Oral steroid treatment for idiopathic sudden sensorineural hearing loss

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ABSTRACT

الأهداف: وصف فعالية استعمال الستيرويد الفَمَوي على المدى الطويل لعلاج فقْدان السمع العصبي الحسي المفَاجئ مجهول السبب (ISSHL) واستكشاف عوامل توقعات سير المرض المُحتملة، وعلاقة نتيجة استعادة السمع بتأثير العقار بعد تعاطيه مع مرور الوقت في ISSHL.

الطريقة: في هذه الدراسة المرجعية تم تحليل 215 حالة شُخِّصت بإصابتها بالصمم المفاجئ أُحادي الجانب مجهول السبب بين يناير 2003 م وديسمبر 2012 م في المستشفى الإقليمي بجنوب تايوان. تلقّت جميعها العلاج بالستيرويد الفَمَوِي وتمت متابعتها لمدة 3 أشهر على الأقل.

النتائج: أظهرت النتائج أن حداثة السن وعدم الإصابة بأمراض أخرى (كالسكري، وارتفاع ضغط الدم، والأمراض القلبية الوعائية) وتلقّي العلاج في غضون سبعة أيام من الإصابة بـ ISSHL، وفقْدان السمع المُعتدل ووجود تخطيطات سمعية ذات انحناءات صاعدة، ساهمت في استعادة السمع بطريقة أفضل بكثير من الناحية الإحصائية. وبلغ قياس سمع النغمة النقية (PTA) في أول الأمر 67.8 ± 23.9 ديسيبل في المتوسط، ثم تحسَّن بين الشهر والشهرين إلى 51.6±28.7 ديسيبل و 49.7±28.6 على التوالي. إلى جانب ذلك، بلغ متوسط PTA في الزيارة الأخيرة 49.9±29.2 ديسيبل.

الخاتمة: استعاد حوالي ثلث المرضى سمعهم بالكامل، واستعاد ثلثهم جزءًا من سمعهم، وحوالي الثلث لم يعافى من فقْدان السمع. بالإضافة إلى ذلك، بقى مستوى السمع ثابتًا نسبيًا بعد العلاج بشهرين. ولا يُستحسن استعمال الستيرويد الفَمَوي لعلاج ISSHL لمدة أكثر من شهرين لأنه لم تثبت له أي فوائد إضافية.

Objectives: To describe the efficacy of long-term oral steroids in idiopathic sudden sensorineural hearing loss (ISSHL), and to explore potential prognosis factors, the relationship of hearing recovery outcome, and the recovery time-course in ISSHL.

Methods: In this retrospective study, we analyzed 215 cases diagnosed with idiopathic unilateral sudden deafness between January 2003 and December 2012 at a regional hospital in southern Taiwan. All of them received oral steroid therapy and were followed for at least 3 months.

Results: Young age, the presence of no other disease (diabetes, hypertension, or cardiovascular disease), treatment within 7 days of the onset of ISSHL, mild hearing loss, and audiograms with ascending curves had a statistically significant better hearing recovery. The average pure-tone audiometry (PTA) was 67.8±23.9 dB initially, and was improved between one month (51.6±28.7 dB) and 2 months post treatment (49.7±28.6 dB). The average last-visit PTA was 49.9±29.2 dB.

Conclusion: Approximately one third of patients had full recovery in hearing, one third had partial recovery, and approximately one third did not recover from hearing loss. In addition, the hearing level remained relatively stable following 2 months of treatment. More than 2 months of oral steroid therapy for ISSHL is not recommended because no additional benefits were evidenced.

Saudi Med J 2015; Vol. 36 (3): 291-296
doi: 10.15537/smj.2015.3.9940

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Received 12th August 2014. Accepted 19th January 2015.

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Disclosure. Authors have no conflict of interests, and the work was not supported or funded by any drug company.

Idiopathic sudden sensorineural hearing loss (ISSHL) is defined as a sensorineural hypoacusis of at least 30 dB over 3 consecutive speech frequencies, occurring within 3 days. It is considered to be an otologic emergency, and the incidence has been estimated to range from 3.9 to 27.5 per 100,000 persons per year.[1] Although the exact cause is still unknown, it has been hypothesized to be caused by viral infection of the labyrinth or cochlear nerve, vascular insult, intra labyrinthine membrane rupture, and autoimmunity.[2] Owing to the variations in the etiopathogenesis of ISSHL, different therapeutic strategies have been developed. Steroids or in combination with vasodilators, plasma expanders, diuretics, anticoagulants, antiviral, vitamins, cytotoxic medications, hyperbaric oxygen, stellate ganglion block, and inhaled carbogen, have become the most widely accepted treatment options.[2-7] However, the length of oral steroid therapy had not been well established. Most of the studies reported the length of steroid therapy ranging between 5-24 days.[2-7] Although little is known about the time course of hearing loss for most patients, improvement in hearing can be anticipated only during the first 1-2 months. Therefore, this study investigated progression in recovery from sudden hearing loss, and the optimal treatment duration with oral steroids.

Methods. A retrospective chart review was performed in the Department of Otolaryngology, Kaohsiung Armed Forces General Hospital, Kaohsiung, Taiwan between January 2003 and December 2012. The study followed the principals of the Helsinki Declaration.

Study participants. All patients with unilateral ISSHL were identified. Exclusion criteria was defined as: 1) Patients who were treated with ISSHL previously, and 2) patients with perilymphatic fistulas, acoustic trauma, acoustic tumors, Meniere's disease, severe infection, pregnancy, peptic ulcer disease, and allergy to steroids. The data were collected from a total of 215 affected ears.

Treatment procedure. Once ISSHL was diagnosed, patients were hospitalized for one week, followed by outpatient clinic visits for at least 3 months. The standard medical treatment in hospitalization consisted of oral administration of high-dose steroids, oral pentoxifylline (400 mg twice per day), and intravenous administration of low-molecular-weight dextran. The prednisolone dose was one mg/kg body weight per day for 4 days, followed by a 3-day taper during admission (0.8 mg/kg, 0.6 mg/kg, and to 0.4 mg/kg). Thereafter, all patients were prescribed with a tapering dosing of oral steroids for 3 months according to the hearing improvement.

Evaluation. The determination of hearing change was based on the 4-tone average (arithmetic mean) of thresholds at 0.5, 1, 2, and 4 kHz. Hearing recovery was measured with Siegel's criteria[3] and according to the classification: type I (complete recovery) included patients whose final hearing level was better than 25 dB regardless of the size of the gain; type II (partial recovery) included patients who showed more than 15 dB of gain and whose final hearing level was between 25 and 45 dB; type III (slight recovery) included patients who showed more than 15 dB of gain and whose final hearing level was poorer than 45 dB; and type IV (no improvement) included patients who showed less than 15 dB of gain. Pure-tone audiometry (PTA) was performed on the initial day and the first, second week, and the first, second, and third month (revising data) after treatment and at the last clinic visit (last visit PTA).

The variables that potentially affected recovery from ISSHL, including patient gender, age, the affected side of ear, the patient's medical history (diabetes mellitus, hypertension, or cardiovascular disease), presence or absence of vertigo or tinnitus, beginning of treatment, severity of hearing loss, and the audiogram shape, were analyzed. The initial (pretreatment) audiogram was classified with the severity of hearing loss as mild (under 45 dB), moderate (46 to 90 dB), and severe ISSHL (over 90 dB).[2] The initial audiogram was labeled as upsloping (left to right), downsloping (left to right), flat, and total deaf pattern according to Sheehy's classification.[8]

Statistical analysis. Statistical analysis was performed with the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) program Version 17.0. Analysis of each prognostic factor, included gender, effected ear, diabetes, hypertension, cardiovascular disease, tinnitus, vertigo, time to treatment, and the pre- and post-treatment of the average PTA was performed with unpaired t-test. One-way analysis of variance (ANOVA) was used to study the relationship between age group, or the severity of hearing loss, and hearing recovery. The post hoc test was analyzed for pairwise comparison for type of initial audiogram. All data in this study was presented as mean ± standard deviation. A p-value less than 0.05 was considered significant.

Results. Of the 215 cases in the current study, 112 (52.1%) were men and 103 (47.9%) were women. The mean age of this group was 48.7 years (range from 9 to 91). On hundred and three (47.9%) of the affected ears were on the right side and 112 (52.1%) on the left. Analysis of medical history showed that 15.8% had type 2 diabetes mellitus, 9.3% had hypertension, and 3.7% had cardiovascular diseases. Tinnitus was present

at the time of insult for more than half (54.4%) of the patients. The ISSHL was accompanied by vertigo in around 6% of the patients in this study. The interval between the onset of symptoms and treatment ranged from 0 to 14 days, with a mean of 4.7 ± 3.7 days.

Table 1 shows that diabetes (p=0.002), hypertension (p=0.002), cardiovascular disease (p=0.002), and treatment beginning later than 7 days after onset of ISSHL (p=0.03) were statistically significantly associated with a poorer recovery from hearing loss. However, gender (p=0.46), affected ear (p=0.36), presence of tinnitus (p=0.15), and vertigo (p=0.06) did not significantly influence recovery from hearing loss.

Table 2 indicates that younger age (p<0.001) and mild hearing loss (p<0.001) had a statistically significant better hearing recovery. **Table 3** demonstrates that significantly better hearing recovery was seen in patients with ascending curve audiograms than in those with descending curve, flat audiograms, and total hearing loss (all p<0.05).

The study group was classified according to Siegel's classification as follows: 33% with type I, 18.1% with type II, 14% with type III, and 34.9% with type IV. The relationship between Siegel's classification and the time lapse from treatment to the final recovery is shown in **Table 4**. Among the 76 patients whose hearing started to recover after discharge, 81.6% (62 patients) acquired the final hearing level within one month after treatment, 9.2% (7 patients) between 1-2 months, 3.9% (3 patients) between 2-3 months, and 5.3% (4 patients) obtained the final hearing level at more than 3

Table 1 - Follow-up results of idiopathic sudden sensorineural hearing loss patients related to demographic, and clinical characteristics in 215 patients.

Prognostic factor	Cases (n)	Complete recovery (I) (%)	Partial recovery (II) (%)	Slight recovery (III) (%)	No recovery (IV) (%)
Gender					
Male	112	37 (33.0)	20 (17.9)	15 (13.4)	40 (35.7)
Female	103	34 (33.0)	19 (18.4)	15 (14.6)	35 (34.0)
Effected ear					
Right	103	32 (31.1)	16 (15.5)	18 (17.5)	37 (35.9)
Left	112	39 (34.8)	23 (20.6)	12 (10.7)	38 (33.9)
Diabetes mellitus					
Positive	34	5 (14.7)	7 (20.6)	6 (17.6)	16 (47.1)
Negative	181	66 (36.4)	32 (17.7)	24 (13.3)	59 (32.6)
Hypertension					
Positive	20	2 (10.0)	3 (15.0)	3 (15.0)	12 (60.0)
Negative	195	69 (35.4)	36 (18.5)	27 (13.8)	63 (32.3)
Cardiovascular diseases					
Positive	8	0 (0)	1 (12.5)	1 (12.5)	6 (75.0)
Negative	207	71 (34.3)	38 (18.4)	29 (14.0)	69 (33.3)
Tinnitus					
Positive	117	41 (35.1)	20 (17.1)	19 (16.2)	37 (31.6)
Negative	98	30 (30.6)	19 (19.4)	11 (11.2)	38 (38.8)
Vertigo					
Positive	13	3 (23.1)	1 (7.7)	4 (30.7)	5 (38.5)
Negative	202	68 (33.7)	38 (18.8)	26 (12.9)	70 (34.6)
Time to treatment					
≤7 days	190	68 (35.8)	35 (18.4)	29 (15.3)	58 (30.5)
>7 days	25	3 (12.0)	4 (16.0)	1 (4.0)	17 (68.0)

Table 2 - Recovery rates according to age and severity of hearing loss among idiopathic sudden sensorineural hearing loss patients.

Prognostic factor	Cases (n)	Complete recovery (I) (%)	Partial recovery (II) (%)	Slight recovery (III) (%)	No recovery (IV) (%)
Age					
≤30	59	32 (54.2)	11 (18.7)	4 (6.8)	12 (20.3)
31-45	30	18 (60.0)	4 (13.3)	2 (6.7)	6 (20.0)
46-60	59	15 (25.5)	12 (20.3)	14 (23.7)	18 (30.5)
>60	67	6 (9.0)	12 (17.9)	10 (14.9)	39 (58.2)
Severity of hearing loss					
≤45dB	35	31 (88.6)	1 (2.8)	0 (0)	3 (8.6)
46-90dB	139	37 (26.6)	35 (25.2)	13 (9.4)	54 (38.8)
>90dB	41	3 (7.3)	3 (7.3)	17 (41.5)	18 (43.9)

Table 3 - Degree of recovery in relation to type of hearing loss among idiopathic sudden sensorineural hearing loss patients.

Prognostic factor	Cases (n)	Complete recovery (I) (%)	Partial recovery (II) (%)	Slight recovery (III) (%)	No recovery (IV) (%)
Type of initial audiogram					
Ascending	30	20 (66.7)	6 (20.0)	1 (3.3)	3 (10.0)
Descending	52	18 (34.6)	6 (11.5)	4 (7.7)	24 (46.2)
Flat	91	29 (31.9)	22 (24.2)	7 (7.7)	33 (36.2)
Total	**42**	**4 (9.5)**	**5 (11.9)**	**18 (42.9)**	**15 (35.7)**

Table 4 - The relationship between Siegel's classification and the time lapse from treatment to the final recovery among idiopathic sudden sensorineural hearing loss patients.

Siegel's criteria	Times when the hearing was recovered after treatment						
	1 week (at discharge)	2 weeks	1 month	2 months	3 months	Others	Total
I	38	20	10	1	1	1*	71
II	16	16	3	1	2	1†	39
III	10	8	5	5	0	2‡,§	30

*at 15 weeks after treatment, †at 16 weeks after treatment, ‡at 15 weeks after treatment, §at 28 weeks after treatment

months after treatment. The mean time interval between initial and last visit was 14 ± 22.3 months (range from 6 months to 8 years 5 months). The average PTA was 67.8 ± 23.9 dB initially, and was improved to 54.9 ± 27.3 dB at discharge.

Our data showed that there was a statistically significant difference in the average PTA measured between one month (51.6 ± 28.7 dB) and 2 months post treatment (49.7 ± 28.6 dB) (p=0.02). However, the average PTAs measured between 2 and 3 months post treatment were not statistically different between each other (p=0.34). The average last-visit PTA was 49.9 ± 29.2 dB. The data revealed that hearing was not improved further after 2 months of treatment for ISSHL patients.

In our study, the complications of a long-term course of oral steroid administration showed the 12.1% of 215 patients were hyperglycemic, 5.1% had high blood pressure, 0.5% had gastrointestinal bleeding, 1.9% had psychiatric disorders (agitation, anxiety, fear, insomnia, irritability, lethargy, and mood lability), and 25.1% had other adverse events (weight gain, or cutaneous adverse events). In addition, osteoporosis was not found in this trial.

Discussion. Idiopathic sudden sensorineural hearing loss was first reported by Kleyn DA[9] in 1944

and called sudden deafness by Hallberg[10] in 1956. The etiology has not been elucidated; however, pathophysiological studies have suggested that ISSHL is caused by hypo-oxygenation and resultant metabolic block due to localized ischemia at the inner ear.[10-12] The natural history of ISSHL varies owing to the multiple factors involved in the pathogenesis. Our data showed hypertension, cardiovascular disease, and diabetes mellitus were prognostic factors for poor recovery from ISSHL. Therefore, these diseases were proposed to be related to the pathogenesis of ISSHL.[11,12]

Many previous studies reported that the initial symptoms at the onset of ISSHL may serve as a predictor of the prognosis[2,13] that tinnitus is considered to be a positive prognostic indicator, but the presence of vertigo has been shown to be a negative prognostic factor. In the current study, no significant difference in recovery was found between patients with and without tinnitus. This may be because tinnitus potentially was a sequelae of hearing impairment, similar to that in patients with presbycusis. Furthermore, patients with vertigo had poorer hearing recovery compared with patients without vertigo in our study. However, the data showed no statistical significance.

We sought to identify other variables that may help predict clinical improvement. Our results revealed that younger age, mild hearing loss, and an ascending curve audiogram on presentation correlated with improved outcomes. We also noted that the "golden hour" for ISSHL is 7 days. Of course, better recovery from hearing loss was shown in patients who were treated early. These findings are also consistent with previous reports on ISSHL.[13,14]

Understanding the progression of ISSHL is important in planning the treatment, estimating the necessary follow-up course, and evaluating the potential outcome. Owing to the variations in the etiopathogenesis of ISSHL, different therapeutic strategies have been developed. However, the length of oral steroid therapy has not been well established, and the prior studies were unclear. In our study, all patients received long-term for 3 months. Our data revealed that hearing was not improved further after two months of treatment for ISSHL patients. As 2 months of treatment is adequate, it may not be beneficial for patients to take excessive dose of steroids for long-term recovery. Some studies also showed that no change of hearing level is expected after 2 months of treatment of ISSHL.[15,16] It is possible that the period of 2 months is embedded in the natural history of the disease, regardless of the treatment protocols. Therefore, any treatment after 2 months may not affect the outcome. Our clinical observation showed that there may still be enough time for alternative treatments even if the patients did not respond to the initial high-dose steroid regime. All patients in the current study were prescribed with oral steroids only, and none received additional therapy, such as intratympanic steroid administration, intratympanic dexamethasone with hyaluronic acid, hyperbaric oxygen, carbogen inhalation, or others. It was shown that 6.5% of 215 patients had delayed recovery occurring later than one month after treatment, whereas 3.3% recovered 2 months after treatment, and hearing was further improved over a period of 3 months. However, the percentage was lower than those reported in other studies where intratympanic steroid administration was used as a salvage treatment to achieve better hearing recovery.[17-19] It is notable that the alternative therapy was performed within 2 months after initial therapy for ISSHL. It is recommended, therefore, that the additional therapy should be performed in patients who do not respond to the initial therapy with expected progress within 2 months.[17-20] In addition, in other studies, intratympanic dexamethasone with hyaluronic acid was used as the additional therapy, and the combination of dexamethasone with a modified hyaluronic acid hydrogel yields significantly higher sustainable perilymph dexamethasone concentrations than by using dexamethasone alone.[21,22]

The limitation of this study was the limited number of patients and our patients were followed for the average value of 14 months, but they may be followed for more than 5 or 10 years in the furture.

Further research is needed to support a causal relationship and its clinical implications. In addition, there are more factors to consider such as laboratory data, and the sample size with long-term follow up may be increased.

In conclusion, based on a retrospective analysis of ISSHL patients, we found that approximately one third of patients had full recovery in hearing, one third had partial recovery, and around one third did not recover from hearing loss. We demonstrate that the hearing remained relatively stable after 2 months of treatment for ISSHL, and emphasize a steroid regime for ISSHL lasting longer than 2 months is not recommended since additional benefits were not evidenced.

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