

## UNILATERAL SENSORINEURAL DEAFNESS IN SCHOOL CHILDREN; A CLINICAL AND AUDIOLOGICAL EVALUATION AT A TERTIARY HOSPITAL OF TELANGANA

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### ABSTRACT

#### INTRODUCTION

Interpersonal communication, day to day activities, learning language and acquiring grades in the school are important parts in the life of school going children. Unilateral or bilateral Loss of hearing affects education and the child feels handicapped socially, emotionally, and scholastically. Such children lose grades and retained in the same class affecting them emotionally. The present study was conducted in order to find out the various causes of unilateral Sensorineural Hearing Loss (USNHL) in children and to study role of various audiological findings in diagnosing the cause of impaired hearing in children.

#### AIMS AND OBJECTIVES

To find out the possible etiological causes and study the role of various audiological tests in finding the causes of unilateral impaired hearing in children.

#### MATERIALS AND METHODS

A prospective study was conducted in the Department of ENT of a tertiary Hospital attached to a Medical College in Warangal, Telangana. A total of 346 children aged between 4 and 15 years attended presenting with complaints of impaired hearing. Among them 73 children with unilateral sensorineural deafness were included in the study. After a thorough ENT examination subjective tests like pure tone audiometry and behavioral observation audiometry and objective tests like impedance audiometry, Oto-acoustic emissions (OAE), and brainstem evoked response audiometry (BERA) were performed.

#### RESULTS

While identifying the possible etiological cause of USNHL, OAE revealed 56.16% REFER and 43.83% PASS results. Impedance audiometric results showed 71.22% as Type A Tympanogram. Pure tone audiometric results were mostly showed severe and profound hearing losses together accounting to 87.66%. BERA findings were mostly on severe and profound hearing loss (90.40%). No children with syndromic or cranio-facial abnormalities were found.

#### CONCLUSIONS

A prospective Hospital based study of school children with USNHL showed acquired nature of the condition with moderate to severe hearing loss. No accompanying syndromic or cephalo-facial anomalies were noted as the cause of USNHL.

#### KEYWORDS

Audiology, Children, Hearing impaired, PTA, Impedance, OAE, BERA and Speech.

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**INTRODUCTION:** The incidence / prevalence of hearing loss in school-age population is about 11.3%.<sup>1</sup> In 1991 National Sample Survey Organization (NSSO) reported 2.7% of children having HL in rural and 3.0% in urban areas and speech disability in 8.9% and 8.3% for rural and urban respectively.<sup>2</sup> Among the childhood disabilities Sensorineural hearing Loss (SNHL) is one of the leading causes, accounting to 6 per 1000 children aged below 18 years and remains a common referral to ENT surgeons.<sup>3</sup> Bilateral hearing loss is

detected earlier than the unilateral hearing loss and the latter is traditionally not appreciated in children. The effect of SNHL in children on the pathophysiologic mechanisms of speech development is now being stressed by both the medical and educational professional.<sup>4</sup> Hearing loss as low as 15 dB can cause impaired speech development, reduced school performance and consequently impairment in mental growth.<sup>5,6,7</sup> Another important aspect of SNHL is unilateral involvement (UHL) and it is detected usually later because one of the other ears is healthy. The impact of unilateral Hearing Loss (UHL) on academic performance of the child was found to be in 30% of children and such children lag 1 to 2 years behind their normal colleagues.<sup>8</sup> Six functional areas like mental maturity, perception. Speech and speaking, cognition and general intelligence, academic achievement and interpersonal behaviours are affected as

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complication of SNHL.<sup>9</sup> Keeping all these unpredictable factors in mind the ENT surgeons should always assess at the first instance when a child is reported to them about loss of hearing. Lack of knowledge, availability of resources and non-cooperation by the parents causes delay in the diagnosis of USNHL. In the prevailing situation in Indian society, the present study is conducted to screen children aged between 4 and 15 years presenting with complaints of loss of hearing affecting the performance at school either reported by the parents or teachers to assess the loss of hearing and to analyze the various causes of SNHL unilateral and bilateral nature.

**MATERIALS AND METHODS:** The present prospective study was conducted in the Department of ENT of MGM Hospital, Warangal, Telangana. The study period was conducted between November 2011 and December 2015 (4 years). Out of 346 children presenting with hearing impairment and defective/delayed speech, 73 children presented with unilateral sensorineural deafness (USNHL).

**Inclusion Criteria:** 1. Children aged between 4 and 15 years. 2. Children with Unilateral Sensorineural Hearing Loss (USNHL). 3. Children with poor performance/loss of academic year in the school. 4. Children with USNHL for more than 6 months. **Exclusion Criteria** 1. Children aged below 4 and above 15 years. 2. Children with conductive hearing loss. 3. Children with history of CSOM, ASOM, OME. The parents were enquired about the history of hearing impairment; 1. Age of onset. 2. History of consanguinity. 3. History of familial incidence of SNHL. **Audiological evaluation** included: 1. Audiological Tests. 2. Pure tone audiometry (PTA). 3. Impedance audiometry. 4. OAE and 5. Brainstem evoked response audiometry (BERA).

After all these investigations, the child was thoroughly assessed to determine the etiological factors associated with hearing impairment and defective speech. The Pure Tone Average (PTA) in the 3 speech frequencies 500, 1000 and 2000Hz were calculated. If this average is 'X', then 25 is deducted from it e.g. X-25. This value is multiplied by 1.5. Thus the formula is: [Average of 3 speech frequencies – 25] × 1.5. Similarly, the percentage of hearing impairment is calculated for the other ear. The total hearing handicap of a person is then calculated as follows: [(Better ear % × 5) + (Worse ear %)] ÷ 6. Type of Tympanogram was noted. Presence or Absence of Acoustic reflexes was noted. Otoacoustic emission was reported as Refer or Pass. BERA was reported as Moderate, Severe and Profound deafness. All the data was analyzed using standard statistical methods.

**OBSERVATIONS AND RESULTS:** Children presenting with Unilateral Sensorineural Deafness (USNHL) were distributed into 4 years age interval. It was found that 41.09% of children of 12 to 15 years age group, 32.87% of 8 to 11 years and 26.02% of 4 to 7 years were affected.

Age group in years	No. of patients	Percentage %
4 to 7	19	26.02
8 to 11	24	32.87
12 to 15	30	41.09

**Table 1: Showing the Age Incidence (n=73)**

Among the 73 children 40 were males and 33 were females. The female to male ratio was 1:1.1 in 4 to 7 years age group, 1:1.18 in the age group of 8 to 11 and 1:1.3 in the age group of 12 to 15 years (Table 2).

Age group in years	Male	Female	Sex ratio
4 to 7	10	09	1:1.1
8 to 11	13	11	1:1.18
12 to 15	17	13	1:1.30
<b>Total</b>	<b>40</b>	<b>33</b>	<b>1:1.21</b>

**Table 2: Showing the Gender Incidence (n=73)**

Among the children 58.90% of the children belonged to the Rural area and 41.09% belonged to the urban area. The distribution of urban and rural children according to their age groups is shown in the (Table 3).

Age group in years	Rural	%	Urban	%
4 to 7	13	17.80	06	8.21
8 to 11	16	21.91	08	10.95
12 to 15	14	19.17	16	21.91
<b>Total</b>	<b>43</b>	<b>58.90</b>	<b>30</b>	<b>41.09</b>

**Table 3: Showing the rural and urban distribution (n=73)**

The present study showed that the children were born out of consanguineous marriage in 28.76% and non-consanguineous marriage in 71.23% of the parents (Table 4).

Marriage Type	Frequency	Percentage
Consanguineous	21	28.76
Non-Consanguineous	52	71.23

**Table 4: Showing the type of marriage 4 (n=73)**

In 24.65% of the children there was family history of early onset of hearing loss and there was no family history in 75.34% of them (Table 5).

Family History	Number of Patients	Percentage
Positive	18	24.65
Negative	55	75.34

**Table 5: Showing history of familial deafness (n=73)**

Among the 73 children 58 children (79.45%) had suffered from Hyperpyrexia and 15 children (20.54%) did not give history of hyperpyrexia (Table 6).

History of Hyperpyrexia	Number of children	Percentage
Present	58	79.45
Absent	15	20.54

**Table 6: Showing history of Hyperpyrexia (n=73)**

Pure tone average results showed mild deafness (25 to 45db loss) in 02.73%, moderate HL (45-65dB) in 09.58%, severe HL (65-90dB) in 45.20% and profound HL (>90dB) in 42.46% of the children (Table 7).

PTA	Number of Patients	Percentage
Mild	02	02.73
Moderate	07	09.58
Severe	33	45.20
Profound	31	42.46

**Table 7: Showing the degree of deafness (n=73)**

Tympanograms of the children studies showed type A in 72.22%, type B in 13.68% and type C in 15.05% of them (Table 8).

Type of Impedance audiometry	Number of Patients	%
Type A right	29	39.72
Type A left	23	31.50
Type B right	04	05.47
Type B left	06	08.21
Type C right	07	09.58
Type C left	04	05.47

**Table 8: Showing the impedance audiometry results (n=73)**

Acoustic reflexes were negative on Tympanogram in 73.97% and positive in 26.02% of the children (Table 9).

Acoustic Reflex	Number of Patients	Percentage
Positive	19	26.02
Negative	54	73.97

**Table 9: Showing the acoustic reflex results (n=73)**

Oto acoustic test results were PASS in 43.83% and REFER in 56.16% of the children in this study (Table 10).

Oto-Acoustic Emission	Number of Patients		%		Total
	Right	Left	Right	Left	
REFER-41	21	20	28.76	27.39	56.16
PASS-32	14	18	19.17	24.65	43.83

**Table 10: Showing the OAE results (n=73)**

BERA showed moderate HL in 09.58%, Severe HL in 38.35% and profound HL in 52.05% of the study group children (Table 11).

BERA findings	Number of Patients	%
Moderate HL	07	09.58
Sever HL	28	38.35
Profound HL	38	52.05

**Table 11: Showing the BERA results (n=73)**

**DISCUSSION:** In the present study the children developed unilateral hearing loss resulting in decrease in school performance as noticed by the teachers and parents. Early identification and appropriate treatment of hearing loss in children is critical for normal development. In their study Fischer C and Lieu J et al found that adolescents with UHL demonstrated worse overall and expressive language scores than controls. They also suggested that UHL in adolescents is associated with a negative effect on standardized language scores and IQ. They also demonstrated that the developmental gap between children with UHL and children with normal hearing does not resolve as the children progress into adolescence and may even widen as the children grow older. Therefore, these results strongly encourage implementation of early intervention for children with UHL to prevent speech-language delays. More studies in adolescents are warranted to evaluate educational outcomes.<sup>10</sup> Brookhouser PE, Worthington DW, Kelly WJ et al in their study observed that early onset, severe USNHL in children may be associated with marked auditory and psycholinguistic skills and school performance. In their consecutive study of 324 children found that pure tone average showed 13% borderline, 16% mild, moderate 12%, severe 19% and profound deafness in 15% of children. Uncertain etiology was found in 34.8% of children, while hereditary in 12.6%, head injury in 10.7% of children. School performance was affected in 31% of children.<sup>11</sup> In the present study Pure tone average results showed mild deafness (25 to 45db loss) in 02.73%, moderate HL (45-65dB) in 09.58%, severe HL (65-90dB) in 45.20% and profound HL (>90dB) in 42.46% of the children (Table 6). Similarly, in developed countries also 1.0 to 2.0 per 100 schools going children show a bilateral SNHL of 50 dB or worse, including 0.5 to 1.0 per 1000 whose bilateral losses exceed 75dB.<sup>12</sup> Watier-Launey C et al found in their study based on the values of PTA, profound loss in 49.7%, loss of more than 10dB in 32.8% of the children. They observed children failing more than in once in their classes of study in 40.4% unlike 16.3% in normal children, (p <0.001). USNHL when more than 40 dB or its delay in identification was significantly associated with failures. A concerted effort aimed at early identification and management strategies in cases of unilateral hearing loss in children is warranted.<sup>13</sup> In their study Kruppa B et al found that 7.4% of children showed rise in thresholds above 20dB at least for one frequency. The definition of HL was given by them as a difference of > or = to 10db between at least one frequency (3, 4 or 6 KHZ). They also observed that Unilateral losses

(lateral difference  $\geq 10$  dB) were more common than bilateral losses (2.5% vs 1.6% of the overall sample). These unilateral hearing losses in the high-frequency range are essentially regarded as the result of playing with impulse-noise producing toys, such as toy guns with caps.<sup>14</sup> The National Programme for Prevention and Control of Deafness was launched in the year 2006 states that there are 291 persons per 100000 populations who suffer from loss of hearing (NSSO, 2002). Out of these a large population belongs to the age group of 0 to 14 years and even larger percentage of population suffers from milder degree of hearing loss. According to Ramanuj Bansal et al 1992; most of the patients belong to age group of 0 -10 years. CSOM was the most common etiological factor resulting in hearing loss.<sup>15</sup> In 1994 a study conducted by C. Das et al in tribal villages of Manipur shows the percentage of children's population in the villages was 35.77% and there was 6.62% prevalence of deafness among the children. The age incidence was found to be highest in the children group of 6-10 years of age.<sup>16</sup> V.N. Chaturvedi et al observed Prevalence of middle ear disease in school going children as 4.6% and in urban area it varied from 5.4% to 14.9% and in rural areas the standard deviation was 03.9%.<sup>17</sup> M. V. V. Reddy et al in 2004 conducted Interview based prospective study in children below 14 years of age with hearing loss which showed 18.57% with syndromic hearing impairment and 81.73% constituted isolated (non-syndromic) deafness. The results on etiology of hearing loss in children with deafness shows that in 15.22% of children, deafness was inherited, in 13.77% it was acquired and in 71.01% the etiology was unknown. They also observed that in their series of 1076 children 41.76% were born out of consanguineous marriages and 58.72% of children out of Non-consanguineous children.<sup>18</sup> The present study showed that the children were born out of consanguineous marriage in 28.76% and non-consanguineous marriage in 71.23% of the parents (Table 4). Behavioural problems have also been found in pre - school and adolescent children with conductive hearing loss. Behavioural problems such as irritability, lack of responsiveness, withdrawn behavioural have been reported. Under National Programme for prevention and control of Deafness screening of children is being done to identify hearing loss; but to identify the actual cause of HL can be challenging. It needs apart from thorough clinical, radiological and audiological investigations, genetic tests to identify syndromic causes of HL.<sup>19</sup> In a similar study by Beigh Z, Malik MA et al, the authors observed incidence of cranio-facial abnormalities (2.85%), one child with Treacher Collins syndrome, one with Pierre-Robin syndrome and 3 children with syndromic (2 with Downs and 1 with Ushers syndromes).<sup>20</sup> In the present study there were no children presenting with either syndromic or cranio-facial abnormalities. All the children were normal in development and appearance. This naturally suggests that the USNHL was an acquired feature. Though the etiology could not be ascertained with the investigations they may be labelled as idiopathic or due to toxic fevers like Enteric fever, Unknown viral fevers and exanthemata (Table

6). In short, early detection of HL, followed by early and suitable rehabilitation gives better speech, language, and social-emotional support to the children.

**CONCLUSION:** In a Hospital based prospective study involving 346 children aged between 4 and 14 years presenting with the complaints of HL when scrutinized to include only children with USNHL which is routinely missed due to a functioning better ear, it was observed that: 1. Children aged 12-15 years were highest affected. 2. Males were affected more than females in a ratio of 1.21:1. 3. Children from rural background (58.90%) were more than urban children (41.09%). 4. Only 28.76% of children were born out of consanguineous parent against 71.23% non-consanguineous, indicating the USNHL could be an acquired disease rather than a congenital one. 5. Absence of familial history in 75.34% against presence of family history 24.65% also would suggest an acquired nature of USNHL. 6. Absence of cranio-facial anomalies or syndromic disease among the study group children suggests acquired disease and not genetic or syndromic type. 7. Audiological investigations pointed out the degree of USNHL to be severe or profound in nature. 8. School going children approaching with complaints of HL or failure in academic performance should be investigated thoroughly for USNHL is always missed. Early detection of HL, followed by early and suitable rehabilitation gives better speech, language, and social-emotional support to the children. If these children are identified at later stage, even rehabilitative measures would be ineffective.

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