

Original Article

The effects of personalized nursing on the hearing recovery of patients with sudden hearing loss and the factors affecting the hearing recovery

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Abstract: Objective: This study aimed to investigate the effects of personalized nursing on the hearing recovery of patients with sudden hearing loss (SHL) and the factors affecting their hearing recovery. Methods: We conducted a retrospective analysis of 92 patients with SHL admitted to our hospital and divided them into the good prognosis group (60 cases) and the poor prognosis group (32 cases) according to the prognosis, and we also divided them into the control group (those receiving routine nursing, 47 cases) and the observation group (those receiving the personalized nursing, 45 cases) according to the nursing methods. Univariate and multivariate logistic regression analyses were used to identify the factors affecting the hearing recovery. The hearing ability, the negative emotions, the stress response scores, and the patients' sleep quality were assessed before and after the nursing. Results: The univariate analysis showed that the hearing recovery in the patients with SHL was related to age, BMI, income, the number of affected ears, the degree of hearing loss, hypertension, diabetes, hyperlipidemia, and dizziness ($P<0.05$). The multivariate logistic regression analysis identified age, two affected ears, the degree of hearing loss, comorbid diabetes, and dizziness as independent risk factors affecting the hearing recovery in SHL patients (all $P<0.001$). After the nursing, compared with the patients from the control group, the patients from the observation group showed a superior hearing ability ($P<0.05$), lower scores on the Self-rating Anxiety Scale (SAS) and the Self-rating Depression Scale (SDS) ($P<0.01$), and lower scores on the Stanford Acute Stress Reaction Questionnaire (SASRQ) and the Pittsburgh Sleep Quality Index (PSQI) (all $P<0.001$). Conclusion: The independent risk factors affecting the hearing recovery in the SHL patients included age, the number of affected ears, the degree of hearing loss, diabetes, and dizziness. Systematic and comprehensive personalized nursing is effective at improving the hearing ability of SHL patients, enlightening new directions for clinical nursing.

Keywords: Sudden hearing loss, hearing recovery, risk factors, personalized nursing, comprehensive and systematic nursing

Introduction

Sudden hearing loss (SHL) is a prevalent hearing loss that lasts for no more than 3 days, manifesting as a hearing decrease by more than 20 dBHL in at least two adjacent frequencies, usually in one ear, and especially in the left ear [1]. The pathogenesis of SHL mostly lies in an ischemic and hypoxic lesion of the ear resulting from a narrowing of the feeding arteries in the ear, triggered by an infection, vascular diseases, chemical poisoning, or immune diseases. The onset of SHL in most patients is induced by mental irritation, negative emotions, stress, and poor sleep quality, which, if

they persist, aggravate the condition and lead to a poor prognosis [2]. SHL is generally accompanied by a hearing impairment to varying degrees, tinnitus, ear fullness, dizziness, vomiting, nausea, and even anxiety and depression, as well as poor sleep quality, affecting patients' normal lives [3]. Middle-aged and elderly people are the most vulnerable to SHL due to their low immunity, malnutrition, often irritated by a series of chronic systemic complications such as diabetes, hypertension, and hyperlipidemia. Higher blood viscosity, abnormal hemodynamics, and increased fragility of blood vessels in elderly people lead to a decrease in the blood supply to the inner ear and a higher risk

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of developing SHL. Elderly SHL patients have a weak self-healing ability and are vulnerable to sequelae and a poor prognosis, triggering clinical concern [4]. An early and timely diagnosis and the effective treatment of SHL are of great significance in alleviating the clinical symptoms and restoring the hearing ability to the greatest extent.

Existing treatment methods for SHL such as glucocorticoids, microcirculation-improving drugs, and traditional Chinese medicine have limited treatment effectiveness [5]. Some people believe that, given the complex factors affecting the incidence and recovery of SHL, conventional treatment alone is not effective. In a previous study, SHL patients receiving glucocorticoids alone only showed moderate responses to the treatment [6]. There is an opinion that a comprehensive understanding of the factors affecting the recovery of SHL patients combined with an intervention can greatly stimulate the recovery [7]. Active and effective nursing interventions are essential means to promote the recovery and treatment efficacy of SHL patients [8]. Factors affecting the hearing recovery vary among individuals, so the concept of personalized nursing is crucial. Here we analyzed the individual differences and designed personalized nursing interventions. A previous study found that performing personalized nursing during the recovery of SHL strongly enhances patients' recovery efficiency [9]. Personalized nursing is tailored to the individual differences that cover patients' physical and psychological care, boasting the advantages of maximizing resource utilization and optimizing nursing efficiency. In this study, we analyzed the factors affecting the recovery of SHL and performed personalized nursing on patients to explore its effectiveness, hoping to provide clinical guidance.

Materials and methods

General information

This study was approved by the medical Ethics Committee of The Second Affiliated Hospital of Fujian Medical University. We conducted a retrospective analysis on 92 patients with sudden hearing loss (SHL) admitted to our hospital and divided them into the good prognosis group (60 cases) and the poor prognosis group (32

cases) according to the prognosis, and we also divided them into the control group (those receiving routine nursing, 47 cases) and the observation group (those receiving the personalized nursing, 45 cases) according to the nursing methods. Univariate and multivariate logistic regression analyses were used to identify the factors affecting the hearing recovery.

Inclusion criteria: Patients diagnosed with SHL according to the diagnostic criteria for SHL according to the *Guidelines for the Diagnosis and Treatment of Sudden Hearing Loss* [10] issued in 2015; patients diagnosed with SHL for the first time, with a course of more than 2 weeks; patients with no communication barriers; patients (or their families on their behalf) who signed a written informed consent.

Exclusion criteria: Patients with space-occupying lesions within the inner and middle ear and the skull; patients with central nervous system diseases diagnosed by craniocerebral CT; patients with hematological disease and coagulation dysfunction; patients with a history of negative life events such as divorce or widowhood; patients with incomplete medical information.

Methods

Gathering the data

After admission, the general medical information of all the participants was recorded, including age, sex, waist circumference, BMI, income, educational level, negative emotions, the number of affected ears, the degree of hearing loss, comorbidities, dizziness, the degree of deafness and tinnitus, and the treatment efficacy.

Nursing methods

Nursing for the control group: Patients from the control group received routine nursing intervention, including health education, medication guidance, and consultation for review.

Nursing for the observation group: Patients from the observation group received systematic and comprehensive personalized nursing, including health education, psychological care, management of their living environment, and dietary guidance. The nursing method is detailed below.

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Health education: At the time of admission, we introduced the characteristics, mechanism, treatment method, treatment effects, and the importance of nursing to the patients according to their disease severity. For patients with a severe condition, our introduction was mainly in the form of pictures, text, animations, or PPTs; for patients with less severe conditions, our introduction was in the form of gestures. The nursing staff were directed to understand patients' personalities and foster a good relationship with them in a friendly and sincere attitude during the health education to ensure good nursing compliance.

Psychological care: We assessed the patients' negative emotions by communicating with them and their families, as well as by checking their responses (shaking or nodding heads) to certain pictures and texts designed for their individual educational level. Then we designed personalized psychological care plans catering to the intensity of the patients' negative emotions. We figured out the causes of the negative emotions and pleased the patients with animated texts in a friendly environment. For patients with tinnitus, we distracted their attention from the symptoms with books and enjoyable scenery. Books can improve patients' understanding of diseases, increase their confidence in the recovery, and alleviate negative emotions. Finally, we guided the patients' family members to keep the patients company and to engage in one-on-one communication to relieve their negative emotions.

Daily care: The daily care covered the diet guidance, environmental management, and sleep improvement. The diet program focused on light foods with low salt and low fat content based on the patients' dietary preferences, supplemented by foods rich in vitamin-E according to the severity of the disease. The intake of pungent, spicy, high-sugar, and high-cholesterol foods was strictly controlled. In addition, we arranged a comfortable living environment for the patients to promote their recovery. Hospital cleaners were required to clean the ward twice a day and to open the windows in the morning for ventilation. The ward was decorated according to the patients' preferences. We asked the patients to go to bed and get up early according to the scientific bedtime schedule, with shorter bedtime during the day. Strong tea, coffee, and intense exercise

were inhibited before bedtime. We persuaded the patients to abandon their bad habits and recommended that they soak their feet in hot water and clean their faces with hot towels for relaxation. We also recommended an on-bed muscle massage by the patients themselves or their families and to breathe deeply for a complete relaxation. In addition, we ordered the patients to minimize the number of phone calls they made and their use of earphones and asked the families to supervise the phone use according to the severity of their hearing loss.

Medication guidance: Professional physicians informed the patients and their families of the types, the dosages, the methods of medication, and the frequency of use of the prescribed drugs and wrote them in detail on the patient's receipt card to promote an active, scientific, and specific administration of the drugs, in order to prevent unexpected medication failure. The drugs prescribed in this study were mostly glucocorticoids and vasodilator drugs, which may induce hypertension. So physicians should inform patients and their family members of such adverse reactions to relieve fear and uneasiness. The changes in the drug dosage were determined based on the presence or absence or the severity of vascular diseases. The physicians monitored each patient's temperature and blood pressure during the daily routine rounds. Any abnormalities were to be reported to the doctors and treated immediately.

Outcome measures

Primary outcome measures

Prognosis: The assessment of prognostic efficacy [11] referred to the *Guidelines for the Diagnosis and Treatment of Sudden Hearing Loss* issued by the Chinese Medical Association in 2005. The efficacy was divided into 4 levels: complete response (the hearing threshold at 0.25-4 kHz returns to normal, or reaches a healthy level, or reaches the level before the illness), marked response (the average threshold at 0.25-0.4 kHz increased by more than 30 dB), moderate response (the average threshold at 0.25-0.4 kHz increased by 15-30 dB), no response (the average threshold at 0.25-0.4 kHz increased by less than 15 dB). Number of cases with a good prognosis = number of cases with a complete response + cases with a mar-

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ked response + cases with a moderate response. Number of cases with a poor prognosis = number of cases with no response. Good prognosis rate = (number of cases with a complete response + cases with a marked response + cases with a moderate response)/total case number * 100%.

Factors affecting the hearing recovery of SHL patients: A univariate analysis was performed to analyze the connection between the hearing recovery of the SHL patients and age, sex, waist circumference, BMI, income, educational level, negative emotions, the number of affected ears, the degree of hearing loss, comorbidities, dizziness, the degree of deafness and tinnitus, and the treatment efficacy. A multivariate logistic regression was used to analyze the independent correlation between the hearing recovery and age, the number of affected ears, the degree of hearing loss, comorbid diabetes, and dizziness in the SHL patients.

Secondary outcome measures

Hearing ability and negative emotions: DB was used to describe the hearing ability of the patients before and after nursing (a lower dB level indicates a higher hearing ability). The Self-rating Anxiety Scale (SAS) [12] and the Self-rating Depression Scale (SDS) [13] were used to assess the patients' anxiety and depression. SAS or SDS is a 20-item scale, with each item scored from 1 to 4 points. The total score of all the items is multiplied by 1.25, and then the integer of the result is taken as the standard score. A higher standard score indicates a greater severity of negative emotions).

Stress response and sleep quality: The Stanford Acute Stress Response Questionnaire (SASRQ) [14] was used to assess the stress response. SASRQ is a 6-item scale with an overall score ranging from 0 to 150 (a higher score indicates a more severe stress response). The Pittsburgh Sleep Quality Index (PSQI) [15] was used to assess the sleep quality. PSQI is a 7-item scale, with an overall score ranging from 0 to 21 (a higher score indicates worse sleep quality).

Statistical analysis

The statistical analysis was performed using SPSS 21.0 software. The levels of the outcome

measures were expressed as the mean \pm standard deviation. The intragroup comparisons between before and after the treatment were analyzed using paired t-tests, while the intergroup comparison were analyzed using independent sample t-tests. Univariate and multivariate logistic regressions were used to analyze factors affecting the hearing recovery of the patients with SHL. A difference was statistically significant when $P < 0.05$.

Results

Univariate analysis of the factors affecting the hearing recovery of SHL patients

Sex, age, BMI, income, the educational level, the number of affected ears, the degree of hearing loss, comorbidities, dizziness, and tinnitus were subjected to a univariate analysis. It turned out that age, BMI, income, the number of affected ears, the degree of hearing loss, hypertension, diabetes, hyperlipidemia, and dizziness correlated with recovery from SHL (all $P < 0.05$). More details are shown in **Table 1**.

Multivariate logistic regression analysis of the factors affecting the hearing recovery of SHL patients

The prognosis of SHL was taken as a dependent variable, while age, BMI, income, the number of affected ears, the degree of hearing loss, hypertension, diabetes, hyperlipidemia, and dizziness were taken as independent variables. The logistic regression analysis identified age, two affected ears, the degree of hearing loss, comorbid diabetes, and dizziness as independent risk factors affecting hearing recovery in SHL patients (all $P < 0.001$). More details are shown in **Table 2**.

Comparisons of the hearing ability and the negative emotion scores before and after the nursing in the two groups

There were no marked differences in the hearing ability or the negative emotion scores between the two groups before the nursing ($P > 0.05$). After the nursing, the patients in the observation group showed a superior hearing ability ($P < 0.05$) and markedly lower SAS and SDS scores ($P < 0.01$) compared with the patients in the control group. More details are shown in **Table 3** and **Figure 1**.

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Table 1. A univariate analysis of the factors affecting the hearing recovery of SHL patients

Index	Poor prognosis group (n=32)	Good prognosis group (n=60)	X ²	P
Sex			0.003	0.847
Male	18 (36.73)	31 (63.27)		
Female	14 (32.56)	29 (67.44)		
Age (years)			4.563	0.010
60-70	8 (22.22)	28 (77.78)		
>70	24 (42.86)	32 (57.14)		
BMI (kg/m ²)			6.211	0.032
≥28	22 (40.74)	32 (59.26)		
<28	10 (26.32)	28 (73.68)		
Income (Yuan/year)			4.631	0.041
≥10000	20 (37.74)	33 (62.26)		
<10000	12 (30.77)	27 (69.23)		
Educational level			1.041	0.160
Below middle school	14 (33.33)	28 (66.67)		
Above middle school	18 (36.00)	32 (64.00)		
Number of affected ears			6.177	0.021
Unilateral	31 (36.47)	54 (63.53)		
Bilateral	1 (5.88)	16 (94.12)		
Degree of hearing loss			4.914	0.010
>70 dB	24 (48.98)	25 (51.02)		
≤70 dB	8 (18.60)	35 (81.40)		
Comorbidities				
Hypertension			6.333	0.016
Yes	24 (70.59)	10 (29.41)		
No	8 (13.79)	50 (86.21)		
Hyperlipidemia			6.126	0.035
Yes	15 (34.09)	29 (65.91)		
No	17 (35.42)	31 (64.58)		
Diabetes			4.963	0.041
Yes	26 (66.67)	13 (33.33)		
No	6 (11.32)	47 (88.68)		
Dizziness			4.312	0.013
Yes	22 (51.16)	21 (48.84)		
No	10 (20.41)	39 (79.59)		
Tinnitus			0.987	0.076
Yes	16 (36.36)	32 (63.64)		
No	16 (36.36)	28 (63.64)		

Note: SHL: sudden hearing loss; BMI: body mass index.

Comparisons of the SASRQ and PSQI scores before and after the nursing in the two groups

There were no marked differences in the SASRQ and PSQI scores in the two groups before the nursing ($P>0.05$). After the nursing,

the patients from the observation group had markedly lower SASRQ and PSQI scores compared with the patients from the control group ($P<0.001$). More details are shown in **Table 4** and **Figure 2**.

Discussion

SHL is commonly seen disease in E.N.T departments. Its age of onset has tended younger recently, attracting much clinical attention [16]. SHL is a threat to human health due to its slow recovery and sequelae like deafness, mental abnormality, nausea, and vomiting. The keys to SHL treatment are early diagnosis and timely treatment to accelerate the recovery and prevent sequelae [17-19].

People most affected by SHL are generally those over 70. The recovery ability is lower in older patients, suggesting a marked correlation between age and recovery from SHL, marking age as a risk factor. According to the univariate analysis in this study, patients over 70 accounted for the majority in the poor prognosis group, far more than those aged 60 to 70 years, indicating a significant correlation between the age of 70 and recovery from SHL. The logistic regression analysis we conducted also identified the age of over 79 years as an independent risk factor for the recovery of SHL, which further suggests that the recovery ability of SHL decreases with age because of the sclerosis and decreased elasticity of the inner ear vessels in elderly patients. Sclerosis of the inner ear blood vessels in elderly patients is followed by an

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Table 2. Multivariate logistic regression analysis of factors affecting the hearing recovery of SHL patients

Index	OR	95% CI	P
Age	1.102	1.011~1.232	0.000
Number of affected ears (Bilateral)	13.321	13.211~15.211	0.000
Degree of hearing loss	1.176	1.122~1.314	0.000
With diabetes	1.031	1.318~1.431	0.000
Dizziness	1.598	1.966~2.012	0.000

Note: SHL: sudden hearing loss.

Table 3. Comparison of the two groups in their hearing ability and negative emotion scores before and after the nursing ($\bar{x} \pm sd$)

Group	Control group (n=47)	Observation group (n=45)	t	P
Hearing (dB)				
Before nursing	62.97±7.33	62.29±7.52	0.022	0.982
After nursing	60.68±6.34*	57.81±6.83*	2.090	0.039
SAS (score)				
Before nursing	45.83±4.62	45.52±4.29	0.202	0.841
After nursing	42.22±3.96*	39.92±3.35*	3.001	0.004
SDS (score)				
Before nursing	43.15±4.33	43.50±4.26	0.006	0.995
After nursing	41.11±3.13*	38.32±3.01*	4.355	0.000

Note: *compared with before the nursing, $P < 0.05$; SAS: Self-rating Anxiety Scale; SDS: Self-rating Depression Scale.

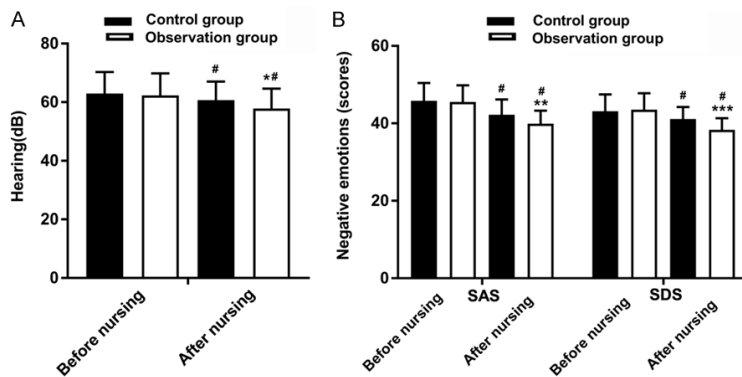


Figure 1. Comparison of the hearing levels and negative emotion scores between the two groups of patients before and after the nursing. A. Comparison of the hearing levels between the two groups of patients before and after the nursing; B. Comparison of the negative emotion scores between the two groups of patients before and after nursing; Compared with the control group, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$; Compared with before nursing, # $P < 0.05$.

increased fragility and a decreased elasticity of the blood vessels, which can cause a lower blood flow and a restricted blood supply, thereby hindering disease recovery. Knowing that the age of over 70 years is a risk factor for the

recovery of SHL, we should focus more attention on elderly patients during the clinical guidance.

A previous study proposed that the number of affected ears is linked to the recovery of SHL, with a poor recovery in patients with two affected ears, identifying two affected ears as a risk factor [20]. SHL patients with two affected ears have a markedly poorer prognosis and a slower recovery of cochlea sensory and nerve cell functions compared with patients with one affected ear [21]. According to the univariate analysis in this study, two affected ears are remarkably correlated with the recovery of SHL. The logistic regression analysis is also recognized two affected ears as an independent risk factor for the recovery of SHL. Such results identify two affected ears as an influencing factor of SHL recovery.

A former study revealed a link between the patient's blood glucose level and the recovery of SHL and discovered a poor prognosis in patients with a high blood glucose level, speculating that diabetes can affect the recovery of SHL [22]. Diabetes is a systemic chronic disease. An increase in the blood glucose and urine glucose can affect the humoral immunity and stimulate the process of glycolysis to produce acetone which causes ketoacidosis in the body. The high level of advanced glycation end products in patients with diabetes prompts macrophages to engulf lipids and produce

foam cells which accumulate on the intima of the relevant arteries and cause damage and inflammation, inducing lipid infiltration of the endarterium and an increase in the blood lipid levels, thereby aggravating the atherosclerosis

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Table 4. Comparison of the two groups in their SASRQ and PSQI scores before and after the nursing ($\bar{x} \pm sd$)

Group	Control group (n=47)	Observation group (n=45)	t	P
SASRQ (score)				
Before nursing	46.07±4.19	46.29±4.52	0.022	0.982
After nursing	42.11±3.96*	38.48±3.64*	4.613	0.000
PSQI (score)				
Before nursing	15.76±2.72	15.63±2.29	0.202	0.841
After nursing	13.22±2.06*	9.41±1.96*	9.081	0.000

Note: *compared with before the nursing, $P < 0.05$; SASRQ: The Stanford Acute Stress Response Questionnaire; PSQI: The Pittsburgh Sleep Quality Index.

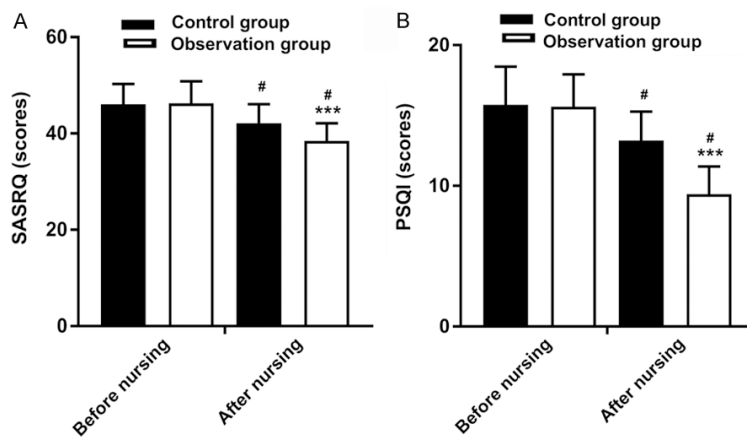


Figure 2. Comparison of the SASRQ and PSQI scores in the two groups of patients before and after the nursing. A. Comparison of the SASRQ scores in the two groups of patients before and after the nursing; B. Comparison of the PSQI scores in the two groups of patients before and after the nursing; Compared with the control group, *** $P < 0.001$; Compared with before the nursing, # $P < 0.05$.

of the inner ear feeding arteries. All these changes caused by high blood glucose levels have a negative impact on the internal environment of the body, restricting the blood circulation and oxygen and blood supply of the inner ear [23]. Therefore, diabetes can seriously affect the prognosis of patients with SHL. According to the univariate analysis in this study, comorbid diabetes is remarkably correlated with the recovery of SHL. The logistic regression analysis also suggested comorbid diabetes is an independent risk factor for the recovery of SHL. Such results identify comorbid diabetes as an influencing factor of SHL recovery. Therefore, we should take measures to control the levels of blood glucose and urine glucose in SHL patients with comorbid diabetes during their clinical treatment.

Opinions vary on whether dizziness is a risk factor restricting recovery from SHL. However, it is now understood that the degree of hearing loss is a direct factor affecting the recovery of SHL, with a slower recovery in patients with severe hearing loss [24, 25]. According to the univariate analysis in this study, dizziness and the degree of hearing loss are in significant correlation with the recovery of SHL. The logistic regression analysis also suggested dizziness and the degree of hearing loss are independent risk factors for the recovery of SHL. Such results identify dizziness and the degree of hearing loss as influencing factors of SHL recovery. Severe hearing loss and dizziness directly affect a patient's hearing ability, aggravate the patient's disability, reduce his or her self-care ability, induce more negative emotions, and hinder the physical and psychological recovery.

The personalized nursing plan in this study mainly included health education, psychological care, daily nursing, and medication guidance tailored to patients. First, we educated the patients on specific health knowledge such as the disease condition according to the personality of the patients to prepare for subsequent nursing practice. Health education proved to be beneficial to the nursing practice. The number of patients with a poor prognosis (32) was markedly smaller than the number of patients with a good prognosis in this study, suggesting the necessity and effectiveness of health education. Psychological care was the core of the personalized nursing here, aiming to understand the negative emotions of patients and relieve them to enhance the nursing cooperation of patients. The scores of SAS and SDS after nursing were markedly lower in the observation group than in the control group, suggesting a great improvement in negative emotions using personalized nursing. As the main part of

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the personalized nursing, the daily care covered diet guidance, sleep improvement, and environmental management. It provided a scientific diet and sleep plans to promote recovery and relieve complications, making the patients satisfied. The SASRQ and PSQI scores after the nursing were markedly lower in the observation group than in the control group, suggesting that personalized nursing can enhance sleep quality and relieve stress responses. The relief of stress responses may be a result of the good rest and emotional improvements of patients. Finally, we offered medication guidance according to the incidence of adverse reactions and the enthusiasm of the patients for their medication. A scientific medication can significantly enhance the treatment effectiveness and directly improve the hearing ability. Patients from the observation group had a superior hearing ability after the nursing compared with the patients from the control group, indicating that personalized nursing is better at improving hearing ability. The advantage of this study is that it analyzed the factors affecting the recovery of SHL. But it is restricted by the small number of research participants, making it less comprehensive.

In summary, the independent risk factors affecting hearing recovery in SHL patients included age, the number of affected ears, the degree of hearing loss, diabetes, and dizziness. Personalized nursing is effective in improving the hearing ability of SHL patients and deserves wide clinical promotion.

Disclosure of conflict of interest

None.

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