International Journal of Pediatric Otorhinolaryngology 84 (2016) 124–131

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Newborn hearing screening at a community-based obstetric unit: Screening and diagnostic outcomes

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ARTICLE INFO

Article history:
Received 26 December 2015
Received in revised form 24 February 2016
Accepted 26 February 2016
Available online 5 March 2016

Keywords:
Developing countries
Community-based newborn hearing screening
Midwife obstetric units
Distortion product otoacoustic emissions
Automated auditory brainstem response
Dedicated screener

ABSTRACT

Objective: Postnatal visits at community-based midwife obstetric units (MOUs) have been proposed as an alternative primary healthcare screening platform in South Africa. This study evaluated the outcomes of distortion product otoacoustic emissions (DPOAEs) and automated auditory brainstem response (AABR) screening conducted by a dedicated non-professional screener at a community-based MOU in the Western Cape, South Africa.

Methods: Universal newborn hearing screening (UNHS) at a community-based MOU was evaluated over a 16-month period. A dedicated non-professional screener was trained to follow a two-stage screening protocol targeting bilateral hearing loss. A two group comparative design was used alternating AABR (Maico MB11 BERAphone$^{TM)}$ and DPOAE (Bio-logic AuDX I) technology on a daily basis. Infants referring the initial screen received a follow-up appointment in two days' time and were rescreened with the same technology used at their first screen. Those referring the second stage were booked for diagnostic assessments.

Results: 7452 infants were screened including 47.9% (n = 3573) with DPOAE and 52.1% (n = 3879) with AABR technology. Mean age at first stage screen was 6.1 days. The initial bilateral referral rate was significantly lower for AABR (4.6%) compared to DPOAE (7.0%) and dropped to 0.3% and 0.7% respectively following the second stage screenings. First rescreen and initial diagnostic follow-up rates of 90% and 92.3% were obtained for the DPOAE group and 86.6% and 90% for the AABR group. Follow-up rates showed no significant difference between technology groups. Diagnostic assessment revealed a higher prevalence rate for bilateral SNHL among the AABR group (1/1000) compared to the DPOAE group (0.3/1000). Screening technology had no significant influence on daily screening capacity (23 AABR/day; 24 DPOAE/day).

Conclusions: Postnatal visits at community-based MOUs create a useful platform for hearing screening and follow-up. AABR technology with negligible disposable costs provides opportunity for AABR screening to be utilised in community-based programmes. AABR screening offers lower initial referral rates and a higher true positive rate compared to DPOAE.

1. Introduction

Infant hearing loss is the most common congenital sensory birth defect with an estimated prevalence of four to six in every 1000 live births in developing countries [1]. The necessity of early hearing detection and intervention (EHDI) to contest the detrimental consequences, both individual and societal, of permanent congenital or early-onset hearing loss (PCEHL) is widely documented [2–4]. With at least 90% of infants with PCEHL residing in the developing world [5], focus has shifted from validation of EHDI

Abbreviations: UNHS, universal newborn hearing screening; EHDI, early hearing detection and intervention; HPCSA, Health Professions Council of South Africa; DPOAE, distortion product otoacoustic emissions; AABR, automated auditory brainstem response; PCEHL, permanent congenital or early onset hearing loss; MOU, midwife obstetric unit; SNHL, sensorineural hearing loss; HL, hearing loss.

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http://dx.doi.org/10.1016/j.ijporl.2016.02.031
0165-5876/

to the development of contextually feasible models of service delivery [6,7].

Although awareness of the need for EHDI in South Africa has grown, legislation requiring infant hearing screening is still lacking. National surveys in the private and public healthcare sectors of South Africa reveal that approximately 90% of newborns have no prospect for hearing screening [8,9]. In the public health care sector, which services approximately 85% of the population, only 7.5% of hospitals offer some form of infant hearing screening whilst less than 1% offer universal screening [9]. Subsequently, the reported average age at time of diagnosis range from 23 to 44.5 months of age [10–13]. Most infants with hearing loss in South Africa do not receive early auditory stimulation which is the foundation for optimal speech and language development [6,14].

Due to the significant number of births taking place outside of hospitals, immunisation clinics have been recommended as platform for community-based infant hearing screening programmes to supplement hospital-based programmes in developing countries [5,15]. Despite initial reports verifying immunisation clinics as a useful platform for infant hearing screening [5,15], Friderichs et al. [16] reported low coverage rates mainly attributed to the use of already burdened nursing staff as screeners. To date, only one systematic government supported community-based infant hearing screening programme has been reported at immunisation clinics in the Western Cape [16]. Friderichs et al. [16] emphasised the need for dedicated screening personnel and proposed an alternative community-based platform such as midwife obstetric units (MOUs). MOUs are birthing units run by midwives in the community for primary healthcare patients. Although discharge at these units usually happens six hours after birth if both mother and baby are in good health, they return to the MOU for postnatal follow-ups focussing on umbilical cord stump care and feeding advice [17]. A small scale study in Gauteng South Africa verified that MOU postnatal visits (also called three-day assessments) offered a practical and efficient option for hearing screening [7].

A significant challenge in implementing widespread hearing screening programmes in developing countries is the general lack of personnel [5]. The Health Professions Council of South Africa (HPCSA) position statement on EHDI programmes in South Africa (2007) states that nursing staff, community health care workers or lay volunteers can be utilised as screening personnel as long as they have received adequate training. The use of these persons as screeners is cost-effective and releases the audiologist to resume the role of programme coordinator or diagnostic specialist. However, despite these recommendations, infant hearing screening conducted by audiologists is still common practice in South Africa [7]. A few studies have investigated the use of nursing staff as screening personnel [15,16], but there are no published reports on the use of non-professional screeners. A dearth of research also exists describing the capacity of screeners, that is, the number of tests that can be performed per day or per month, for different screening technology. Information on screening capacity is essential for programming planning.

Currently, the only techniques endorsed for infant hearing screening are otoacoustic emissions (OAEs) and automated auditory brainstem responses (AABRs) [4,18]. OAEs measure outer hair cell functioning in the cochlea and are recommended for screening in well-baby nurseries and community-based programmes [18]. OAE measurement utilising rather simple probe placement and automated 'pass/refer' criteria is feasible by non-professional screeners [15,19]. The AABR is a measure of neural synchrony in the eighth cranial nerve and lower brainstem. AABR is the technology of choice in neonatal intensive care units (NICUs). There is a higher prevalence of infants with auditory neuropathy spectrum disorder (ANSD) in the NICU population. ANSD is only detectable with a neural-based screening test such as the AABR [18].

AABR screening can also be conducted by non-professionals [5], but it is an ineffective screening tool for immunisation visits because six week old infants rarely remain in a sleeping state required for successful recordings [15]. Furthermore, AABR screening with most devices is more expensive than OAE screening especially due to increased disposable costs [20]. New generation AABR technology, such as the Maico MB11 BERAphone™, offers several advantages for more widespread application including reduced test-time, ease of use, and negligible disposable costs [21–24].

In designing the current study we posed the following research question: *How do the outcomes of infant hearing screening with DPOAE and AABR using the MB11 BERAphone™ compare when performed by a dedicated screener within a community-based MOU*?

2. Material and methods

2.1. Study design

A two group comparative design was employed to investigate infant hearing screening outcomes at a community-based MOU. A dedicated non-professional screener alternatively performed either AABR or DPOAE hearing screenings on a daily basis. Referral rates, follow-up rates and diagnostic outcomes were investigated for both technologies. The study was approved by the institutional review board of the University of Pretoria and the Western Cape Government: Health (WCGH) prior to the commencement of data collection.

2.2. Research context

A community-based universal newborn hearing screening (UNHS) programme was initiated at three MOUs in the metropolitan area of Cape Town (Western Cape, South Africa) as part of a government supported pilot project. MOUs are birthing units linked to Community Health Centres (CHCs). In addition, the MOUs offer antenatal and postnatal care encompassing all aspects of mother and baby health and well-being [17].

This study was conducted at the largest of the three units based on the number of births (approximately 3000 annual live births) and postnatal follow-up visits. The unit is the only MOU within the Mitchell's Plain health district that covers an area of approximately 5000 ha with a population of 507 237. The socio-economic profile of the health district is characterised by an unemployment rate of 32% and 61% of households having a monthly income of R3 200 (±229 USD) or less [25].

2.3. Study population

Infants that were born either at the MOU, at home or at surrounding hospitals, together with their mothers/caregivers, attend postnatal follow-up visits at their local community-based MOU. They often return every second day until the infant's umbilical cord has fallen off. There were no exclusion criteria in this study as all infants attending the postnatal follow-up visits were offered routine screening as part of the universal screening programme. Informed consent was obtained from each parent/caregiver prior to enrolling the infant into the study. Data collection stretched over 16 months (24 September 2012–31 January 2014).