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Hearing screening tests for newborns – An analytic outlook

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***Abstract*—**A major obstacle for the potential growth, education and development of children across the world is hearing impairment. Surveys reveal that around 0.5 to 5 of every 1000 infants have some kinds of hearing disability. It is a serious issue as it may lead to delayed and insufficient development of speech, language and cognitive skills. An inevitable element of this process is the early detection to provide adequate support for the affected infants and neonates and help them enjoy equal opportunities in the social environment. Latest developments in medical field now make it possible to identify and analyze hearing loss of various types in infants and kids. Bringing this technology to the centre stage the important medical techniques in hearing screening for neonates, newborns to 3 months old infants are otoacoustic emission- OAE and auditory brainstem response- ABR tests. ABR test gained focus when 71% of infants with mild hearing loss failed OAE but passed a test called automated auditory brainstem response- AABR, a newer development in ABR. A general OAE test pass did not give much information but it was an indication that the sensory, middle and outer ear mechanism were all intact since it mainly focused on the free flow and reflection back of specially designed acoustic waves targeted to the cochlea of inner ear. ABR is an electrophysiological response that arises from synchronized activity of the auditory nerve and auditory brainstem. The tests had a broader difference in the results as it was found that external and middle ear conditions did not have much of an effect in the recording of an ABR than the recording of an OAE in neonates. We will look through a comparative study of both tests and have a general outlook on the developments that have been made in this budding technological field.

Keywords— hearing impairment, technological developments, hearing screening tests, otoacoustic emission, auditory brainstem response, comparative study.

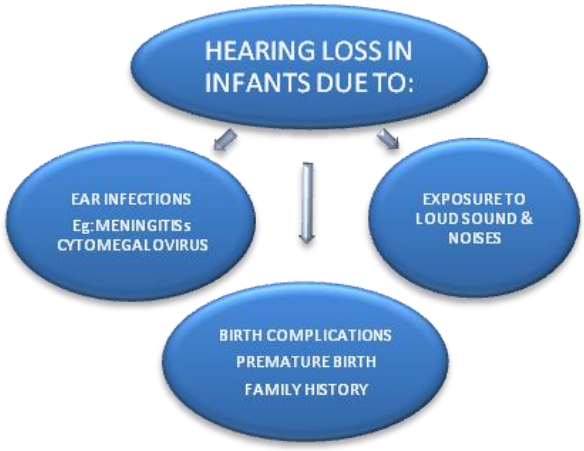
I. INTRODUCTION

An alarming obstacle to the efficient development and education of children across the world is hearing impairment. Studies have shown that around 0.5 to 5 in every 1000 neonates and infants have some kind of hearing disability due to a variety of reasons some known and some unknown. It is not very surprising to know that these kids face delayed progress in language skills and cognitive development. So, consequently it is a major setback for them in the school environment where they become unable to cope up with learning conditions and lag in their abilities. This slow learning is the major cause for their under-developed progress in the learning period.

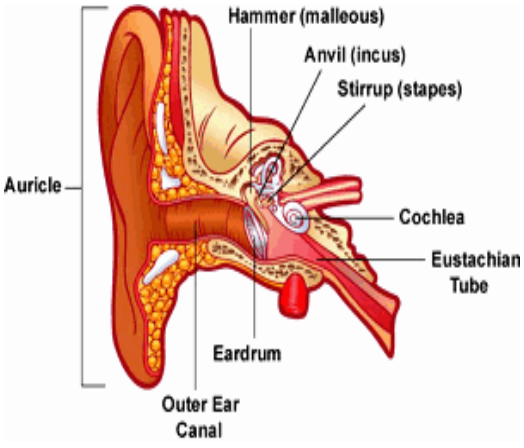
Evidently, they become the target of the dangerous auditory neuropathway problems which have a possibility of occurring at a later stage of congenital or early onset of deafness in childhood. Provision of suitable and effective diagnosis and treatment within the crucial period of central auditory pathway development is always a challenging task. Hence, early detection is always a critically important element in providing suitable support for hearing-impaired babies that can help them in the long run.

II. HEARING LOSS IN INFANTS:

Hearing loss in infants is commonly occurring. There may be a large number of reasons that can lead to hearing loss:



Internal diagram of ear:



Symptoms of a Hearing Loss:

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Continuous care for normal hearing is very important after all infants passing the basic screening tests. There are certain hearing signs a Infant should show in the first year of life:

In 3 Months	•A Baby should Recognize a parent's voice
In 6 Months	•The baby will Usually turn his or her head towards a sound
In 12 Months	•The Child might usually say a few words.

As the baby grows into a child, signs of a hearing loss may become evident as:

- requiring increased TV volume
- difficulty in learning
- fails to respond to people speaking
- regularly inattentive
- limited, poor, or no speech

Need for early detection:

Hearing screening is a major way of diagnosis of most children who are born with a hearing loss. But in a few situations, the hearing loss is caused by infections, trauma, and damaging noise levels. The major drawback is that it doesn't emerge until childhood. So, regular evaluation of kids is very essential. It is ideal to have a hearing screening within the first three weeks of life. It doesn't actually mean there's a hearing loss, if the baby does not pass the test. Because fluid or debris in the ear can disturbs the test. It's important to get another test within three months, if the newborn doesn't pass the initial hearing screening.

Treatment for hearing loss can be the most efficient only if it is started when the child is 6 months old. Hearing screening can be done at different ages even after the child has grown till about adulthood and then whenever it is required.

III. LATEST TECHNOLOGIES:

Recent technological advancements have made it easier to detect hearing loss in infants in the first few days of their birth. Also the simplicity and ease of handling these state-of-the-art instruments has enabled non-medical staff to also perform these tests. Hence, they have proved to be easy and efficient ways of doing the tests without much concern of the medical practitioners & specialists.

A. OTOACOUSTIC EMISSION TEST:

Otoacoustic emission refers to the acoustic energy generated by hair cells of inner cochlea in response to noise passing through the ear canal. The test majorly signifies the stability of the inner ear. Click sounds are generated regularly by placing light weight testing probes in the ear canal. The probe contains microphone that is inbuilt and can detect the acoustic energy generated by the hair cells as a response. Using signal averaging techniques the noises due to breathing and motion artifacts are efficiently reduced. Proper functioning of middle and external ear is very significant to interpret result of OAE tests as cochlear function. The response may not be received accurately if it is diminished by fluid in the middle ear or any external ear canal peculiarities, though the cochlea functions normally and produces OAE. Approximately it takes about 5 minutes to complete the test. In testing scenario, the average time taken must be only 20 minutes. In explaining the test and interpreting result to parents takes the time. From recent days automated OAE systems are used, it just displays the indications on the screen establishing the concern. Transient evoked and distortion product OAEs are the recent developments in OAE tests and are widely used in clinical study. Both methods provide accurate interpretations for specific frequency levels.

Neonatal hearing screening utilizing otoacoustic Emission screener:

Pic courtesy: Australian Prescriber Vol. 26 No. 4 2003

B. AUTOMATED-AUDITORY BRAINSTEM RESPONSE TEST:

Synchronized and patterned activity of the auditory system (nerve and brainstem) produces an accurate electrophysiological response. Small electrical currents are generated on exciting the normal auditory system. This is the major response measured during the process of response measurement in ABR tests.

An essential part of this process is the attachment of small electrodes over the baby's head at certain important points. It is the normal method of measuring the activities at electrode surfaces when sounds are played in the ears. All the responses including the ABR are recorded, amplified and fed to a computer. It is an integral part to average the signals and condition them to remove the electrical brain activity from the comparatively low auditory response signals.

To prove a good hearing level, the responses should be evident even at a low stimulus. Hearing thresholds are found to be elevated in the case of hearing loss. ABR is not much dependent on the middle ear response like the OAE tests. This is a great advantage since the responses are measured over the head surface only and prevents other losses while sound travelling back and fro the middle and external ear. This acts as a fantastic method to measure effectiveness of inner ear and

stability of auditory brainstem response. Earphones and ear canal electrodes may be used to send stimulus while scalp electrodes are placed to detect and measure the response. It is a great improvement to have brought in automated devices which helps even non-staffs to perform tests. Many stimuli are presented and corresponding responses are measured to effectively pass through a response algorithm to give either a 'pass' or a 'fail' result. 35 decibels is set as a minimum 'pass' level. Time is not at all a constraint since it takes only 20 minutes unless the child is restless. It is a exploring method of diagnosis to detect auditory neuropathy which is a rare case in kids that cannot be detected by normal otoacoustic emissions.

Neonatal hearing screening utilizing automated auditory brainstem response screener:

Pic courtesy: Australian Prescriber Vol. 26 No. 4 2003

IV. Conclusion

Thus the various recommendations shows that both screening program is not perfect, the confirmation and detection of rare forms of PHL are not straight forward. But variation in AABR, may improve the appropriateness in identifying cases of mild hearing loss. This provides increased false-positive Rate, then targeting infants with congenital disorder and neonatal onset hearing loss of moderate degree. There are many different factors which help to determine the decision, but examination of middle ear function in addition to sensory & neural integrity will give u more detailed information for detection of hearing loss across childhood.

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