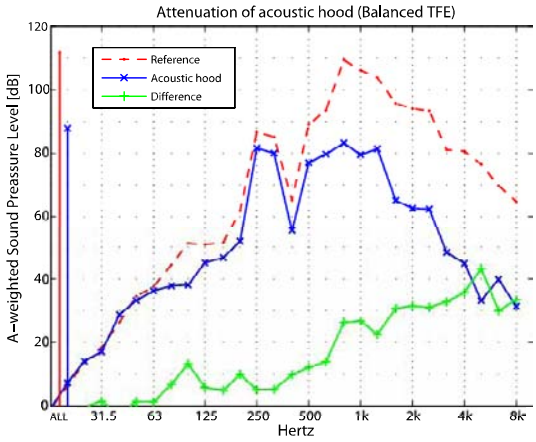

Figure 2. Attenuation during a Balanced TFE pulse sequence with a 100mm acoustic hood.

Discussion/Conclusion

The acoustic hood is a reliable way of attenuating acoustic noise thereby facilitating the neonatal MRI examination. It may also reduce the need for supplemental sedative medications. This simple method can also be used in other sensitive patient groups, e.g. those with anxiety, or for functional MRI experiments with acoustic stimuli.

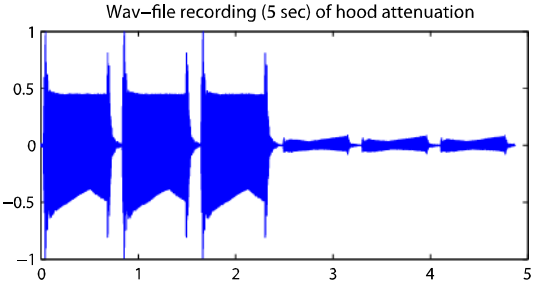

Figure 3. The acoustic noise signal reduction.

References

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