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ORIGINAL ARTICLE

Prognostic Factors of Sudden Sensorineural Hearing Loss in Children

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Objective: To evaluate the prognostic factors of sudden sensorineural hearing loss (SSNHL) in children.

Materials and Methods: Sixty two children with SSNHL were analyzed in this study. Those who had probable etiology and different treatment were excluded. The factors that were demonstrated to have impact on prognosis were investigated.

Results: Twenty-five ears (50%) were accompanied by tinnitus, 14 ears (28%) by vertigo. The recovery rate (including mild, significant and complete) of hearing loss in those ears with tinnitus was 52% (13 ears), whereas the recovery rate in those ears accompanied by vertigo was 28.5 % (4 ears). 23 ears (46%) had demonstrated total hearing loss at the beginning of treatment, with a recovery rate of 39%. The recovery rate of children who had given treatment within 10 days of the appearance of SSNHL was 69%. In bilateral cases (14 ears), the recovery rate was 36%.

Conclusions: Of the factors investigated to put forth their effect on prognosis statistical significance was seen in only vertigo and delayed-onset (>10 days) of treatment. ($p<0.05$) But the relatively high ratios of nonrecovery in bilateral cases and in those cases with severe initial hearing loss, although no statistical significance was noted, seemed clinically significant.

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Introduction

Sudden sensorineural hearing loss (SSNHL) is a relatively infrequent disease with an annual incidence of 5 to 20 per 100000. [1,2] It is one of the otologic emergencies in which etiology is seldom clarified. SSNHL can be defined as an idiopathic hearing loss of sensorineural origin, greater than 30 decibel (dB) in 3 contiguous frequencies that occurs within 3 days. [2,3] SSNHL was first described by Everberg in 1860. [4]

In addition to hearing loss, vestibular dysfunction, tinnitus and aural fullness can also accompany the clinical picture. [5] A specific etiologic factor is found in 10 to 15 % of cases. [6,7] Although several studies have been carried out on epidemiology and etiology, less is known about the incidence and treatment. [5] It is generally accepted that initial severe sensorineural hearing loss, associated vestibular symptoms, age less than 15 years, downward audiometric curve and delayed-onset of treatment are considered as negative prognostic factors. [2,5]

The incidence of SSNHL in children is less than that in adults and the low incidence in children has resulted in very limited data for pediatric age group.

A variety of treatment options have been tried out for SSNHL. This includes corticosteroids, antivirals, vasodilators, anticoagulants, plasma expanders, hyperbaric oxygen (HBO) therapy and carbogen inhalation. Nevertheless, corticosteroids have become the most widely accepted treatment option. [8]

The recovery rate of SSNHL without treatment is reported to range from 30% to 68%. [6,9] Recovery, if it occurs, is mostly seen in the first 2 weeks after onset.

This study was designed to clarify the prognosis of SSNHL in children and to examine the factors that may influence the final outcome.

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Materials and Methods

This study is a retrospective analysis of patients with SSNHL under the age of 15 years presented to Cerrahpasa Medical Faculty Otolaryngology Department from 2000 to 2008.

The age and sex of the patients were recorded. Patients who had a specific condition known to cause SSNHL were excluded from the study. Absence of preexisting deafness was confirmed from the parents.

The patients were investigated by:

1. History: History was taken from both parents and children, if possible. Special attention was given on the following:

- The time and way of appearance of SSNHL.

- The uni- or bilateral nature of hearing impairment.

- The presence of any barotrauma and pre-existing deafness.

- The presence of associated symptoms especially tinnitus and vestibular symptoms.

- The presence of any co-morbidity including diabetes, hypertension and others.

- The presence of any infection especially mumps, measles and upper respiratory tract infection, preceeding deafness.

2. Physical examination: A general medical and routine ear-nose-throat and neurotologic examinations were performed on all patients. All ears were examined by binocular ear microscopy to rule out any external or middle ear disease that may impair hearing.

3. Laboratuary investigations: Routine complete blood count, erythrocyte sedimentation rate, C-reactive protein, blood lipid profile, thyroid – liver – kidney function tests, and hemostasis parameters were investigated. Also, serologic survey was carried out including antibody titers to mumps, measles, syphilis, cytomegalovirus (CMV), hepatitis B and C viruses.

4. Audiometry: The level of hearing loss was measured by pure-tone audiometry between 250 Hz and 8,000 Hz. The average hearing threshold (decibel) was calculated by taking the arithmetic mean of hearing levels at 250, 500, 1,000, 2,000 and 4,000 Hz frequncies, both at the time of diagnosis, during and at the end of the treatment. Four types of audiometry curves were obtained regarding the pattern of hearing loss: *(1) ascending (rising),* when the average hearing threshold was 25 dB lower in 250 and 500 Hz frequencies than in 4,000 and 8,000 Hz frequencies, *(2) descending,* when the average hearing threshold was 25 dB higher in 250 and 500 Hz frequencies than in 4,000 and 8,000 Hz frequencies, *(3) flat,* when the diffence of hearing threshold did not exceed 25 dB between any frequencies, *(4) total,* when avarage hearing loss was 90 dB or more.

Hearing recovery at the end of the treatment was defined as four separate stages:

- Complete recovery: Hearing threshold less than 20 dB in all frequencies.

- Significant recovery: Average hearing threshold gain more than 30 dB.

- Mild recovery: Average hearing threshold gain between 11 and 29 dB.

- No recovery: Average hearing threshold gain between 0 and10 dB.

5. Tympanometry and temporal bone computerized tomography (CT) scan: Tympanometry and temporal bone CT scan were performed on all patients to exclude any middle ear disease and inner ear malformation, respectively.

6. Treatment: Systemic corticosteroids and HBO therapy were given to all patients. The dosage of corticosteroids was 1mg/kg/day of methylprednisolone, tapering gradually.

7. Prognostic factors: Tinnitus, vestibular complaints, the type of audiometry curve, the severity of initial hearing loss, the time of begining of treatment and uni- or bilateral nature of the deafness were evaluated as prognostic factors.

8. Statistical analysis: Chi-square and Fisher exact tests were utilized for statistical analysis. Logistic regression analysis was performed for the time of begining of treatment and vertigo. p value less than 0.05 was considered as statistically positive. SPSS statistical package program version 10.0 was used.

Results

Sixty two patients, between 5 and 15 years of age with SSNHL were analysed in this study. 19 patients were excluded due to the presence of probable etiology (mumps, carbonmonoxide poisoning) and treatment differences, so that the study was carried out with 43 patients. 7 of these patients had bilateral deafness, so as a total, 50 ears were examined with the diagnosis of

idiopathic SSNHL. The mean age of the patients was 11.14 (range: 5 – 15). 30 of the patients were male (70%), 13 were female (30%).

None of the children had any pathologic finding on temporal CT scan and tympanometry. Biochemical and serologic survey of all children were normal and no co-morbidity was detected. Upper respiratory tract infection was not diagnosed preceeding or during presentation, in any of the patients.

The average hearing loss at the time of presentation was 83,76±25,18 dB (range: 37 and 120 dB), whereas at the end of treatment was 64,40±36,94 dB (range: 5 and 120 dB).

The mean interval between the onset of deafness and the beginning of treatment was 17,70±25,26 days (range: 1 and 150 days).

Of the 50 ears with SSNHL, 27 were on the right side and 23 were on the left side (including 7 bilateral cases). If we omit the 7 bilateral cases, the number of right sided SSNHL was 20, whereas left sided was 16.

Complete recovery was achived in 8 ears (16%), significant recovery in 10 ears (20%), mild recovery in 9 ears (18%) and no recovery in 23 ears (46%). Of the 7 patients who had had bilateral SSNHL, 5 had given binaurally the same respone (4 had no recovery, one had significant recovery); whereas one patient had no recovery on the right, mild recovery on the left ear, and the remaining patient had significant recovery on the right, mild recovery on the left.

At the time of diagnosis, 22 patients (3 of whom had bilateral SSNHL, thus 25 ears [50%]) had tinnitus to some degree. After treatment, tinnitus had regressed in 8 ears (32%) and completely disappeared in 11 ears (44%), whereas no change in tinnitus severity was observed in 6 (24%) ears. Only one patient who had had no tinnitus at the time of diagnosis, had developed tinnitus after treatment. This patient demonstrated mild recovery (27 dB gain). The ratio of recovery (including mild, significant and complete) in those ears with tinnitus was 52% (13 ears), whereas in those without tinnitus was 56% (14 ears), but the difference between these had not reached a statistical significance ($p>0.05$).

Fourteen ears with SSNHL were accompanied by vertigo at initial presentation. 8 of these ears had total hearing loss (HL), 3 had flat type, 2 had descending type and 1 had ascending type of audiometry curves at time of diagnosis. The recovery rate of HL in those ears accompanied by vertigo was 28.5% (4 ears), whereas in those not accompanied by vertigo was 64% (23 ears). The difference in treatment outcome between those with and without vertigo had reached statistical significance ($p<0.05$).

The ratios of different types of audiometry curves, accompanying tinnitus and vertigo for each recovery group was given in Table 1.

Hearing loss at the time of diagnosis had descending audiometric pattern in 11 ears (22%), ascending in 2 ears (4%), flat in 14 ears (28%) and total in 23 ears (46%). No statistical significance was found between these groups in terms of recovery after treatment ($p>0.05$).

The recovery rate of children who had given treatment within 10 days of the appearence of SSNHL was 69%, whereas of those given treatment after 10 days was 33.3%. The difference had statistical significance ($p<0.05$).

Table 1. Distribution of tinnitus, vertigo and audiometry types in different recovery groups

	No recovery	Mild recovery	Significant recovery	Complete recovery
Number of ears	23	9	10	8
Tinnitus	12 (52%)	4 (44%)	4 (40%)	5 (62.5%)
Vertigo	10 (43%)	2 (22%)	1 (10%)	1 (12.5%)
Audiometry type				
Descending	4 (17%)	3 (33%)	3 (30%)	1 (12.5%)
Ascending	1 (4%)	1 (11%)	0 (0%)	0 (0%)
Flat	4 (17%)	3 (33%)	2 (20%)	5 (62.5%)
Total	14 (61%)	2 (22%)	5 (50%)	2 (25%)

The recovery rates in 7 bilateral cases (14 ears) and in 36 unilateral cases were given in Table 2. In bilateral cases, complete recovery was not seen and 'no recovery' ratio was much higher (64%) than in unilateral cases (39%). ($p>0.05$)

Logistic regression analysis of vertigo and initiation of treatment after 10 days of the appearance of deafness was carried our and both of the two parameters were found to affect outcome negatively ($p<0.05$). (Table 3)

Table 2. Treatment outcomes of uni- and bilateral SSNHL*

	Bilateral SSNHL (14 ears)	Unilateral SSNHL (36 ears)
Complete recovery	-	8 (22%)
Significant recovery	3 (21%)	7 (19%)
Mild recovery	2 (14%)	7 (19%)
No recovery	9 (64%)	14 (39%)

** Sudden sensorineural hearing loss*

Table 3. Logistic regression analysis of treatment time and vertigo

	Significance (p value)	ODDS	95,0% C.I.for EXP(B)	
			Lower	Upper
Initiation of treatment after 10 days (n:21)	0.016	6.934	1.443	33.319
Accompanying vertigo (n:14)	0.034	5.654	1.142	27.987

Discussion

Sudden sensorineural hearing loss continues to be a both diagnostic and therapeutic difficulty, especially for children. Relatively low incidence of the disease and high incidence of spontaneous recovery (30 – 60 %) are some of the confounding factors in management. [10] Various factors were reported to affect prognosis such as vestibular complaints, tinnitus, age of the patient, severity of initial hearing loss, shape of the audiometry curve and etc. [2,5,10-12] In many of the studies, prognostic factors were reported for adults. Since this study was carried out for only children under 15 years of age with a relatively high number of participants, we hope some valuable information will be gained about prognosis of idiopathic SSNHL in children.

The recovery rate (including mild, significant and complete) for SSNHL was 54% in this study. Byl reported a partial or total recovery rate of 69% in a large series of 222 patients, including both adults and children. [1] Chen YS et al., in a series of 14 children with SSNHL between 9 and 18 years old, reported a complete recovery rate of 57% and a partial recovery rate of 36%. [5] This last study, including only the pediatric age group, had a total recovery rate of 93%, which is much more higher than our result, although the definitions of recovery were almost similar to ours (partial recovery: ≥10 dB gain in 3 frequencies, complete recovery: same hearing level compared to the non-affected ear). A more limited number of participants compared to our series may cause this difference. Mamak et al. gave a recovery rate of 64% in their series of 72 patients with SSNHL. 6 children were included in that study, 3 of whom (50%) had recovered to some extent. [13]

The time of beginning of the treatment is considered to affect the prognosis in many papers. [1,13,14] In our study, if we compare the recovery rates in those receiving treatment within and after 10 days of the beginning of SSNHL, the recovery rate in the latter group was lower, which was statistically significant ($p<0.05$). This finding was similar to some reports which had designated that hearing improvement was more likely to occur in patients treated in the first 7 or 14 days from the onset. [9,13]

It is well known that severe initial hearing loss constitutes a negative prognostic factor in contrast to mild or moderate HL. [2,13] In our study, although the 'no recovery rate' for total hearing loss was higher (61%) than others, it could not reach a statistical significance. ($p>0.05$) But it is clear that, this higher 'no recovery' rate sounds clinically significant. We could not find a statistical difference in recovery between flat and descending types of audiometry curves, and descending type of audiometry curve should not be considered as a negative prognostic factor in our report, in contrast to reports by Nakashima and Roman et al. [2,15]

Vertigo, probably the sole which was considered as a negative prognostic factor in many papers, continues to be a negative prognostic factor in this study. [1,2,9,10,13,15] Patients with SSNHL accompanied by vertigo, had a recovery rate (28.5%) much lesser than those without vertigo (64%). ($p<0.05$)

Although tinnitus was considered as a positive prognostic factor in some previous reports, it has not been found to be a prognostic factor in our study. [2,13,16] This is consistent with the findings of Byl. [1]

Bilateral involvement in SSNHL is rare and simultaneous bilateral involvement is very rare in SSNHL. In our series, the incidence of bilateral SSNHL was 16%. Jeong-Hoon Oh et al reported an incidence of 4.9% for bilateral SSNHL in their series of 324 patients with a mean age of 41.6 years, whereas Fetterman et al. reported an incidence of 1.7% in a series of 823 patients. [17,18] We could not reach any incidence of bilateral SSNHL in children in search of the literature. Nevertheless, bilateral SSNHL can be considered as a negative prognostic factor in our series, since the recovery rate is lesser, although statistical significance was not found. Bilateral nature of SSNHL was also considered as a negative prognostic factor by Jeong-Hoon Oh et al. [17]

Although a consensus exists about prognostic factors for SSNHL in adults to some extent, prognostic factors are harder to determine in children, since very limited number of studies were carried out in this age group. Tinnitus, early-onset of treatment, unilateral nature of the disease were considered as positive prognostic factors for SSNHL, whereas vertigo, delayed-onset of treatment and bilateral nature of HL were considered as negative prognostic factors in the previous reports. We can conclude that only vertigo and delayed-onset of treatment had acted as negative prognostic factors in our series, which has one of the largest children populations with SSNHL.

References

1- Byl FM Jr. Sudden hearing loss: eight years' experience and suggested prognostic table. Laryngoscope 1984;94:647-61.

2- Roman S, Aladio P, Paris J, Nicollas R, Triglia JM. Prognostic factors of sudden hearing loss in children. Int J Pediatr Otorhinolaryngol 2001;61:17-21.

3- Conlin AE, Parnes LS. Treatment of sudden sensorineural hearing loss: I. A systematic review. Arch Otolaryngol Head Neck Surg 2007;133:573-81.

4- Everberg G. Deafness following mumps. Acta Otolaryngol 1957;48:397-403.

5- Chen YS, Emmerling O, Ilgner J, Westhofen M. Idiopathic sudden sensorineural hearing loss in children. Int J Pediatr Otorhinolaryngol 2005;69:817-21.

6- Haberkamp TJ, Tanyeri HM. Management of idiopathic sudden sensorineural hearing loss. The American Journal of Otology 1999;20:587-95.

7- Desloovere C, Knecht R, Germonpre P. Hyperbaric oxygen therapy after failure of conventional therapy for sudden deafness. B-ENT 2006;2:69-73.

8- Psifidis AD, Psillas GK, Daniilidis JCh. Sudden sensorineural hearing loss: long-term follow-up results. Otolaryngol Head Neck Surg 2006;134:809-15.

9- Tiong T.S. Prognostic indicators of management of sudden sensorineural hearing loss in an Asian hospital. Singapore Med J 2007;48:45-9.

10- Narozny W, Kuczkowski J, Kot J, Stankiewicz C, Sicko Z, Mikaszewski B. Prognostic factors in sudden sensorineural hearing loss: our experience and a review of the literature. Ann Otol Rhinol Laryngol 2006;115:553-8.

11- Chang NC, Ho KY, Kuo WR. Audiometric patterns and prognosis in sudden sensorineural hearing loss in southern Taiwan. Otolaryngol Head Neck Surg 2005;133:916-22.

12- Yeo SW, Lee DH, Jun BC, Park SY, Park YS. Hearing outcome of sudden sensorineural hearing loss: long-term follow-up. Otolaryngol Head Neck Surg 2007;136:221-4.

13- Mamak A, Yilmaz S, Cansiz H, Inci E, Güçlü E, Dereköylü L. A study of prognostic factors in sudden hearing loss. Ear Nose Throat J 2005;84:641-4.

14- Amin JM. Idiopathic sudden sensorineural hearing loss. University hospital experience. Med J Malaysia 1993;48:407-9.

15- Nakashima T, Yanagita N. Outcome of sudden deafness with and without vertigo. Laryngoscope 1993;103:1145–9.

16- Danino J, Joachims HZ, Eliachar I, Podoshin L, Ben-David Y, Fradis M. Tinnitus as a prognostic factor in sudden deafness. Am J Otolaryngol 1984;5:394-6.

17- Oh JH, Park K, Lee SJ, Shin YR, Choung YH. Bilateral versus unilateral sudden sensorineural hearing loss. Otolaryngol Head Neck Surg 2007;136:87-91.

18- Fetterman BL, Luxford WM, Saunders JE. Sudden bilateral sensorineural hearing loss. Laryngoscope 1996;106:1347-50.