Geert De Ceulaer
Kristin Daemers
Kristin Van Driessche
Marjan Yperman
Paul J. Govaerts

Neonatal hearing screening with transient evoked otoacoustic emissions – retrospective analysis on performance parameters

University Department of Otolaryngology, St. Augustinus Hospital, Antwerp-Wilrijk, Belgium

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ADDRESS FOR CORRESPONDENCE:
Paul J. Govaerts, University Department of Otolaryngology, St. Augustinus Hospital, Oosterveldlaan 24, BE-2610 Antwerp-Wilrijk, Belgium.
E-mail: govaerts@uia.ua.ac.be

The present paper reports on the implementation of a maternity based neonatal hearing-screening program in a private hospital. A retrospective analysis is performed on the test pass rate, the coverage and the number of children that become lost to follow-up. The data show a steady learning curve with a time course of several years. In the current screening practice, the test pass rate is at 99.0%, the coverage is at 96% (birth rate of 2000 per annum) and almost no babies get lost to follow-up.

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Introduction

A consensus is growing that neonatal hearing screening is important (European Consensus Statement on Neonatal Hearing Screening, 1998). Several programs are being implemented in several developed countries. In many other countries people are still looking for a feasible program that fits the national health care system. The authors believe that it is important that these programs are reported in order to share experiences and to facilitate the organization of new programs.

The goal of a hearing screening program is the early detection and referral of every hearing-impaired child. In order to meet this, a screening program needs to include (1) a high test pass rate; (2) a high coverage; and (3) a stringent follow up management (low number of children that become Lost To Follow-Up, LTFU). This paper reports the evolution of these parameters from the start of the maternity based neonatal hearing screening program in 1993 until the end of April 1999.

Material and methods

From 1993 until April 1999, 5422 neonates were tested by the University ENT department of St Augustinus Hospital by means of registration of non-linear click evoked TEOAEs. The test apparatus used was ILO288 and Echocheck. The test method was adopted from Bray & Kemp (1987). Until the end of 1998 there was no funding for this test, so the parents had to pay the full cost of the test, which was about 40 Euro. Since January 1999, Universal Neonatal Hearing Screening has been implemented in Flanders under the auspices of the Well Baby Clinics. This means that parents no longer have to pay for the test. The initial screening protocol (93_1) included testing in a quiet room at the Audiological Center of the ENT department, as soon as possible after the parents registered for the test, and the use of a qualitative visual scoring criterion. Over the years we have been auditing the performance of the screening program. To improve the performance, several modifications were made to the screening protocol. Currently

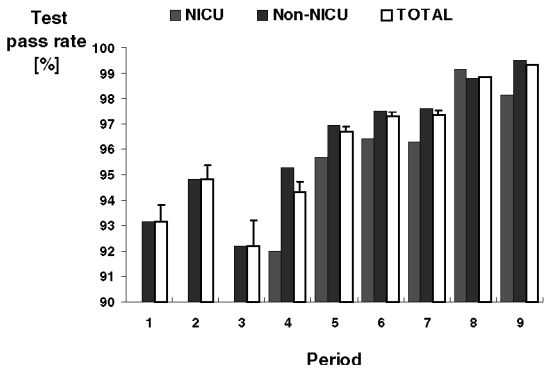

Fig. 1. Evolution of the test pass rate for the non-NICU, the NICU and the total population. A 'pass' means that the screening criterion was met uni-or bilaterally. NICU = Neonatal Intensive Care Unit.

(1999), we do the test on site in the maternity ward (portable OAE-equipment), one day before mother and child leave the hospital (day 3 or 4) and using a numerical scoring criterion (6 dB SNR in three frequency bands). The total evaluation time of 5.3 years was divided into nine discrete periods (93_1 to 99). Each division represents a modification made to the program.

Results and discussion

The analysis will focus on the modifications made to the screening program and their effect on the screening performance in terms of (1) pass rate; (2) coverage and (3) number of children Lost To Follow-Up (LTFU).

Test pass rate

The results of the pass rates are shown in Fig. 1. A pass means that the test criterion was met uni-or bilaterally. To improve this pass rate, the test moment was delayed from as soon as possible after registration (93_1) to testing as late as possible, which is typical at day 4 (93_2). This is probably the main factor in explaining the increase in pass rate from about 93% to almost 95%. Debris and vernix are thought to obliterate the external meatus and middle ear in some cases during the first one to three days of life (Kok et al., 1993; Smurzynski, 1994).

After changing from a visual (93_2) to a more rigid numerical pass criterion (94_1), a decrease of test pass rate was observed. From period 94_1 to 96 the pass rate grew to around 97%, although no relevant changes took place during these periods. The increase is thought to be due to a learning effect of the testers, especially concerning the probe fit. According to Culpepper (1997), the probe fit is the single most important factor in maintaining low referral rates. In 1998 and 1999, another 2% was added to the pass rate, probably because of the availability of portable (ILO288) and handheld (Echocheck) screening devices. This gave the opportunity to do the test on-site in the maternity ward and resulted in fewer awake babies at the time of testing.

Compared with other studies, these pass rate figures (NICU and non-NICU) are very high. A possible explanation for this may be that, in contrast to most other countries, in Belgium neonates typically reside for 5 days in the maternity ward and thus testing can be done as late as day 4 or 5. By this time, transient obliteration of middle ear and external meatus becomes extremely rare. The fact that all testers were dedicated and trained audiologists may be a secondary factor in explaining these high pass figures, together with the fact that unilateral fails are not considered as a 'fail' but as an overall 'pass'.

Coverage

Charging the parents for the cost of the screening and the fact that in 93_1 there was very little general awareness for this kind of testing resulted in a very low initial coverage, of about 20%. A consensus with the NICU to have all their children tested added some 10% to the total coverage (94_2). Giving information sessions to both pediatricians and general practitioners and the growing general awareness of the public for the test and the ease of testing is thought to be responsible for the steady growth of the coverage. In period 98, the coverage was about 56%. Simultaneous actions were undertaken to educate political authorities on the feasibility of neonatal hearing screening. This resulted in the decision of the implementation of universal hearing screening in Flanders. As a part of this, it meant that we no longer had to charge the parents for the cost of the test and thus obtained a coverage of 96%.

Lost to Follow-Up (LTFU)

The number of children that became LTFU after

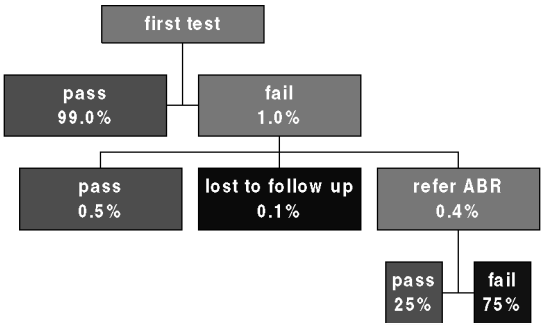

Fig. 2. The two-stage screening program and diagnostic ABR testing. The pass, fail and LTFU rates are shown for the total of all neonates tested in period 98. LTFU = Lost To Follow-up.

failing the first test was, in the beginning, the major problem. One of the children that were LTFU in period 93_2 was later identified as bilaterally deaf. After identification of this problem (93_2), a more strict follow up strategy was installed and this resulted in a drop of LTFU from about 50% in periods 93_1 and 93_2 to about 25% in periods 94_1 and 94_2. Contacting the family doctor or pediatrician to educate the parents further decreased the number of LTFU to 10% in period 98. Since 1999, we can contact the Well Baby Clinics to perform the retest at home if necessary. As a consequence, so far there are no LTFU in period 99.

In Fig. 2 the global evaluation for period 98 is shown for the screening as well as for the outcome. The pass rate of the first test was 99%. This means that out of 1000 tested, only 10 would need a retest (3 weeks later). In this second test, 5 would pass (screen pass rate of 99.5%), 1 would become LTFU and 4 would need further diagnostic ABR testing. Three babies would fail this test (1 with a profound hearing impairment, 1 with a moderate hearing impairment and 1 with a mild hearing impairment). This brings the test pass rate to 99.3% and the screen pass rate to 99.9%.

Conclusions

It is our experience that starting a neonatal hearing screening program requires permanent quality control and daily efforts to improve the outcome. We believe that the results clearly show that the case is worth the investment and that high quality figures can be reached.

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