Acoustically Evoked Short Latency Negative Response (ASNR) in Children with Hearing Loss

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Inner ear composes of two main parts:

- Cochlea and vestibule.
- Vestibular function is controlled by semicircular canals and otoliths (utricle and saccule).

- The caloric and the rotatory chair tests assess semicircular canals and superior vestibular nerve function (Sazgar et al., 2005).

- A small external ear canal in infants and children can reduce the intensity of the caloric stimulus. Consequently, a reduced response may result from inadequate irrigation, rather than vestibular hypofunction (Fife et al., 2000).

- VEMP is a short-latency response evoked by high-level acoustic stimuli recorded from surface electrodes over the tonically contracted sternocleidomastoid (SCM) muscle. It is a clinical test of the saccule and inferior vestibular nerve function (Colebatch, 2001).

- VEMP is dependent on normal vestibular function. However, it is independent on cochlear function as it is preserved in patients with severe-to-profound sensorineural hearing loss (Basta et al., 2005).

- ✓VEMP response is affected by many factors including the patient‘s age. It may vary among infants due to lack of cooperation with the task required for optimization of results.

(Zagolski and Jurkiewicz,2006)

- The auditory brain-stem responses (ABR) have been widely used as a clinical test of the auditory pathway.

- Apart from the positive waves (I-V), Nong et al.,(2000) reported a peculiar V-shaped acoustically evoked short latency negative response (ASNR), at approximately 3 to 4 milliseconds.

- Considering the short latency of 3 to 4 milliseconds, Nong et al.,(2002) speculated that ASNR is virtually one type of vestibular evoked potentials from the second order neurons at the lower part of the brainstem.

- It has been shown that among the vestibular organs, only the otolith organs, especially the saccule, respond to sound stimulation, whereas the semicircular canals do not. On the basis of this theory, ASNR is thought to be of saccular origin.

(Nong, et al.,2000 and Nong et al., 2002)

- ASNR is present only in ears with profound hearing loss which is free from the superimposition of ABR waves (Dong et al., 2002).

- ASNR waveform obviously differs from ABR. ASNR was not interpreted as a potential generated from the conventional auditory pathway. However, ASNR morphologically resemble vestibular evoked potentials (VsEP) (Hausler,et al.,1992).

- Audiological evaluation of infants and children does not include vestibular tests as they are particularly difficult to be performed in this age group and their results might not be reliable.

- Only some of the vestibular tests performed in adults can be applied in infants and children (Zagolski,2007).

Aims of the work:

- To assess the presence of ASNR in children with severe and profound SNHL.

- To investigate the relationship between ASNR and VEMP in children with severe and profound SNHL.

Subjects and Method:

23 children with age range from 4.0 to 14.0 years with bilateral severe to profound SNHL.

All subjects were submitted to:

1- Full audiological history and otological examination.

2- Basic audiological evaluation.

3- ABR.

4- VEMP.

5- Caloric test.

According to Murofushi et al.,(2005) ASNR was regarded as a response when the following conditions were fulfilled:

- Negative repeatable peak appears 3–5 msec after the onset of the stimulation.
- The onset to peak amplitude should be more than 0.05 μV.
- If there are two or more peaks, the largest peak is considered as ASNR.

Results& Discussion

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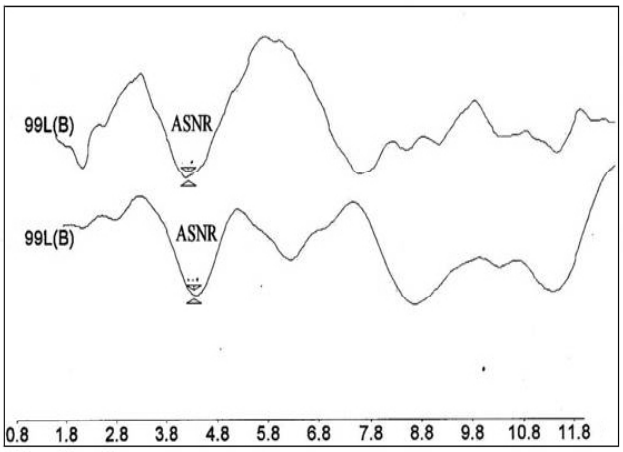
Demographic Data of the patients

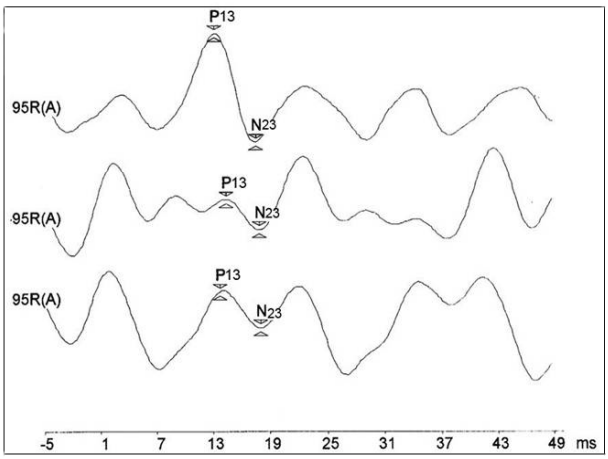
Age (Years)	PTA (dBHL)	ASNR N=14/46	Non-ASNR N=32/46
7.19(3.9)	89.1(6.7)	30.43%	69.57%

- **ASNR** with medium latency 3.54 ms and amplitude 0.095µV was elicited from 14 ears (30.43%) with severe to profound sensorineural hearing loss. This result agreed with Dong et al., (2002).

ASNR Response



VEMP Response



Comparison of VEMP findings in the two groups

	P13		N23	
	Latency msec	Amplitude µv	Latency msec	Amplitude µv
ASNR (100%)	12.23 (1.43)	1.43 (0.9)	20.94 (2.3)	1.71 (1.2)
Non-ASNR (53.12%)	12.86 (1.4)	1.15 (0.6)	22.03 (2.2)	1.03 (0.4)
T-Value	0.83	1.01	1.34	-2.19
P-Value	0.41	0.32	0.19	0.04*

- VEMP was evoked to all the ASNR ears. This agreed with Zagolski,(2007).

- For the ears with profound hearing loss and absence of ASNR, about 46.8% were considered to have saccular afunction because of absence of VEMP. This result agreed with Nong et al., (2002).

Relationship between presence and absence of ASNR and VEMP in the studied groups

VEMP N=31	ASNR N=14	Non-ASNR N=32	Fisher's Exact Test
Absent	0(0%)	15 (46.88%)	0.001*
Present	14(100%)	17(53.12%)	

- In this study, VEMP was evoked by sound stimulation in 31 ears with severe and profound SNHL (67.39%) implying normal saccular function. These results agreed with Ochi and Ohashi, (2001).

- A significant relationship was found between the presence of ASNR and VEMP. This agreed with (Zagolski,2007).

- The ASNR individuals are of good vestibular function in contrast to their poor hearing. This suggests the relation between the ASNR and the vestibular system. This agreed with Ochi and Ohashi,2000).

Correlation between Latency and Amplitude of ASNR and VEMP

VEMP		ASNR			
		Latency		Amplitude	
		r-Value	P-Value	r-Value	P-Value
P13	Latency	0.56*	0.04		
	Amplitude			-0.018	0.95
N23	Latency	0.69**	0.009		
	Amplitude			-0.10	0.73

- No spontaneous symptoms of vestibular dysfunction, like nystagmus, were found in the examined children. Normal reaction to caloric stimulation was obtained bilaterally in 38/46 ears (82.6%).

Caloric hypofunction was present in 8/46 ears (17.4%):

- ✓ One ear showed both ASNR and VEMP.
- ✓ Another ear showed only VEMP.
- ✓ The other six ears showed neither ASNR nor VEMP.

- The results disagreed with Angeli (2003), who reported that the frequency of semicircular canal disorders in infants is estimated about 20–70%, and is higher in profound sensorineural hearing loss individuals.

Conclusions:

- ✓ **ASNR** was recorded by sound stimulation from ears with severe and profound SNHL.
- ✓ **ASNR** could be of vestibular origin, especially of saccular origin.
- ✓ Presence of **ASNR** is dependent not on residual hearing but on normal saccular function. Furthermore, ASNR and VEMP were elicited from an ear diagnosed with semicircular canal hypofunction.

- ✓ The methodology of eliciting **ASNR** in early childhood is much simpler than VEMP. Therefore, recording ASNR could be an easy way to assess saccular function in infants and children.

- ✓ **ASNR** may be measured from subjects who cannot contract neck muscles due to their ages, mental states, or consciousness disorders.

- ✓ In combination with VEMP, **ASNR** may be useful for the detection of lesion sites.

Recommendation

- ASNR has been recorded only in patients with peripheral profound SNHL. If we can record ASNR potentials in subjects with preserved hearing, recording ASNR potentials might be a new clinical test of the vestibular system.

Thank You

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