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Otoacoustic emission (OAE) features in newborns at Dr. Kariadi Central Genetal Hospital, Semarang, Indonesia

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ABSTRACT

The joint committee on infant hearing (JCIH) recommends the detection and intervention of hearing impairment in newborns. Dr Kariadi Central General Hospital, Semarang, Indonesia is a referral hospital in Central Java province that has implemented an early detection program for hearing loss in newborns. Screening or early detection using otoacoustic emissions (OAE). This study aimed to find out the description of OAE in newborns at Dr. Kariadi Central General Hospital, Semarang. This research was a descriptive analytic using secondary data the OAE results on newborns with or without risk factors (FR) who are treated at Dr. Kariadi Central General Hospital, Semarang in 2020. The result of OAE pass meant that the outer hair cell (OHC) was functioning properly in both ears while refer was if the OHC in one ear or both was not functioning properly. Total 1338 newborns with and without FR whose OAE pass resulted as much as 1297 (97%) and refer 41 (3%). Most risk factors were low birth weight 331 (42%) with the results of OAE pass 312 (94.3%), and refer 19 (5.7%). In conclusion, this study shows that OAE passed in 97% of newborns.

ABSTRAK

Joint committee on infant hearing (JCIH) merekomendasikan deteksi dan intervensi kurang pendengaran pada bayi baru lahir. RSUP Dr. Kariadi Semarang, Indonesia telah melaksanakan program skrining pendengaran pada semua bayi baru lahir, Skrining atau deteksi dini menggunakan *otoacoustic emissions* (OAE). Tujuan penelitian ini untuk mengetahui gambaran OAE pada bayi baru lahir di RSUP Dr. Kariadi Semarang. Penelitian ini adalah deskriptif analitik yang menggunakan data sekunder berupa hasil OAE pada bayi baru lahir dengan atau tanpa faktor risiko (FR) yang dirawat di RSUP Dr. Kariadi Semarang tahun 2020. Hasil OAE p*ass* artinya *outer hair cell* (OHC) kedua telinga berfungsi dengan baik sedangkan r*efer* apabila OHC pada salah satu telinga atau keduanya tidak berfungsi dengan baik. Bayi baru lahir sebanyak 1338 dengan dan tanpa FR dengan hasil OAE *pass* sebanyak 1297 (97%) dan *refer* 41 (3%). Faktor risiko terbanyak adalah berat badan lahir rendah 331 (42%) dengan hasil OAE *pass* 312 (94,3%), dan *refer* 19 (5,7%). Simpulan, peniltian ini menunjukkan bahwa OAE *pass* pada 97% pada bayi baru lahir.

Keywords:
otoacoustic emissions;
risk factors;
newborns;
outer hair cell;
early detection

INTRODUCTION

Otoacoustic emissions (OAE) which is an objective, non-invasive, and practical examination, efficient for newborn hearing screening program. Otoacoustic emissions with a sensitivity of 100% and a specificity of 82-87%.[1] Dr Kariadi Central General Hospital is a referral hospital in Central Java province that has implemented an early detection program for hearing loss in newborns. The results

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of OAE screening can provide data on the prevalence of hearing loss cases and describe the risk factors contributing to hearing loss.

Hearing impairment in infants and children can be caused by maternal and child factors during prenatal, perinatal and postnatal periods.[2] The most common cause of hearing impairment in newborns is congenital abnormalities, with a prevalence of 4-6 infants out of 1000 live births in developing countries. More than 30% of hearing impairment in the prenatal period is caused by diseases, such as measles, mumps, rubella, meningitis, or ear infections. The use of ototoxic drugs in pregnant women can also contribute to the occurrence of the disease. About 17% of perinatal hearing impairment is caused by complications at birth, including prematurity, low birth weight (LBW), birth asphyxia, and neonatal jaundice. Postnatal hearing loss can be caused by ventilator usage, jaundice or hyperbilirubinemia.[1,3,4]

The Joint Committee on Infant Hearing (JCIH) recommended early hearing detection and intervention (EHDI) for the detection and intervention of hearing impairment with the '1-3-6' guidelines. This guideline suggested that screening should be carried out when at the age of less than 1 mo, diagnosis made at the age of 3 mo, and early intervention carried out at the age of 6 mo.[1] Early detection and intervention of hearing impairment are expected to help overcome hearing impairment. This study aimed to describe the result of OAE screening in newborns at Dr Kariadi Central General Hospital Semarang, Indonesia.

MATERIALS AND METHODS

Subjects

This research was a descriptive analytic study. Data were taken from medical records in the form of patient identity, OAE results, and risk factors (RF). The samples were newborn patients treated at Dr. Kariadi Central General Hospital on January 1 to December 31, 2020.

Protocol of study

Infants were screened for hearing impairment with distortion product otoacoustic emission (DPOAE). Otoacoustic emission results can be either a pass or a refer. Pass means that the outer hair cell (OHC) is functioning properly in both ears. Refer if one ear or both are with the refer result. The RF obtained in this study include LBW, premature, asphyxia, hyperbilirubinemia, infants with HIV/AIDS (BIHA), toxoplasma, rubella, cytomegalovirus and herpes (TORCH). If there were multiple FRs then they were included in the group > 1 FR.

Statistical analysis

We analyzed FR using the Chi-square test with p value <0.05 indicates significant.

RESULTS

A total of 1363 infants were screened with OAE and 1338 infants with a pass result of 1297 (97%), refer 41 (3%) as shown in TABLE 1.

TABLE 1. OAE results

	Infants [n (%)]	Pass [n (%)]	Refer [n (%)]
With risk factors	481 (36%)	471 (36%)	10 (24%)
Without risk factors	857 (64%)	826 (64%)	31 (76%)

Most risk factors found were LBW as much as 331 (42%), premature 314 (40%), asphyxia 74 (94%), hyperbilirubinemia 29 (4%), infants with HIV/AIDS (BIHA) mothers 26 (3%), toxoplasma, rubella, cytomegalovirus and herpes (TORCH) 12 (2%). Infants with one risk factor the result of OAE pass 56 (11%), refer 6 (2%). Meanwhile, infants with risk factors >1 with OAE result 425 (83%) pass and 21 (4%) refer. The number of risk factors was not associated with OAE results p = 0.102 (TABLE 3).

TABLE 2. Risk factors analysis

	Pass [n (%)]	Refer [n (%)]	p	CI 95%
1 Risk factor	56 (11%)	6 (2%)	0.102	0.179-1.191
>1 Risk factors	425 (83%)	21 (4%)		

TABLE 3. Distribution of risk factors in newborns and outcomes of OAE

Risk factors	Total [n (%)]	OAE	
		Pass [n (%)]	Refer [n (%)]
BBLR	331 (42%)	312 (94.3%)	19 (5.7%)
Premature	314 (40%)	301 (95.9%)	13 (4.1%)
Asphyxia	74 (9%)	65 (87.8%)	9 (12.2%)
Hyperbilirubinemia	29 (4%)	28 (96,2%)	1 (3.4%)
Baby with aids mother	26 (3%)	25 (96.2%)	1 (3.8%)
TORCH	12 (2%)	10 (83.3%)	2 (16.7%)

DISCUSSION

Speech and language development in children is closely related to hearing function because the ability to hear has a very important role in speech development. The listening process through sound stimulation will affect brain development. Thus the importance of knowledge about early detection of hearing impairment so that intervention can be obtained as early as possible.5 The JCIH 2019 recommends screening for all newborns. Screening was performed on infants within 72 h of discharge from hospital.1

One of the screening tools is OAE which it is used to assess cochlear function. It is a low tone acoustic response to an external sound stimulus received by the OHC of the cochlea. The cochlea acts as an external sound sensing organ. In the cochlea the sound will be selected based on the frequency so it will be transmitted to the auditory nervous system and brain stem, then sent to the brain. In the brain, sound will be perceived. Damage that occurs in external hair cells, for example due to viral infection, ototoxic drugs, reduced blood flow to the cochlea causes OHC to not produce OAE.[6,7]

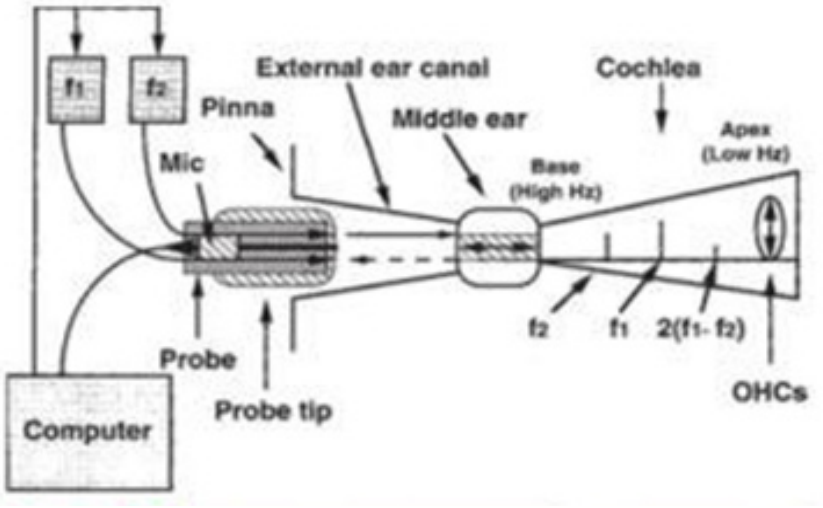

FIGURE 1. OAE mechanism [8]

The method of screening for newborns in Indonesia based on a method developed by the Ministry of Health of the Republic of Indonesia in 2019 (FIGURE 2). Initial screening is carried out with OAE examination after the baby is >24 h old or before being discharged from the hospital. If the first stage of screening results in refer, then at the age of 3 mo should be evaluated with otoscopy, tympanometry, DPOAE, and automated auditory brainstem response (AABR) or brain evoked response auditory (BERA). If the results of the second stage remain the same, a hearing evaluation is carried out with an auditory steady-state response (ASSR).[9,10]

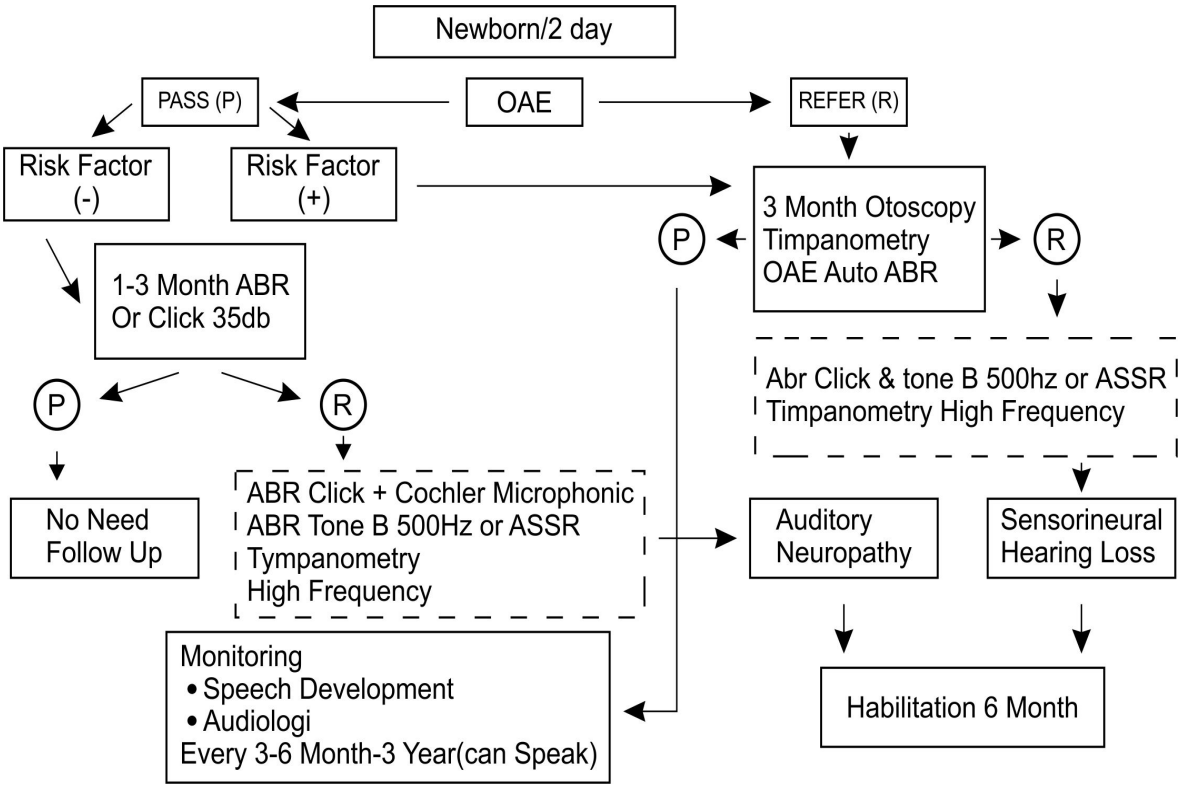

FIGURE 2. Hearing screening in Indonesia [9,10]

The JCIH program (2019) and the Ministry of Health of the Republic of Indonesia (2019) are universal newborn hearing screening (UNHS). Dr. Kariadi Central General Hospital has implemented UNHS where all newborns did the OAE examinations, both babies at risk and without the risk of hearing impairment. Hearing loss in infants and children can be caused by maternal and child factors, it can occur during prenatal, perinatal and postnatal periods. Risk factors for hearing loss in infants aged (0-28 d) are family history of congenital deafness, prenatal infections such as TORCH, anatomical abnormalities of the head and neck, syndrome associated with congenital deafness, LBW (<1500 g), bacterial meningitis, hyperbilirubinemia, severe asphyxia, giving ototoxic drugs, and using a breathing apparatus/mechanical ventilation >5 d in the NICU.5

A total of 1338 infants were examined for OAE in the period January-December 2020, for a total of 41 babies (3%) indicated referral. That could be caused by damage to the OHC or due to technical errors, it could also be due to obstruction in the outer and middle ear. The maximum allowable of fail are 5-10%.11 In this study, 3% of failures were reported, so the results of the OAE that have been carried out show the correct way to use the OAE, and the results of the OAE reference obtained indicate that there is damage to the OHC. The most risk factors found were LBW 331 (42%) then premature 314 (40%). This result is in accordance with previous studies which reported that the most risk factor was LBW 102 (67.7%). Other studies found LBW to be one of the risks of hearing loss in newborn screening.[12]

The results of this study found that there was no relationship between the number of risk factors and OAE results (p = 0.102). The same results were obtained in a previous study which reported that 2,284 infants were not associated with risk factors (p > 0.05).[13,14] Another study linking prematurity, LBW with OAE features in newborns concluded that there was a relationship between LBW and preterm pregnancy with OAE examination results (p = 0.027).[15]

CONCLUSION

Screening for newborns (UNHS) resulted in 1297 passes (97%) and 41 refer (3%). Infants with the most risk factors were LBW 331 (42%) with OAE pass results 312 (94.3%) and refer 19 (5.7%). The number of RF was not associated with OAE results. This study only carried out screening with OAE, did not continue the next screening stage for refer results with otoscopy, tympanometry, OAE, and AABR or BERA and ASSR. Further study can be carried out by screening evaluation with OAE tympanometry and BERA in the next 6 mo and a 2 y cohort study to identify the incidence of hearing loss and speech language.

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