Influence of postconceptional age on universal newborn hearing screening in NICU-babies

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Abstract

The feasibility of universal newborn hearing screening (UNHS) using automated auditory brainstem response (AABR) devices in the neonatal intensive care unit (NICU) is already well demonstrated. The aim of this study was to find out whether the postconceptional age (PCA) of the babies at the time of the AABR measurement has an influence on the measuring results and to determine the earliest time point for a reliable hearing screening in preterm neonates. Hearing screening measurements of 634 neonates (NICU-Babies) were included. We had complete data for 577 of these babies. The babies were born between 24 and 42 weeks of gestation in the years 2007-2008 and were screened in the Neonatal Unit of the Marburg University hospital. In this group, the hearing screening had been performed at or after 32 weeks of PCA. The AABR measurements showed a specificity of 93.9% (babies tested between 32 and 34 weeks of PCA), 95.8% (tested between 35 and 37 weeks), 95.9% (tested between 38 and 40 weeks of PCA) and 92.1% (tested after 40 weeks of PCA). Hearing screening yields reliable results at 32 weeks PCA. Therefore, an UNHS can be already performed before term without risking a higher rate of false positive results. However, individual factors such as cardiorespiratory and temperature stability of the baby should be considered.

Introduction

The feasibility and reliability of universal newborn hearing screening (UNHS) with automated auditory brainstem response (AABR) devices in preterm and term neonatal intensive care unit (NICU) patients is already well demonstrated,1-11 but there is no information about the postconceptional age (PCA) of the babies at the time of testing. For the last nine years the Department of Phoniatrics and Pedaudiology, Philipps University Marburg has gained experience in the use of AABR machines for the UNHS of newborn infants.12 Since 2004 systematic UNHS has been conducted on risk and high-risk babies at the NICU of the Marburg University Hospital. The aim of this study was to find out whether the PCA of the babies at the time of the AABR measurement has an influence on the specificity of the hearing screening measurements. Particularly the PCA at the point of screening, regarding the specificity is of special interest, because of an early point of detection of hearing losses. This is because if one can screen the babies in a reasonable measurement time and with a high specificity, we don’t come under threat that we lose these babies for the hearing screening. Furthermore one can use the time, when the babies stay calm in their NICU. If any hearing loss has been detected in that early stage, there additionally is an opportunity to do further diagnostics while the babies are still in the hospital, so all diagnostics can be done at this time.

Materials and Methods

Patients

Between January 1, 2007 and December 31, 2008, a total of n=634 infants was admitted to the NICU. Of these, n=57 were excluded because of incomplete data. Thus, n=577 infants with complete data were included into this analysis.

Methods

For the hearing screening we used the AABR device MB 11 with BERaphone® (MAICO-Diagnostics, Berlin, Germany). The screening was done at both ears sequentially to examine for unilateral and bilateral hearing loss. If the first screening was a refer, the babies were screened again at least once more before leaving the hospital. The MB 11 with BERaphone® uses the CE-Chirp-Stimulus at a level of 35 dB (HL). The screening was done on the NICU while the babies were sleeping in their cots. There were two stages of hearing screening. The stage 1 was the first measurement. The stage 2 was done on the same day for example if the baby was not calm enough during the first measurement. That means that if a baby had a refer, it could be measured
once again later on the same day when it sleeps more soundly. Our results show the data of stage 2.

**Statistical analyses**

For statistical analyses we used Microsoft Excel® and descriptive statistics (exploratory data analysis) of SPSS®.

**Results**

**Clinical data**

The babies were born between 24 and 42 weeks of gestation (Figure 1).

**Screening data**

For further analysis, we divided our population into four groups according to the PCA at time of testing: 32-34 weeks (n=49), 35-37 weeks (n=166), 38-40 weeks (n=185) and >40 weeks (n=177) of PCA. The babies were screened within the first up to the 87th week of postnatal age (mean 3.75 weeks, median 2.14 weeks, SD 5.95). In the 32-34 weeks age group 85.7% of the babies were screened within the first 4 weeks after birth; in the 35-37 weeks age group 81.3%, in the 38-40 weeks age group 83.2% and in the >40 weeks age group 60.5%. Figure 2 shows the distribution of the postnatal age (in weeks) at screening for the different age groups.

The results of the AABR-measurement for each age group of PCA are visualized in Figure 3 and the values and specificities are shown in Table 1. We calculated the specificity with the data of the single measurements. For that reason Figure 3 and Table 1 shows the amount of ears and not the amount of babies.

The results of the specificity of the four age groups are not significantly different (Cramer’s V value 0.087; approximate significance level 0.032).

**Discussion**

The purpose of the UNHS is the early identification of hearing impairment and early intervention. Therefore, UNHS should be performed as early as possible, before discharge from the hospital or transfer to another institution. In addition, the parents of a child often would like to know as soon as possible whether a hearing disturbance is present or not.

The characteristics of auditory brainstem response (ABR) in moderately preterm infants and preterm very low birth weight (VLBW) babies and the correlations between the ABR and clinical characteristics are already investigated. There were no correlations between ABR threshold and PCA.

In our study population the earliest time of hearing screening in NICU infants was 32 weeks of PCA. PCA at the time of the AABR meas-

**Table 1. Specificity of the automated auditory brainstem response in the age groups (number of ears).**

| Age groups (PCA in weeks) | 32-34 | 35-37 | 38-40 | >40 |
|---------------------------|-------|-------|-------|-----|
| Total (ears)              | 98    | 332   | 370   | 354 |
| Pass                      | 92    | 318   | 355   | 326 |
| Fail/refer               | 6     | 14    | 15    | 28  |
| Specificity [%]           | 93.9  | 95.8  | 95.9  | 92.1|

PCA, postconceptional age.
urement had no significantly different influence on the result of the measurement. Particularly no higher fail/refer rate could be noted for the exclusion of binaural hearing disorders. Because of the very good specificity in all four groups, UNHS should not be delayed unnecessarily. In addition, mechanical ventilation, sepsis or antibiotic treatment did not have a negative influence on the specificity of the AABR. It should be performed in NICU patients as soon as possible according to the clinical condition of the patient (cardiorespiratory and temperature stability). However further research is needed considering specific situations for the UNHS in the NICU setting. For identification of delayed-onset hearing loss in an infant without known risk factors a close audiological and speech/language follow-up should be part of the developmental screening of NICU patients.17

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