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Noise exposure in neonatal intensive care unit (NICU) and during neonatal transport: effects and effectiveness of noise protection

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Aim: Noise is a hazard and exposes sick neonates to potential hearing loss, autonomic disturbance and behavioural changes. Safe environmental sound pressure levels (SPL) should not exceed 45 dB (decibel) in neonatal ICUs (NICU). Noise reduction strategies are not routinely used. This study looked at SPLs in NICU and transport situations with mannequins, and the effects of noise levels on real patients during inter-hospital transfer.

Methods: For mannequin studies, a 4-channel sound level meter was connected to 3 microphones, measuring simultaneously continuous SPL in decibels-A (dBA) from the patient ear, inside and outside the incubator and then repeated the measurements with noise protective equipment (standard headphone or active noise cancelling). Similar methods were used for patient studies with additional pulse oximetry recording. Data were analysed using specialist software and SPSS v.24®.

Results: Noise levels represented in (dBA) were described as peak SPL (Lpeak) and total sound energy (Leq). In the NICU mean Lpeak was 59.5 (at ear), 66.7 (incubator) and 73.8 (outside incubator) and the mean Leq was 44.1 (at ear), 52.8 (incubator) and 58.9 (outside incubator). During transport, mean Lpeak was 69.4 (at ear), 76.6 (incubator) and 83.1 (outside incubator) and mean Leq was 53.3 (at ear), 61.4 (incubator) and 66.2 (outside incubator). Mean (SD) environmental SPL (dBA) were 84.4 (6.9%), 76.1(8.6%) in the incubator and 72.2(7.7%) at the infant ear. 80.8% of external noise was transmitted to the infant ear in the NICU simulation, reducing to 78.1% with headphones and 74.8% with ANC protection. In transport, similar reductions were seen: 87.1% of environmental SPL at the ear, reducing to 72.1% with ANC ($p<0.05$) but with an unexpected increase when standard headphones were used. 10% of real patient recording time showed SPL >80, which is considered harmful. There was no clinical significant difference in oxygen saturations with SPL>80. However, heart rate was significantly higher (139 vs. 148, $p<0.001$).

Conclusion: SPLs detected at the neonatal ear in the NICU and during transport exceed recommended safe levels. 10% of SPLs recorded exceed 80dBA and these episodes were associated with a raised heart rate. Active noise cancelling equipment reduces SPL exposure for neonates during transfer. Further study is required.