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Original Article

Efficacy of vestibular rehabilitation therapy for idiopathic sudden hearing loss with vertigo in vertigo and psychological status

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Abstract: Objective: To analyze how the vestibular rehabilitation therapy contributed to the recovery of patients suffering from idiopathic sudden hearing loss along with vertigo. Methods: In the randomized controlled retrospective analysis, 87 patients who were diagnosed with idiopathic sudden hearing loss and vertigo in our hospital were assigned in line with a random number table to receive routine rehabilitation instruction (control group, n=43) or vestibular rehabilitation therapy as intervention (observation group, n=44). To compare the efficacy of the two therapies, DHI, SAS & SDS, pure tone audiometry threshold, and WHOQOL-BREF were considered as four indicators to evaluate anxiety, depression, hearing and quality of life, respectively. Results: I. The observation group showed significantly lower DHI score with respect to vertigo severity than that of the control group after 1 month and 3 months of intervention (P<0.05). II. While downgrading was found of SAS and SDS in both groups post intervention, the observation group undergoing the vestibular rehabilitation therapy had markedly lower SAS and SDS scores (P<0.05). III. The pure tone audiometry thresholds of both groups decreased after 1 month and after 3 months of intervention, which was statistically significant (P<0.05). IV. In terms of quality of life, both groups were assessed at the above two time points through WHOQOL-BREF and got better results (P<0.05), in contrast to the status before treatment. V. The nursing satisfaction of the observation group was 95.45%, while that of the control group was 81.40% (X^2=4.225, P=0.040). Conclusion: Vestibular rehabilitation therapy deserved wide application as it might significantly alleviate vertigo and adverse psychological conditions, resulting in higher quality of life for patients whose idiopathic sudden hearing loss was accompanied by vertigo.

Keywords: Idiopathic sudden hearing loss, vertigo, vestibular rehabilitation therapy, vertigo severity, psychological state

Introduction

Idiopathic sudden hearing loss (ISHL) occurs as an unexplained, sudden sensorineural loss of hearing, with gradually increasing incidence over years [1]. In this condition, a 20 dB or more loss in hearing at any two adjacent frequencies will be reached within 3 days, together with vomiting, nausea and vertigo, among which vertigo is the most common concomitant symptom [2, 3].

Clinically, the majority of patients living with both ISHL and vertigo are characterized by high-frequency hearing loss, and all experience poorer recovery than ISHL patients. In them, hearing loss may be aggravated by the prevalence of vestibular impairment [4, 5]. Kuhn M et al. [6] revealed obvious damage to the labyrinth of the inner ear in ISHL complicated with vertigo. According to Zhou et al. [7], vertigo is one of the factors behind poor prognosis of ISHL, which keeps the auditory system from functioning normally. While the pathogenesis of ISHL has not been established, what has been proved is that it may be induced by systemic factors, and local factors in the inner ear, commonly including viral diseases, vascular diseases, infectious diseases, autoimmune diseases, and tumors [8, 9].

The vestibular rehabilitation therapy is a type of physical exercise for enhancing the body's ability to balance and getting better tolerance to vertigo through repeated training of the total body and body parts like head, neck, and eyes

[10, 11]. Its efficacy is still closely related to patient compliance. Previously, patients did exercises for vestibular rehabilitation by themselves upon instruction [12, 13]. In this study, 87 diagnosed patients were included and subjected to analysis on efficacy of the vestibular rehabilitation therapy under the guidance of doctors, so as to provide useful guidance for implementing clinical intervention in ISHL along with vertigo.

Materials and methods

Materials

To complete the retrospective analysis of clinical data of 87 patients that were diagnosed with ISHL and vertigo in our hospital, they were divided in line with a random number table into 2 groups. Of them, 43 constituted the control group, who were aged 37-68 years old and weighed 54-60 kg with length of stay ranging from 11 to 15 days. The remaining 44 formed the observation group, aged 38-70 years old, weighing between 55 kg and 62 kg, with length of stay ranging from 10 to 16 days. (1) Inclusion criteria: diagnosed with ISHL [14]; vertigo; no communication disorders; no mental disorder; the patients or their legal guardians signed the informed consent after informed of what was in the study which was also approved by the ethics committee of our hospital. (2) Exclusion criteria: ear trauma; space occupying lesion of external auditory canal; vertigo caused by other reasons; hereditary deafness; and mental disorders.

Methods

The control group was instructed in routine rehabilitation, principally in exercise contents and methods without continuous supervision and guidance. Then the patients did rehabilitation exercise by themselves and with the assistance of their families.

The vestibular rehabilitation therapy was performed on the patients in observation group. Basic knowledge of the intervention was delivered to patients to adapt them to the hospital upon admission. Essential assessment, examinations, and consideration introduction were subsequent. Doctors and implementers filmed exercise process and made it into a video to savvy exercise frequency, coordination methods and considerations. All implementers received training prior to the initiation of vestibular rehabilitation, and provided instruction on the whole process of daily exercises which shift nurses were responsible for and lasted for half an hour. It was briefed as follows:

(1) Horizontal head movements in a sitting position: patients remained seated, with a table in front and a target at eye level on the table. They were guided to keep both eyes on the target all the time and shake heads 30° at a constant speed. Patients turned heads from the left to the right and back to the left as a movement, which was repeated 15 times. Turning the head left stimulated the left horizontal semicircular canal, while turning right stimulated the right. (2) Vertical head movements in a sitting position: patients remained seated, with a table in front and a target at eye level on the table. They were guided to keep both eyes on the target all the time and nod at a constant speed. Moving the head down and then back up was considered as a movement, and repeated for 15 times. Head-forward posture stimulated the anterior semicircular canal, while head-backward extension stimulated the posterior. (3) Horizontal head-body movement in a sitting position: patients were sitting upright on rotating chairs. They straightened and raised one arm while thumbing up at eye level with both eyes fixed on the thumb. Subsequently, they rotated their heads and bodies from side to side. One round-trip exercise was a movement, which was repeated 15 times. (4) Horizontal head movement when standing on the legs astride: patients were standing, with legs astride. They kept their eyes on the target, and nodded at a proper speed. Patients turned heads from the left to the right and back to the left as a movement, which was repeated 15 times. Turning the head left stimulated the left horizontal semicircular canal, while turning right stimulated the right. (5) Vertical head movements when standing on the legs astride: patients were standing, legs astride. They kept their eyes on the target, and nodded at a proper speed. Moving the head down and then back up was considered as a movement, which continued for 15 times. Head-forward posture stimulated the anterior semicircular canal, while head-backward extension stimulated the posterior. (6) Head-body movement when standing on the legs astride: patients were standing, with legs astride. They straightened

Table 1. Comparison of general data ($\bar{x}$ ± sd)/[n (%)]

		Observation group (n=44)	Control group (n=43)	t/χ^2	*P*
Gender	Male	23 (52.27)	24 (55.81)	0.110	0.740
	Female	21 (47.73)	19 (44.19)		
Age (years old)		53.75±12.49	54.94±12.44	0.445	0.657
Height (cm)		162.45±10.49	164.80±12.34	0.958	0.341
Weight (kg)		56.83±4.49	57.81±5.26	0.935	0.352
Length of stay (d)		14.12±1.63	14.08±1.37	0.124	0.902

and raised one arm while thumbing up at eye level with both eyes fixed on the thumb. Then they rotated their heads and bodies from side to side. One round-trip exercise was a movement, which was repeated 15 times. (7) Horizontal head movement upon standing with feet together: patients were standing with their feet together. With their eyes on the target, patients shook their heads 30° from the left to the right and back to the left at an appropriate speed, which was a movement and repeated for 15 times. Turning the head left stimulated the left horizontal semicircular canal, while turning right stimulated the right.

Observation indicators

Vertigo severity: both groups were evaluated regarding vertigo before intervention, after one month and three months of intervention with the dizziness handicap inventory (DHI) [15]. DHI was a 25-item inventory to evaluate the body, function and emotion. A "Yes" in each item counted for 4 scores, an "Occasional" for 2, and a "No" for 0. The higher the score, the severer the vertigo. Ranging from 0 to 100 points, DHI scores were graded as mild (≤30 points), moderate (31-60), and severe (61-100).

Anxiety and depression: the self-rating anxiety scale (SAS) and the Self-rating depression scale (SDS) [16] developed by William W.K. Zung were used to evaluate patients' anxiety and depression before and after intervention respectively. Both have 20 items, with each item using a 4-point scale. With total points between 20 and 80, 50-80 indicated anxiety and depression. The higher the score, the severer the anxiety and depression.

Hearing: the two groups took the tests of the pure tone audiometry thresholds before, 1 month after, and 3 months after intervention, respectively.

Quality of life: the World Health Organization Quality of Life Scale-Brief Form Questionnaire (WHOQOL-BREF) [17] was used to evaluate the quality of life before, 1 month after, and 3 months after intervention, respectively. It consists of 26 items in 4 fields: physiology, psychology, social relation and environment. It is a 5-point Likert scale with a total score of 104 points. The higher the score, the better the quality of life is.

Nursing satisfaction: the patient's satisfaction with the nursing was investigated post intervention from the aspects of nurse attitude, nursing method, nurse-patient relationship, exercise method, and exercise selection. It was rated as satisfied, neither satisfied nor dissatisfied, and dissatisfied based on what patients felt about the nursing. The total satisfaction = "satisfaction" rate + "neither satisfaction nor satisfaction" rate.

Statistical analysis

SPSS Statistics V22.0 was used for the statistical analysis. A mean plus or minus one standard deviation defines the measurement data, which were compared herein intra or inter group with the independent-samples *t* test. The count data were expressed as [n (%)] and analyzed between groups and within groups through X^2. The results were considered statistically significance at $P<0.05$.

Results

Comparison of general data in observation and control groups

Male (52.27%) and female (47.73%) ratios, average age (53.75±12.49 years), average height (162.45±10.49 cm), average weight (56.83±4.49 kg), and average length of stay (14.12±1.63 d) in observation group had no obvious difference compared with those in control group ($P>0.05$) (**Table 1**).

Comparison of vertigo severity in observation and control groups

The DHI score concerning vertigo severity was 51.34±5.92 and 50.94±6.78 before interven-

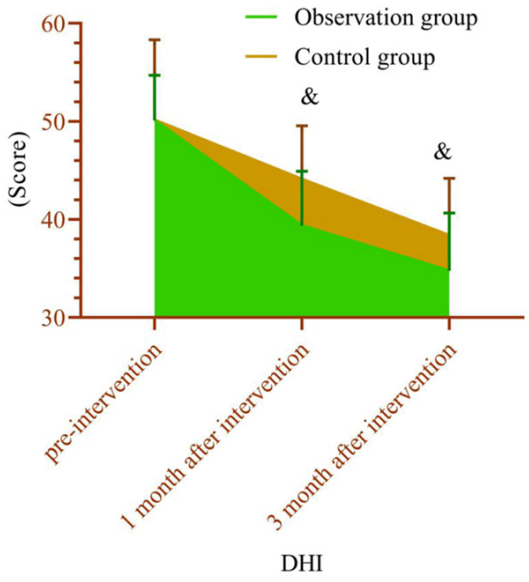

Figure 1. Comparison of DHI score between the observation and control groups. The observation group did not differ a lot from the control group in DHI score before intervention (P>0.05), but showed significant decrease after one month (P<0.05) and after three months of intervention (P<0.05) compared with the control group. &Shows P<0.05 when the time point was compared in two groups.

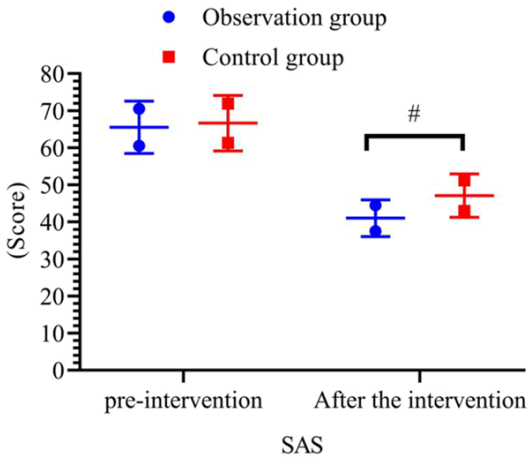

Figure 2. Comparison of SAS scores between the observation and control groups. The observation group did not differ a lot from the control group in SAS score before intervention (P>0.05) while it showed significant decrease after intervention (P<0.05) compared with the control group. #Indicates P<0.05 when SAS was compared in two groups after intervention.

tion, 40.95±4.37 and 44.75±4.65 after 1 month of intervention, 34.79±3.76 and 38.16±4.29 after 3 months of intervention in the observation group and the control group, respectively. It followed that the two groups showed no significant difference in DHI score before intervention (P>0.05) while the observation group had obviously lower DHI scores after 1 month and 3 months of intervention (P<0.05) (**Figure 1**).

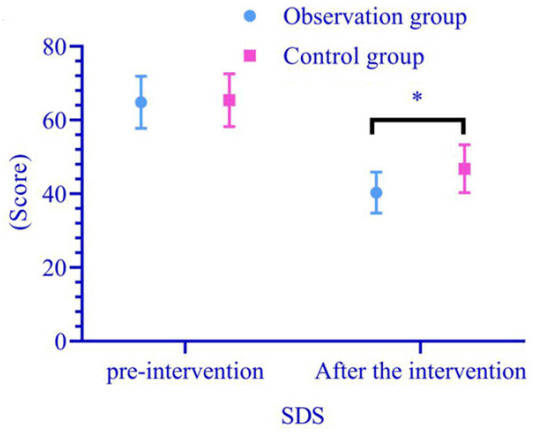

Figure 3. Comparison of SDS scores between the observation and control groups. The observation group did not differ a lot from the control group in SDS score before intervention (P>0.05) while SAS read significant less scores in the observation group after intervention (P<0.05). *Indicates P<0.05 when SDS was compared in two groups after intervention.

Comparison of anxiety and depression in observation and control groups

SAS read 65.49±5.27 points and 66.49±5.43 points before intervention, and 41.39±3.75 and 47.61±4.29 post intervention in the observation group and the control group, respectively. SDS scores were 64.89±5.75 and 65.92±5.73 before treatment while 40.68±4.21 and 46.92±4.37 post treatment, in observations and controls. The two groups did not differ significantly in SAS and SDS scores before intervention (P>0.05). But decreases were found in both indicators after intervention in the two groups, of which the observation group showed significantly lower scores (P<0.05) (**Figures 2** and **3**).

Comparison of hearing in observation and control groups

The pure tone audiometry threshold in observation group (61.53±12.49) did not reveal significant difference than that of control group (60.38±11.75) before intervention (P>0.05). Nevertheless, after 1 month of intervention, the pure tone audiometry threshold in observation group (46.38±8.79) and control group (52.34±9.68) were decreased compared with

Table 2. Comparison of pure tone audiometry threshold before and after intervention ($\bar{x}$ ± sd, points)

	Before intervention	After 1 month of intervention	After 3 months of intervention
Observation group (n=44)	61.53±12.49	46.38±8.79	37.49±7.63
Control group (n=43)	60.38±11.75	52.34±9.68	44.27±8.62
t	0.442	3.008	3.887
P	0.660	0.004	0.000

Table 3. Comparison of quality of life before and after intervention ($\bar{x}$ ± sd, points)

	Before intervention	After 1 month of intervention	After 3 months of intervention
Observation group (n=44)	52.34±10.49	69.86±11.43	78.84±12.65
Control group (n=43)	51.94±9.87	61.75±11.38	70.49±11.34
t	0.183	3.316	3.239
P	0.855	0.001	0.002

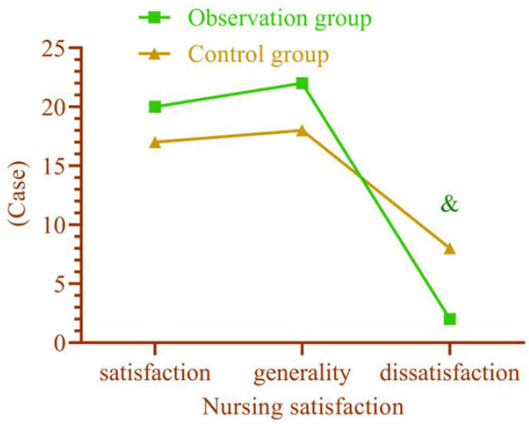

Figure 4. Comparison of nursing satisfaction between the observation and control groups. The observation group differed slightly from the control group in the proportion of patients who were satisfied with the nursing (*P*>0.05) and who were neither satisfied nor dissatisfied (*P*>0.05) but those dissatisfied with the nursing were in an obviously lower proportion in the observation group (*P*<0.05) than in the control group. &Indicates *P*<0.05 when the dissatisfaction was compared in two groups.

that of before intervention, indicating that intra-group comparison was statistically significant (*P*<0.05). After 3 months of intervention, the pure tone audiometry threshold in observation group (37.49±7.63) and control group (44.27±8.62) were significantly decreased compared with those after 1 month of intervention, indicating that intra-group comparison was statistically significant (*P*<0.05). After 1 and 3 months of interventions, the pure tone audiometry threshold in observation group was obviously lower than that of control group, respectively (*P*<0.05) (**Table 2**).

Comparison of quality of life

Before intervention, the quality of life in observation group (52.34±10.49) was not significantly different from that of control group (51.94±9.87) (*P*>0.05). The quality of life scores in observation group (69.86±11.43) and control group (61.75±11.38) after 1 month of intervention were increased compared with those before intervention, and the comparison within the group was statistically significant (*P*<0.05). The quality of life scores in observation group (78.84±12.65) and control group (70.49±11.34) after 3 months of intervention were increased compared with those before intervention and 1 month after intervention, and the comparison within the group was statistically significant (*P*<0.05). The quality of life score of the observation group was significantly higher than that of the control group 1 month and 3 months after intervention (*P*<0.05) (**Table 3**).

Comparison of nursing satisfaction

Those who expressed satisfaction with the nursing totaled 20 in the observation group, against 17 in the control group. 22 in the observation group and 18 in the control group were neither dissatisfied nor satisfied. Two were dissatisfied in the observation group in comparison to 8 in the control group. Nursing satisfaction was 95.45% in the observation group, while it was 81.40% in the control group, which difference was statistically significant (X^2= 4.225, *P*=0.040) (**Figure 4**).

Discussion

ISHL occurs with vertigo as an unexplained, sudden loss of hearing, during which balance dysfunction is developed. It will lead to poor physical and mental performance, especially in patients not fully aware of the disease. ISHL

correlates with mental health to form a vicious circle in which ISHL generates negative emotions, and negative emotions aggravate ISHL [18]. In this case, medication alone cannot achieve satisfactory results unless it has synergism with rehabilitation exercises, generating higher efficacy.

The vestibular system is important for the human body as it maintains balance and coordinated movements including eye-head coordination, total balance and visual acuity [19]. Vestibular functions are exerted in persistent, proper exercises; otherwise, refusal of movements for fear of vertigo or fall will exercise a negative influence over vestibular functions and deteriorate vertigo, making the two into a vicious circle [20]. The vestibular rehabilitation, which was highly specialized, was a non-traumatic and non-medication physical therapy for the injured vestibule in the study. It can gradually recover the injured vestibule, mitigate vertigo, and improve the ability to balance in patients with ISHL [12]. In the study, the observation group which received vestibular rehabilitation had much lower DHI scores than the control group after 1 month and 3 months of intervention ($P<0.05$), and so it was in terms of the pure tone audiometry threshold ($P<0.05$) while WHOQOL-BREF scores were on the contrary ($P<0.05$). Besides, post-treatment SAS and SDS scores of the observation group were significantly lower than those of in the control group ($P<0.05$). In the observation group, 95.45% of patients were satisfied with nursing, significantly higher than 81.40% in the control group ($X^2=4.225$, $P=0.040$). This demonstrated such favorable outcomes of vestibular rehabilitation as less severe vertigo, less negative emotions, better hearing, higher quality of life, better rehabilitation, and higher nursing satisfaction.

Vestibular rehabilitation is an easy-to-learn/use therapy with high safety but no side effects, which is feasible in each period of vertigo attack. It may effectively act on unilateral vestibular dysfunction and bilateral vestibular dysfunction [13]. Jahn K et al. [21] found that vestibular rehabilitation can lower the recurrence rate in patients with vertigo, and vestibular rehabilitation was reported by Sparrer I et al. [22] to relieve negative emotions in addition to suppressing vertigo. Most ISHL patients are disinclined to exercises due to vertigo at the early stage, but some studies believe that the earlier rehabilitation exercises start after onset of ISHL, the faster people rehabilitate. It is of vital importance to enhance patient compliance in treating vestibular disorder caused by vertigo-induced balance diseases [23]. For best rehabilitation, patients were subject to whole-process intervention and guidance in the study to ensure the continuity, accuracy and effectiveness of the exercises. By comparison between medication alone and medication-vestibular-rehabilitation combination therapy by Basta D et al. [24], it was found that the latter was much more effectively in relieving vertigo and anxiety. Wan L et al. [25] reported that vestibular rehabilitation after routine treatment provides the leading contribution to faster rehabilitation, shorter length of stay, and higher patient satisfaction.

Vestibular rehabilitation is valuable in application. To implement intervention via vestibular rehabilitation can significantly alleviate vertigo and adverse psychological conditions while improving the quality of life in patients suffering from ISHL along with vertigo. However, it was a retrospective analysis study with too fewer subjects and indicators to fully disclose the application value of vestibular rehabilitation. Longer and more comprehensive prospective studies with larger sample sizes should be preferred in the future to make results more comprehensive and to provide more guidance for treating ISHL along with vertigo.

Disclosure of conflict of interest

None.

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