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Editorial for "Auditory effects of acoustic noise from 3-T brain MRI in sedated neonates with hearing protection"

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Performing MRI exams in neonates presents a variety of challenges, amongst them include the potential exposure to high levels of acoustic noise (1). Neonates, with immature anatomic development, are particularly sensitive to acoustic noise and may exhibit undesirable physiological responses indicative of stress when exposed to loud noise levels, including those associated with MRI (1-3). This sensitivity to noise has led to guidelines for neonatal intensive care units that recommend that acoustic noise levels be maintained below 60-dBA (A-weighted scale) for short term exposures (4). An acoustic noise level below 60-dBA is difficult to implement for neonates undergoing MRI, considering that acoustic noise may reach 130-dB or higher in association with certain pulse sequences (5).

The acoustic noise levels adults examined by MRI are recommended to be < 85-dBA by the Medicines and Healthcare Products Regulatory Authority (MHRA), and ≤ 99-dBA by the U.S. Food and Drug Administration and International Electrotechnical Commission (IEC) (6-9). To date, there is no similar regulatory guideline for vulnerable patients, such as neonates.

Passive hearing protection devices (e.g., foam ear plugs and ear muffs) are utilized in patients during MRI to prevent exposure to excessive acoustic noise and are deemed effective for adults because they provide a noise reduction rating (NRR) of 20- to 30-dB (1). Neonatal patients routinely receive double-passive protection, such as foam earplugs, which are typically altered (i.e., cut-down) to ensure a tight fit in the ear canal, and padding placed around their heads. The noise reduction of this form of hearing protection is unknown.

In this issue of JMRI, Yang, et al. (10) provide welcomed data on the impact on MRI-related acoustic noise on neonates that wore "adequate hearing protection". In their investigation, two cohorts of sedated neonates had detailed auditory, functional assessments performed shortly before and after undergoing a 40-minute, brain MRI exam, that delivered sound pressure levels ranging from 103.5- to 113.6-dBA. Notably, sophisticated auditory tests were conducted by the investigators using two complimentary techniques: (1) the automated auditory brainstem (ABR) response to assess function of the auditory nerve, and (2) distortion product optoacoustic emission (DPOAE) to assess cochlear function. Their results showed that there was no significant difference ($p<0.008$) between pre- and post- values for auditory nerve function or cochlear function detected over the hearing range that was evaluated for the neonates (i.e., 1.2- to 7- kHz). Yang, et al. (9) offer an interesting discussion of potential factors contributing to the lack of auditory differences that they assessed. Their findings were somewhat limited by the relatively small sample sizes (i.e., 18 and 19 subjects in each cohort), the lack of longer-term follow-up, and the fact that the data were acquired using a comparatively old, MR system. Modern-day scanners are expected to generate lower levels of acoustic noise (i.e., because of the use of "silent" pulse sequences, more attention to sound isolation, and use of sound-absorbing materials) and, as such, any small comparative differences in exposure to acoustic noise in the present study can be assumed to have been over-estimated.

Considering the relative lack of available data, the findings of Yang, et al. (9) provide critical information for an important patient group, neonates, insofar as sound pressure levels produced by a 3-Tesla MR system appear to be safe for this special patient population, as long as adequate hearing protection is utilized.

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