

The Toxoplasma Rubella Cytomegalovirus Herpes (Torch) Infection Risk Factor of Sensorineural Hearing Loss in Children

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Abstract

Objective: Sensorineural hearing loss in children can cause speech language, social communication and developmental delays. Sensorineural hearing loss in children can be caused by congenital and acquired (infectious and non-infectious) factors.: This study aimed to determine the most significant risk factors for the sensorineural hearing loss in children. **Methods:** This study used a case-control design. Study samples were patients at Dr. Sardjito General Hospital Yogyakarta between January 2014 until April 2015. Inclusion criteria for the case group were sensorineural hearing loss (SNHL), and aged 0-5 years, while the control group was normal hearing children. Exclusion criterion for both groups was incomplete data. Diagnostic criteria were based on Oto-Acoustic Emission (OAE) and Brainstem Evoke Response Audiometry (BERA) results. There were 31 samples in the case group and 31 samples in the control group. **Results:** Bivariate statistical analysis showed that the TORCH (*Toxoplasma Rubella Cytomegalovirus Herpes*) variable was a significant risk factor for SNHL (OR 11.94; 95% CI: 2.41-59.02), while hyperbilirubinemia (OR: 0.75; 95% CI: 0.26-2.14), low birth weight (OR: 2.36; 95% CI: 0.81-6.91), neonatal asphyxia (OR: 2.28; 95% CI: 0.94-8.47), and prematurity (OR: 1.70; 95% CI: 0.52-5.55) were not significant risk factors. Bivariate statistical analysis showed that the TORCH (*Toxoplasma Rubella Cytomegalovirus Herpes*) variable was a significant risk factor for SNHL (OR 11.94; 95% CI: 2.41-59.02). Based on multivariate analysis we found TORCH infection was a significant risk factor for the incidence of SNHL in children (OR 15.63; 95% CI: 2.84-85.95). **Conclusions:** Based on the results of this study, TORCH infection is a statistically significant risk factor for the incidence of sensorineural hearing loss in children. Early screening for at-risk children is highly recommended.

Keywords

Infection risk factor, Children, Sensorineural hearing loss, TORCH, Viral infection.

Introduction

Hearing, one of the main senses, has a very important role in the development of speech as the primary component of social communication. Prevalence of hearing disorders are reported to be more than 350 million people in the world. The WHO in 2005 reported there were 278 million people who suffered from hearing loss, and 75-140 million of which are found in Southeast Asia. A WHO multi-center study in 1998 reported that Indonesia was one of 4 (four) countries in Southeast Asia that have a high incidence of deafness (4.6%), with the other 3 being Sri Lanka (8.8%), Myanmar (8.4%) and India (6.3%) (WHO, 2006) [1].

Congenital deafness (CD) is a serious health problem. Several studies reported that CD occurred in 1:1000 newborns [2]. The prevalence of CD in America is 1:1000 or about 0.1%. Prevalence of the hearing impaired neonate in varying degrees is 3:1000 and the prevalence of infants with risk factors for impaired hearing reaches 6:1000 [3]. Children diagnosed with hearing disorders do not have the ability to hear sound on the spectrum 250 Hz - 4 KHz. This hearing loss causes delay speech and language development [3,4,5]. Based on the cause, deafness in children is divided into syndromic (10-15%) and non-syndromic cases (60%) [4].

The global prevalence of severe sensorineural hearing loss (SNHL) in children is around 1:2000 in newborns and 6:1000 age < 18 years. Although this number indicates the occurrence of SNHL, this is still not completely representative due to challenges in diagnosing it. For example, unilateral heavy hearing loss and very heavy hearing loss are sometimes not recognized until the time when school children enter into their kindergarten. Then the child is diagnosed after undergoing audiometric examination. The examination of children with high risk factors is designed to help determine impairment through early hearing screening. Since many countries do not have legislation concerning screening of children and tend to ignore the risk factors, many children are not early

detected[6].

The risk factors for SNHL in the neonatal period as determined by the Joint Committee on Infant Hearing (JCIH) are non-infectious factors: born premature (age of pregnancy < 34 weeks); low birth weight (LBW, body weight < 1500 gm); and infectious factors: *Toxoplasmosis, Rubella and Cytomegalovirus and Herpes* (TORCH). The presence of auditory nerve damage, such as hyperbilirubinemia syndrome is associated with hearing impairment and severe asphyxia at birth (APGAR < 7 at 5 minutes) [7]. Other risk factors are the use of drugs during pregnancy, high lung pressure, sedentary lifestyle, intra-ventricular hemorrhage, and high C-reactive protein (CRP) (≥ 10 mg/dl) [8,9,10]. The aim of this research was to determine the significant risk factors of sensorineural hearing loss in children.

Material and Methods

This research used an analytic case-control design. The study was conducted at the Perinatology and ENT Department, Dr. Sardjito General Hospital, Yogyakarta between January 2014 until April 2015. The study started after approved by Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Universitas-GadjahMada. All subjects signed an informed consent for participated in this study. The study started by identifying sensorineural hearing loss (SNHL) patients as the case group, and children with normal hearing acuity as the control group, and then detecting the infectious and non-infectious risk factors in both groups.

The inclusion criterion for case and control groups were: 1) child patients less than 5 years old, 2) OAE and BERA examinations (cases: sensorineural hearing loss and control: normal hearing) [11], and 3) risk factor examination data (TORCH infection, hyperbilirubin, LBW, premature birth, asphyxia). Exclusion criteria for both groups were incomplete data.

Based on α : 5%, β : 20%, power: 80%; proportion of patients with risk factors for congenital SNHL examination was 70%, and estimation of the proportion of normal pa-

tients with hearing risk factors at 35%, and Odds Ratio (OR) 2:1, minimum samples required for each group ($n_1 = n_2$) were 31 subjects.

The statistical analysis

The statistical analyses used: X^2 test, OR, and multivariate analysis.

Results

The subjects of this study were 62 samples consisting of 31 samples of children with sensorineural hearing loss (SNHL) as the case group and 31 samples of children with normal hearing as the control group. Distribution samples based on each variable are shown in **Table 1**.

Table 1. Distribution samples based on each variable in both groups.

	SNHL (n = 31)	Normal (n= 31)	<i>p</i>	OR (95% CI)
Sex:				
Male	14	20	0.126	
Female	20	11		
Mean age (month)	16.13 ±9.73	21.94 ±14.59	0.070	
TORCH	14	2	0.001	11.94
Normal	17	29		(2.41-59.02)
Hyperbilirubinemia	10	12	0.596	0.596
Normobilirubinemia	21	19		(0.23-2.43)
LBW (low birth weight)	14	8	0.61	2.37
Normal birth weight	17	23		(0.72-7.98)
Neonatal Asphyxia	14	7	0.07	2.82
Normal	17	24		(0.83-9.87)
Premature	9	6	0.374	1.7
Normal	22	25		(0.45-6.53)

Based on bivariate statistical analysis, this study found a significant risk factor contributing to sensorineural hearing loss: TORCH, then all risk factors were analyzed by multivariate analysis (**Table 2**).

Based on TORCH infection examination results, out of 31 case samples of children with sensorineural hearing loss (SNHL), 14 samples were detected positive TORCH infection and 17 samples were without any TORCH infections. In the control group there were 2 samples detected positive TORCH and 29 were undetectable for

TORCH (**Table 2**). This difference was statistically significant OR: 15.63; 95% CI: 2.84-85.95).

The blood bilirubin level examination results were obtained for all 31 samples of the case group, showing 10 samples with hyperbilirubinemia and 21 samples with normal bilirubin level. In the control group of 31 children, 12 samples were found with hyperbilirubinemia and 19 samples had normal bilirubin level (**Table 2**). This difference was not statistically significance (p : 0.947; OR: 1.044; 95% CI: 0.29-3.66).

Table 2. Multivariate analysis all variables to SNHL.

Variable	p	OR	95% CI
TORCH	0.002	15.63	2.84-85.95
Hyperbilirubinemia	0.947	1.044	0.29-3.66
LBW (low birth weight)	0.364	2.05	0.43-9.68
Asphyxia neonatorum	0.059	3.40	0.95-12.11
Premature birth	0.848	1.18	0.21-6.62

In the case group, 14 samples were detected with low birth weight (LBW), and 17 samples normal birth weight, while in the control group there were 8 samples with LBW, and 23 samples of normal birth weight (**Table 2**). This difference was not statistically significant (p : 0.364; OR: 2.05; 95% CI: 0.43-9.68).

Asphyxia neonatorum was detected in 14 samples of the case group, and 17 normal samples. In the control group there were 7 samples detected with asphyxia neonatorum and 24 normal (**Table 2**). This difference was not significant statistically (p : 0.059; OR: 3.40; 95% CI: 0.95-12.11). There were 9 premature birth samples in the case group and 22 normal births. In the group control there were 6 premature birth samples and 25 normal (Table 2). This difference was not statistically significant (p : 0.848; OR: 1.18; 95% CI: 0.21-6.62).

Multivariate analysis results showed that only the TORCH infection was a statistically significant risk factor contributing to sensorineural hearing loss (p : 0.002; OR: 15.63; 95% CI: 2.84-85.95). All non-infection variables were shown to not be significant risk factors for sensorineural hearing loss.

Discussion

From the results of this study we found that children with TORCH infection risk factors were more susceptible to impaired cochlear function and auditory nerve damage up to about 15.63 times compared to children without TORCH risk factors. This finding is similar with the research undertaken by Chalkiadakis *et al.* that reported TORCH infection was found to be a significant contributor in causing hearing loss [12].

This conclusion can be explained by the discovery of the abnormal histopathological changes in striaevascularis, membrane Reissner, limbus spiralis and other balance organ [13]. TORCH disease as an intrauterine infection can cause congenital malformations of the central nervous system, resulting in neurological abnormalities, visual impairment and deafness, in addition to other malformations, such as congenital heart disease [14].

TORCH investigations in children with profound SNHL, aged older than 1 year, are considered to be not useful in the management of patients and expensive. The current review indicates the importance of establishing an early diagnosis with an automated otoacoustic emissions (AOAE) program and also by auditory brainstem response (ABR) in order to provide early intervention and management [15].

In this research we also found some risk factors that are not statistically significant as risk factors: hyperbilirubinemia, LBW (low birth weight), asphyxia neonatorum, and prematurity. Accordingly, in order to handle the significant risk factor of TORCH optimally an early screening program needs to be conducted. Every child detected with risk factors especially TORCH needs to undergo a thorough evaluation of hearing which includes cochlear evaluation, auditory nerve, and when possible, examination of auditory center function in the brain, as well as consultation and cooperation with other departments related to suspected abnormalities.

The limitation of this study, did not analyzed predominant infection type of TORCH which contributed to SNHL in children. Up to now in DR Sardjito General Hospital, this examination is not yet as a routine clinical

examination procedure beside of relative expensive enough to examine each infection type.

Conclusions and suggestions

The risk of pediatric sensorineural hearing loss due to TORCH infection is considerably higher than children without TORCH infection. Additional study concerning the type of TORCH infection is needed for determining predominant infection type as a risk factor of sensory-neural hearing loss in children.

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Disclosure of conflict of interest

None.

Key message

Hearing, as one of the main senses, has a very important role in the development of speech as the primary component of social communication. Children with hearing disorders do not have the ability to hear sound on the spectrum 250 Hz - 4 KHz. This hearing loss causes delayed speech and language development. TORCH infection was found to be a significant risk factor contributing to sensorineural hearing loss in children. Every child detected by risk factors especially TORCH needs to undergo a thorough evaluation of hearing to ensure early intervention and remediation.

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