ORIGINAL ARTICLE

Long-term Follow-up Results of the Patients Suffering from Sudden Hearing Loss

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Objective: The aim of this follow-up study was to evaluate the time-dependent course of hearing recovery in idiopathic SHL patients.

Materials and Methods: Forty-four unilateral idiopathic SHL patients treated with the same standard regimen for 10 days were retrospectively reviewed, then they were invited to return to our hospital for their last visit and last audiogram during the study period. Gender, age, duration and severity of hearing loss, the shape of the audiogram and, the presence of tinnitus were evaluated. Thus, the long-term audiometric data, the final hearing outcome and, the rates of hearing recovery was obtained.

Results: There was a significant difference in the degree of hearing loss and the rates of hearing recovery between early stage and long-term follow-up (p<0,001). The most common audiogram shape was flat. Hearing was significantly worse in SHL patients with tinnitus compared to SHL patients without tinnitus (p<0,001).

Conclusion: Our results revealed that even if the failure of an initial 10-day course of treatment, a delayed recovery continues and there may still be enough time for complete recovery except profound SHL. Tinnitus on presentation with SHL and profound SHL has been identified as a negative prognostic indicator.

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Introduction

Sudden hearing loss (SHL) is a sensorineural type hearing impairment and commonly encountered in otolaryngologic practice. It has been considered a medical emergency. The definition of SHL is a loss greater than 30 dB or more at least three consecutive audiometric frequencies occurring within a 72 hour period [1]. The estimated incidence of SHL is reported to range from 5 to 20 per 100,000 population [2]. SHL occurs with equal incidence in men and women and individuals of all ages can be affected but, the peak incidence is in the fourth or fifth decade [3]. The prevalence of bilateral SHL is 2% [2]. In most SHL patients, the etiology remains unknown. Poor hearing is the major symptom in SHL. In addition to hearing loss, sometimes it is associated with tinnitus and vertigo[4].

Treatment of SHL remains controversial. Due to diversity in the etiopathogenesis of SHL and the lack of a clearly definitive therapy, numerous agents have been investigated for the treatment of idiopathic SHL including corticosteroids, vasodilators; plasma expanders; anticoagulants; antivirals; diuretics; vitamin, and herbal preparations; batroxobin; carbogen inhalation; and hyperbaric oxygen [1, 2,4-8]. Systemic steroid therapy is currently the mainstay of the treatment for SHL[4, 6, 7]. There have been many reports in the literature about the etiology,

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clinical presentation, short term prognosis, and treatment modality of SHL. On the other hand, there is little known about the course of SHL in the long term follow-up [9, 10]. Because, usually these patients are followed by clinicians in a few months only, after discharge or cessation of therapy. The prognosis of hearing recovery for idiopathic SHL is affected by patient demographic characteristics, hearing loss characteristics, and audiogram characteristics at presentation [1, 2, 6, 11]. Therefore, we investigated demographics (gender, age), the degree of SHL, the severity of SHL, the final recovery rates, the shape of audiogram, the time delay before therapy initiation, and the rate of tinnitus accompaniment in this study.

The aim of this study was to evaluate the time-dependent course of hearing recovery in idiopathic SHL patients.

Materials and Methods

The study was approved by the local ethics committee of the department and carried out in accordance with the Declaration of Helsinki as amended in 2008 (.18.07.2012-662.) We reviewed the medical records of patients with SHL treated in the Department of Otorhinolaryngology-Head and Neck Surgery, Dicle university hospital, between January 2009 and June 2011. After reviewing the medical records of these patients retrospectively, 54 cases were identified and then they were reevaluated for their last visit during the study period. It was paid attention to interval between the initial hospitalization and last visit. Patients, having at least one year duration after the initial hospitalization were included into the study. They were examined again and thus, their final audiogram was obtained. Only idiopathic unilateral SHL patients were included.

Diagnosis of idiopathic SHL was made after exclusion of the various possible causes of SHL. Patients associated with a possible cause such as perilymphatic fistulas, acoustic trauma, head trauma, barotrauma, acoustic tumors, history of ototoxic drug use or ear surgery, acute or chronic otitis media, mastoiditis, Ménière's disease and those with unstable or systemic disease such as uncontrolled diabetes mellitus not capable of tolerating systemic steroid treatment were excluded from the study. Patients with delayed treatment (had an interval of more than a week from onset of SHL) were also excluded. Onset date of hearing loss was precisely recorded according to patients' history. SHL patients with tinnitus were included but SHL patients with vertigo were not included due to small number of cases (2 patients). Ten cases were excluded for reasons above and 44 patients were enrolled in the study.

Our standard treatment was provided for all patients diagnosed with SHL during hospitalization. They were admitted for 10 days. All patients received systemic steroid treatment (injection of methylprednisolone 1 mg/kg/day intravenously for five days, then gradually tapered over five days).

Otorhinolaryngologic examination with specific attention on audiometry were performed in all patients. Pure tone audiometry was conducted to all participants in sound-treated booths for objective hearing assessment according to the guidelines of the American Speech–Language–Hearing Association (ASHA). Pure-tone average (PTA) of hearing thresholds at 0.5, 1, 2, and 4 kHz was calculated (arithmetic mean). The severity of hearing loss was classified into 6 categories depending on the degree of SHL as following: slight, 16–25; mild, 26–40; moderate, 41–55; moderately severe, 56–70; severe, 71–90; and profound, over 90 dB[12]. The average of; initial PTA (the first day of hospitalization), the post treatment PTA (the tenth day after admission) and the final PTA on the last visit (at least 1 year after being discharged) were determined and compared. SHL was defined as a hearing loss of sensorineural type developing within 72 hours and the patients all had minimum 30 dB hearing loss at three consecutive frequencies. The degree of hearing improvement was judged according to Siegel's criteria on the last visit, using the average gain in dB in 4 audiometric speech frequencies of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. Siegel classification is divided into four types according to degree of recovery as follows: no improvement, less than 15 dB of gain; slight improvement, more than 15 dB of gain and a final hearing loss poorer than 45 dB; moderate improvement more than 15 dB of gain and final hearing level between 25 and 45 dB; and complete improvement, hearing level better than 25 dB regardless of the size of the gain[8]. The initial audiogram, the post

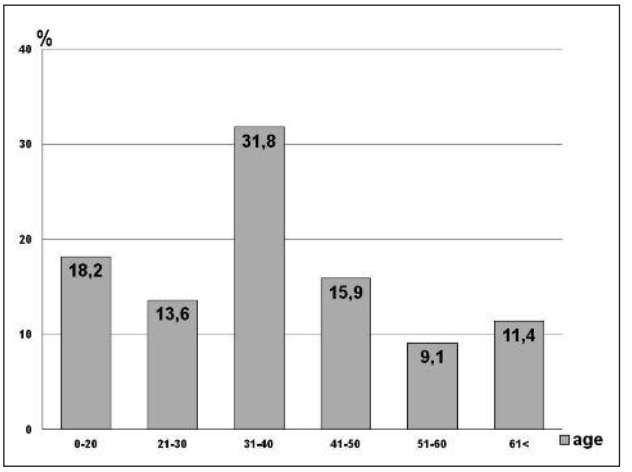

Figure 1. Age distribution in patients with sudden hearing loss

treatment audiogram and the final audiogram was labeled according to the configuration as flat, upsloping (left to right), downsloping (left to right), cookie-bite (midfrequency hearing loss), inverse cookie-bite (low- and high-frequency hearing loss) and total deafness.

The degree and the severity of SHL, the final recovery rates, and the shape of audiogram were recorded on the admission (the first day of hospitalization), tenth day after admission (the last day of therapy administration) and the last visit. Then, obtained hearing results were compared each other. In addition to hearing loss, the patients demographic characteristics (gender, age), and the time delay before therapy initiation were recorded and analyzed. Furthermore, patients were specifically asked about tinnitus. The presence of tinnitus symptom since the onset of hearing loss were recorded and evaluated. Also, continuing tinnitus were recorded on the last visit.

Statistics

All the statistical analyses were performed with using SPSS 15.0 version (SPSS Inc., Chicago, IL, USA). Chi-square test was used to compare categorical variables. For the comparison of continuous variables Kruskal-Wallis test was used. Mann-Whitney U test was also used for the comparison of continuous variables where the data did not show normal distribution. Wilcoxon Signed Rank test was used to compare the data before treatment and after treatment. All of the data in this study are described as mean ± standard deviation (SD). P value of <0.05 was considered significant.

Results

A total of 44 patients, ranging in age from 11 to 73 years (average 38.0 years, SD, 16.5). The age distribution is illustrated in Fig. 1; there is a relative increased incidence of SHL between 31 and 40 years old. There were 34 (77.3%) men and 10 (22.7%) women, with 24 (54.5%) left and 20 (45.5%) right ears affected.

The time distribution in our long-term follow-up regarding the interval between the initial and the last visit is shown in Table 1. The mean interval time was 17.5 months (SD, 5.7, between 12-30 months). The average duration from onset to initiation of treatment was 2.5 days (SD, 1.3, between 1-6 days). The mean hospitalization time was 10.0 days. So, we observed closely, especially the first two weeks after the onset of SHL (10 day hospitalization + 2.5 days average delayed time).

Table 1. ime interval between initial and last visit

Interval (month)	% (n)
12	27,3 (12)
13-14	13,6 (6)
15-16	15,9 (7)
17-20	13,6 (6)
21-24	13,6 (6)
25-30	15,9 (7)

Table 2 summarizes the distribution of the degree of hearing loss in our patients. Five cases (11.4%) had mild, 12 cases (27.3%) had moderate, 8 cases (18.2%) had moderately severe, 11 cases (25.0%) had severe and 8 cases (18.2%) had profound SHL during the admission. According to the post treatment audiogram results (10th day after admission, the last day of therapy administration and then discharge); 2 cases (4.5%) had normal hearing level and 4 cases (9.1%) had slight hearing loss, whereas 10 cases (22.7%) had mild, 11 cases (25.0%) had moderate, 5 cases (11.4%) had moderately severe, 4 cases (9.1%) had severe and 8 cases (18.2%) had profound SHL. On the last visit, normal hearing level was noted in 8 cases (18.2%). On the other hand, 11 cases (25.0%) had slight, 5 cases (11.4%) 6 cases (13.6%) had moderate, 4 cases (9.1%) had moderately severe, 2 cases (4.5%) had severe and 8 cases (18.2%) had profound SHL.

The average severity of hearing loss is illustrated in Fig. 2 according to the initial, post treatment and last audiogram. The average initial PTA was 65.2 dB (SD, 20.1) and the average post treatment PTA in 10th day was improved to 53.8 dB (SD, 26.5). The average final PTA was 39.0 dB (SD, 27.8). There was a significant difference in the degree of hearing loss and the rates of hearing recovery between initial PTA and post treatment PTA (p<0,001), and between post treatment PTA and last PTA (p<0,001). Age did not affect the final SHL outcome (p=0,857). Also, statistical analysis showed that, the final hearing outcome was not relevant with sex (p=0,734).

Patients were classified to evaluate the degree of hearing improvement according to Siegel's classification as follows: complete improvement in 20 patients (45.5%), moderate (partial) improvement in 6 patients (13.6%), slight improvement in 7 patients (15.9%), and no improvement in 11 patients (25.0%) (Table3). There was no significant difference between the sexes (p=0,626). Among the no improvement group (11 cases); 8 patients had profound SHL and 3 patients had severe SHL.

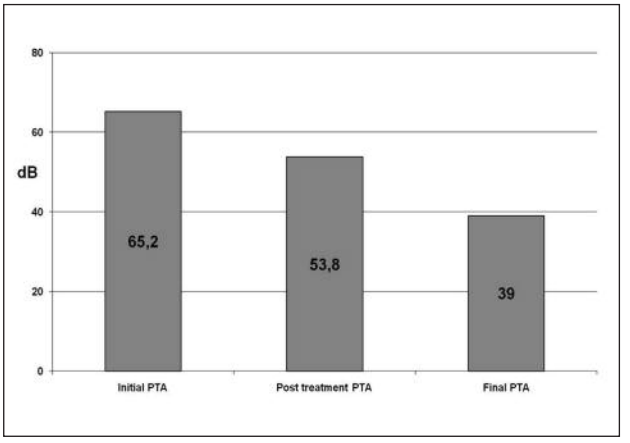

Figure 2. The comparison of the average PTA in patients with sudden hearing loss (Initial: The first day of hospitalization, Post treatment: The tenth day after admission, Final: On the last visit)

With regard to the audiometric configuration of SHL, the majority of audiogram shape was flat (15 cases, 34.1%), followed by downsloping (11 cases, 25.0%), upsloping (7 cases, 15.9%), cookie-bite (3 cases, 6.8%) and inverse cookie-bite (3 cases, 6.8%). On the last visit, the same audiogram shape was maintained in all cases. The mean PTA was 48.2 dB in flat shape, followed by 47.0 dB in downsloping, 39.9 dB in upsloping, 40.5 dB in cookie-bite, and 62.9 dB in inverse cookie-bite. Total deafness was found in 5 cases (11.4%). The initial PTA, post treatment PTA, final PTA and the average PTA according to audiogram shape was shown in Table 4. Additionally, the relationship between hearing improvement rates according to Siegel classification and the shapes of audiogram was shown in Fig. 3.

Tinnitus was present in 63.6% of the patients (28 cases) at the time of SHL onset and, on the last visit 17 cases (38,6%) had tinnitus (p<0,001) (Table 5). Long-standing tinnitus occurred in a great proportion of our patients suffering from profound and severe SHL. The average hear loss level was 77,25 dB in SHL patients with tinnitus, whereas the average hear loss level was 49,93 dB in SHL patients without tinnitus (p<0,001).

Discussion

Studies have shown that most patients with idiopathic SHL will regain some degree of hearing. Spontaneous recovery rate without medical treatment ranges from approximately 32 to 70 percent within two weeks after

Table 2. The distribution of the frequency of hearing loss degree in patients with sudden hearing loss (Initial: The first day of hospitalization, Post treatment: The tenth day after admission, Final: On the last visit)

Hearing loss degree	Frequency % (n)		
	Initial	Post treatment	Final
Normal	0 (0)	4,5 (2)	18,2 (8)
Slight	0 (0)	9,1 (4)	25,0 (11)
Mild	11,4 (5)	22,7 (10)	11,4 (5)
Moderate	27,3 (12)	25,0 (11)	13,6 (6)
Moderately Severe	18,2 (8)	11,4 (5)	9,1 (4)
Severe	25,0 (11)	9,1 (4)	4,5 (2)
Profound	18,2 (8)	18,2 (8)	18,2 (8)

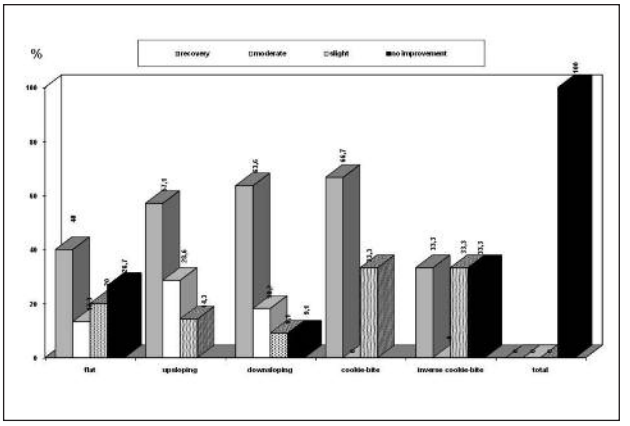

Figure 2. The comparison of the average PTA in patients with sudden hearing loss (Initial: The first day of hospitalization, Post treatment: The tenth day after admission, Final: On the last visit)

onset and 10% or less after 3 months [1,2,5,6,11,13]. Surprisingly, these findings are not compatible with our results. Completely recovery rate in early stage (the first two weeks after the onset of SHL) even with medical treatment was only 13.6% in present study. It can be explained as follows that the number of patients with mild and moderate SSHL was limited, and the patients suffering from moderately severe to profound SHL were consisted the largest part of our sample (61.4%). Also, it has been reported that patients with higher hearing thresholds on initial audiogram after SHL onset have a decreased rate of hearing recovery as compared to patients with mild losses [2, 13].

Table 3. The distribution of the patients with sudden hearing loss by gender and in total according to Siegel's classification(p<0,001).

Siegel classification	Male Percent (n)	Female Percent (n)	Total (n)
Recovery	47,1 (16)	40,0 (4)	45,5 (20)
Moderate	14,7 (5)	10,0 (1)	13,6 (6)
Slight	11,8 (4)	30,0 (3)	15,9 (7)
No improvement	26,5 (9)	20,0 (2)	25,0 (11)

Table 4. The distribution of the average PTA according to the shape of audiogram in patients with sudden hearing loss (Initial: The first day of hospitalization, Post treatment: The tenth day after admission, Final: On the last visit)

Audiogram shape	% (n)	The average PTA (dB)			
		Initial	Post treatment	Final	Mean
Flat	34,1 (15)	59,0	49,4	36,1	48.2
Downsloping	25,0 (11)	62,5	49,2	29,3	47.0
Upsloping	15,9 (7)	53,0	42,8	24,0	39.9
Cookie-Bite	6,8 (3)	62,0	36,6	23,0	40.5
İnverse Cookie-Bite	6,8 (3)	81,6	61,6	45,6	62.9
Total Deafness	11,4 (5)	99,0	97,8	95,8	97.5

Table 5. The comparison of hearing loss degree according to ASHA* between tinnitus (+) and tinnitus (-) sudden hearing loss patients(p<0,001). (Initial: The first day of hospitalization, Final: On the last visit, HL: hearing loss, *ASHA: American Speech–Language–Hearing Association

The degree of HL (according to ASHA)	Initial % (n)		Final % (n)	
	(+) Tinnitus	(-) Tinnitus	(+) Tinnitus	(-) Tinnitus
Mild	0 (0)	11,4 (5)	0 (0)	11,4 (5)
Moderate	11,4 (5)	15,9 (7)	0 (0)	15,9 (7)
Moderately Severe	13,7 (6)	4,5 (2)	4,5 (2)	13,7 (6)
Severe	20,4 (9)	4,5 (2)	15,9 (7)	9,1 (4)
Profound	18,2 (8)	0 (0)	18,2 (8)	0 (0)
TOTAL	63,6 (28)	36,4 (16)	38,6 (17)	61,4 (27)

Following a long-term follow-up period (the mean interval time was 17.5 months), complete improvement rate was 43.2% and no improvement rate was 25.0% in our study. On the contrary, in another study, complete improvement was noted in 15% of patients and no improvement was noted in 65% of patients at the end of a long-term follow-up [9]. Risk factors such as hypertension, hypercholesterolemia, and diabetes mellitus, implicated in the pathogenesis of SHL, are relatively common compared to other studies in that report that may explain the low rate of complete improvement and high rate of no improvement.

In addition to high number of severe and profound SHL and presence of risk factors, the prognosis of idiopathic SHL depends on a variety of factors including age, gender, pre-treatment hearing, duration of hearing loss, audiogram characteristics, associated symptoms (tinnitus, vertigo), time to treatment initiation, and treatment modalities [1,2,6,14]. Age is considered by some authors to be a prognostic factor, as older patients have a worse outcome [2,11]. Nosrati et al. [11] reported that advanced age gives a significantly lower chance of improvement. On the other hand, many authors found no correlation between age and outcome [4,9]. The incidence of SHL has been reported to increase among patients over 40 years of age but we found a significant peak at 31-40 years of age. In our study, there was a significant predominance of men, whereas some studies showed no differentiation between sexes [2,3].

Most reports stated that longer durations of hearing loss are associated with a decreased possibility of hearing recovery, and on the contrary, SHL with shorter duration is more likely to heal regardless of modality or timing of treatment [2,5,11,13]. Many authors agree that SHL that lasting longer than 2-3 months likely becoming permanent and no change of hearing level may be expected [1,2,5,9,13]. According to some recent reports, after a period of two months from the onset of SHL, hearing remained relatively stable and the average PTA at this time did not changed after the long period of follow-up [9,13]. Similarly, Psifidis et al. [9] concluded that the period of two months could be consistent with the natural history of the disease, regardless of which therapeutic strategy is applied. Thus, two months of treatment is adequate and any additional treatment should not affect the outcome of the hearing further. Therefore, in terms of cost-effectiveness, moreover, any additional effect has not been proven yet, it is not recommended to consume excessive doses of therapeutic drugs for SHL after two months.

Due to most authors agree on this issue that SHL lasting more than 2-3 months likely becoming permanent, in present study, unlike some previous studies, we evaluated and compared the hearing results between the first two weeks and long-term follow-up, instead of between 2-3 months and long-term follow-up. According to our results, there was a significant difference in the degree of hearing loss and the rates of hearing recovery between short-term (the first two weeks) and long-term follow-up ($p<0,001$).

According to the results of Psifidis et al. [9], patients with severe SHL at initially had more frequently slight, partial, or complete improvement, and those with profound SHL had no improvement on the last visit. Our results were compatible with this finding; profound hearing loss is a poor prognostic indicator in SHL. Because, 18.2% of the patients complaining of profound SHL showed no improvement in hearing in a short-term (the first two weeks) and long-term follow-up period. In addition to patients with profound SHL, 3 patients (6.8%) with severe SHL had no improvement. A significant proportion of our patients (75.0%) was improved in a long-term follow-up period (Table 3). Consequently, our results suggest that even if the failure of an initial 10-day course of treatment, a delayed recovery continues and there may still be enough time for complete recovery except profound hearing loss.

Our statistical analysis did not show any relationship between sex and final hearing outcome. Additionally, it was noted that age did not affect the final hearing outcome. The relatively low mean age (38.0 years) may be an important factor to explain this result. Because it is expected and shown that patients older than 40 years present risk factors in a higher proportion than younger patients [9]. Furthermore, it is already reported in most studies that advanced age (over 60 years) has been correlated with decreased rates of hearing recovery [1,2 6].

Audiograms have been compared and discussed each other according to their shapes in many studies. Our statistical analysis revealed that the most common audiogram shape was flat, followed by downsloping and upsloping (Table 4). The shape of cookie-bite and inverse

cookie-bite was relatively uncommon. The best average PTA (39.9 dB) was seen in upsloping shape, whereas the worst average PTA (62.9 dB) was seen in inverse cookie-bite shape. Furthermore in present study we compared the relationship between hearing improvement rates according to Siegel classification and the shapes of audiogram (Fig. 3). There was no improvement in hearing and audiometric shapes in any of total deaf patients. Other than this, the best recovery rate was seen in the shape of cookie-bite audiogram, followed by the shape of downsloping and upsloping. Less improvement was seen in the shape of flat and inverse cookie-bite audiogram. However, the small number of patients should be considered.

It has been reported that tinnitus is the most frequent long-term accompanying complaint in SHL, especially in patients with profound or severe type, as shown present study [9]. In more than half of the patients (63.6%), tinnitus was present at the time of SHL onset (Table 5). On the last visit, tinnitus was decreased but not rare (38, 6%) ($p<0,001$). On the other hand, hearing was significantly worse in SHL patients with tinnitus compared to SHL patients without tinnitus in present study ($p<0,001$). Tinnitus on presentation with SHL has been identified as a negative prognostic indicator [1].

The treatment of SHL is one of the most controversial topics in the otolaryngology literature. Some otolaryngologists choose not to treat SSHL at all, citing high spontaneous recovery rates. Indeed, idiopathic SHL will often spontaneously improve even without medical treatment, with average gains of 35 dB [2]. Nevertheless, medical treatment is usually administered [2,6]. Because, some reports suggested that patients who were treated with medical treatment were more likely to improve [5, 6]. Yet the evidence is questionable, systemic corticosteroid therapy is accepted as the most common and efficient treatment modality for idiopathic SHL so far. However intratympanic steroid injections are also suggested in patients who did not response to the conventional intravenous treatment [15]. Wilson et al. [6] found a statistically significant greater rate of recovery for patients treated with steroids compared with placebo, whereas Nosrati et al. [11] found that the steroid-treated patients had the same outcome as the non-treated patients. Similarly, Cinamon et al. [4] reported no significant differences between steroids and placebo. They stressed that none of medical treatments was superior to placebo either immediately after treatment or at a later date, and regardless of the treatment modality, hearing continued to improve during follow-up [4].

Conclusion

In conclusion, this is the study to statistically evaluate the time-dependent changes on hearing in idiopathic SHL patients, despite the relatively small number of patients. The course of idiopathic SHL are quite variable. Especially in the long-term follow-up, there is little known about the prognosis of SHL. Therefore in this study, the hearing results and prognostic factors in idiopathic SHL patients were presented.

Conflict of interest

The authors report no conflicts of interest.

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