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Benefits and costs of universal hearing screening programme

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Summary Hearing loss affects 1–3 out of 1000 newborns. A programme of universal newborn hearing screening (UNHS) was implemented in our ENT department in February 2000. In 2001, the programme was extended to all the hospitals of the canton Geneva. The programme is based on the recording of transient evoked otoacoustic emissions (TEOAE) from all newborns. In addition, automated auditory brainstem responses (aABR) are recorded in high-risk neonates. In the report, we compare the mean age at which rehabilitation of hearing was undertaken during a 5-year period before and after the screening programme was instituted. We also identify some causes of delayed diagnosis and intervention and the pitfalls of universal hearing screening. The price of the UNHS programme is estimated at 26 Swiss francs (17 Euros; 21 US dollars) per infant screened, including the material required, the personal involved to run the programme, and the follow-up.

1. Introduction

A hearing screening programme in children started in our department in 1980. It was limited to high-risk newborns as defined by the Joint Committee on Infant Hearing [1] (adapted later on to the Year 2000 Position Statement), using auditory brainstem responses (ABR). In 1999, following the guidelines edited by the Joint Committee on Infant Hearing and also of the European Consensus Development Conference [2], a national universal neonatal hearing screening (UNHS) programme was implemented in Switzerland. It started in our Department on 1 February 2000 in partnership with the Department of Paediatrics and Neonatology. In 2001, it was extended to all the hospitals of the canton Geneva, covering 350,000 inhabitants. During its first 2 years, the screening was based on the recording of the transient evoked otoacoustic emissions (TEOAE) from all the neonates older than 24 h. In addition, since 2002 automated auditory brainstem responses (aABR) have been recorded in high-risk newborns.

The aim of this study is (1) to evaluate the influence of the UNHS programme on the age at

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which the rehabilitation of hearing is started in children with hearing loss; (2) to analyse the causes of delayed diagnosis and/or delayed intervention; (3) to evaluate the costs of the programme.

2. Materials and methods

The age at which the babies, toddlers and children with hearing loss receive a hearing aid or a cochlear implant in two periods of 5 years was compared. The first covered the 1995—1999 period (period 1), and the second the 2000—2004 period (period 2). Children with all types of hearing loss were included (congenital, late-onset, progressive, acquired).

2.1. Period 1

Between 1995 and 1999, the screening was limited to high-risk infants only, based on the ABR recording (Amplaid MK4®, Nicolet CA 2000®, Caldwell 5200®).

2.2. Period 2

Between 2000 and 2004, the screening at birth was systematic and universal. It consisted in measuring the TEOAE with a signal-statistical criterion (EchoScreen® and AccuScreen®). The automated responses were either '*pass*'or '*refer*'. The screening was successful when a '*pass*' response was obtained on one ear. In case of bilateral '*refer*' responses, the test was repeated if possible before discharge of the baby from the maternity or some days or weeks later in the ENT department. If the second test was '*refer*' again, the hearing evaluation was completed with the recordings of distorsion products otoacoustic emission (DPOAE) and aABR. DPOAE were recorded using 'ILO92 Otodynamic®' equipment. The aABR were evoked using alternating polarity clicks stimuli at 40 dB nHL (Bio-logic®), and evaluated with a point optimized variance ratio/signal detection algorithm comparing it with a preset criterion, and that provided a '*pass*'/'*refer*' result [3]. Since 2002, aABR have been systematically recorded in neonates at risk.

When a hearing deficit was detected, the hearing thresholds were established based on ABR and middle latency responses (MLR) recordings, in a sound attenuating booth (Nicolet Spirit®; forehead-ispilateral mastoid derivation; average of 2 or 3× 1000 clicks for ABR, 1000 Hz tone pips for MLR). Finally, behavioural tests were performed.

In both periods, hearing evaluations were repeated later in life when a deficit was suspected by the parents or the paediatricians, and systematically at school at the age of 4.

The evaluation of the costs of the programme was based on the material used, the number of persons involved and the daily time they spent running the UNHS and the follow-up programmes, and on the data provided by the administration of the hospital.

2.3. Statistical analysis

A two-tailed Student's *t*-test of the mean was performed to compare the age at which children of both groups were fitted with a hearing aid or cochlear implant.

3. Results

3.1. Period 1

Between 1995 and 1999, about 1000 high-risk newborns were screened. A hearing deficit was detected in six. In addition, 36 children were referred to the department later in life for different types of hearing loss. A hearing aid was fitted at a mean age of 48.36 months. Only eight infants received amplification before 18 months of age. In 10 children, a hearing deficit was diagnosed at age 6 years at the screening test when they started to attend school (Fig. 1).

3.2. Period 2

Between February 2000 and 2004, 17,535 newborns were screened. The rate of newborns screened increased from 96.7% in 2000 to 99.5% in the subsequent years. At the first TEOAE, 7.51% of infants obtained a '*refer*' response. The rate decreased to 1.51% at the second test. These cases were further

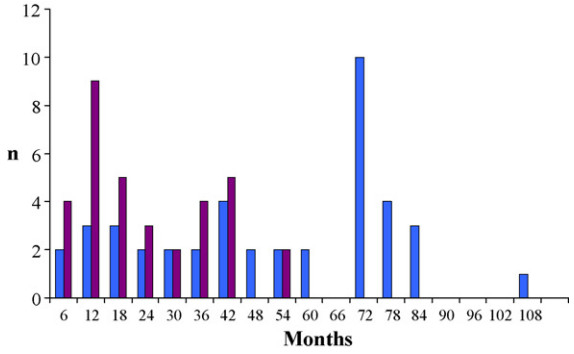

Fig. 1 Age at which a hearing aid could be fitted or a cochlear implantation performed in children with hearing loss. The mean age at which the rehabilitation started was significantly lower in the 2000—2004 period (■: 20.41 months) after the UNHS program started than in the 1995—1999 period (■: 48.36 months; $p < 0.001$).