Original Article

The Efficacy of Nurse-Led Hyperbaric Oxygen Therapy in Improving the Quality of Life in Patients with Sudden Hearing Loss

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Abstract

Background: The quality of life decreases in patients with sudden hearing loss due to hearing problems. In addition, complications due to hyperbaric oxygen therapy can reduce the quality of life. **Aim:** This study was conducted to examine the efficacy of nurse-led hyperbaric oxygen therapy in improving the quality of life in patients with sudden hearing loss. **Subjects and Methods:** This one-group pretest-posttest design study was conducted with 34 patients with Sudden Hearing Loss who applied to a university hospital for Hyperbaric Oxygen Therapy between November 2018 and February 2019. The data were collected using the Patient Information Form, World Health Organization Quality of Life Scale (WHOQOL-BREF), and Pure Tone Threshold Audiogram. **Results:** WHOQOL-BREF's quality of life rating (2.59 ± 0.86–3.68 ± 0.59), satisfaction with health status (2.65 ± 0.69–3.62 ± 0.60), physical domain (11.58 ± 2.08–14.84 ± 2.38), psychological domain (12.80 ± 2.21–15.82 ± 2.26), social domain (14.63 ± 3.09–16.78 ± 2.67) and environmental domain (14.25 ± 2.55–16.34 ± 2.60) mean scores significantly increased compared to the pre-treatment scores ($p < 0.001$). The presence of an acute illness in the last month, the persistence of sudden hearing loss symptoms, level of hearing loss, presence of chronic illness, and smoking were found to affect the quality of life. **Conclusions:** At the end of the nurse-led hyperbaric oxygen therapy in patients with sudden hearing loss, the quality of life increased and the hearing loss decreased. The most important factor affecting the quality of life was the persistence of symptoms of sudden hearing loss.

Keywords: *Hyperbaric oxygen therapy, nursing, quality of life, sudden hearing loss*

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Introduction

Sudden hearing loss (SHL) is defined as a sensorineural type of hearing loss that starts within 72 h and presents with a hearing loss of 30 dB or more at 3 consecutive frequencies.[1,2] Annual incidence of SHL is estimated to be 5–20/100,000.[3] Individuals suffering from SHL experience problems such as social isolation, fear, depression, anxiety, functional and cognitive impairments, decreased self-confidence, disappointment, and decreased communication. These problems lead to distancing from daily life, resulting in a decrease in psychological well-being and negatively affecting the quality of life of individuals. Studies evaluating the quality of life of patients with SHL have reported low levels of quality of life.[4-10]

Hyperbaric oxygen therapy (HBOT) is one of the treatments applied in SHL.[11,12] The aim of HBOT is to utilize hyperbaric oxygenation to increase the oxygen level in the inner ear due to the higher rate of oxygen dissolution in plasma and thus prevent or mitigate ischemic damage.[13,14] Studies examining the effect of HBOT on the hearing levels of individuals with SHL have reported significant improvements.[15-20] However, complications such as transient myopia, a feeling of fullness in the ears, pain, and dizziness may develop due to hyperbaric oxygen

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therapy.[13] In addition to hearing problems, complications related to HBOT negatively affect the quality of life in patients with SHL. Hyperbaric nurses positively contribute to the quality of life of patients by keeping the patient informed, correctly applying HBOT, monitoring the patient during and after treatment, and evaluating the patient in terms of treatment complications.[21-23]

Hyperbaric oxygen therapy is a new field of work for nurses.[21] Nurses undertake key responsibilities in hyperbaric oxygen therapy units by educating and guiding the patient, in compliance with the treatment, in preventing complications, and therefore in increasing the quality of life. Today the largest patient group admitted to these units is patients with SHL. Although studies evaluating the quality of life in patients with SHL exist, to the best of our knowledge, no study has focused on patients with SHL who are receiving HBOT. Therefore, this study aims to examine the efficacy of nurse-led hyperbaric oxygen therapy in improving the quality of life in patients with sudden hearing loss.

Research questions

1. Is nurse-led hyperbaric oxygen therapy effective in improving the quality of life in patients with sudden hearing loss?
2. What are the factors associated with the quality of life in patients with sudden hearing loss receiving nurse-led hyperbaric oxygen therapy?

Materials and Methods

Design and sample

This one-group pretest-posttest design study was conducted in the HBOT centre of a university hospital located in the Central Anatolia region of Turkey between November 2018 and February 2019.

A moderate change was predicted between the quality of life scores of individuals before and after treatment, and the power analysis performed with a 5% alpha error margin and 80% power revealed that the minimum sample size for the study was 34. The study sample comprised 34 patients who were 18 years of age or older, who were literate, who were receiving HBOT due to SHL, and who volunteered to participate in the study.

Data collection tools

The data of the study were collected using the Patient Information Form, World Health Organization Quality Of Life Scale WHOQOL-BREF-TR, and Pure Tone Threshold Audiogram.

Patient information form

Pre-test: The form developed by the researchers[2,24] included 14 questions on gender, age, educational status, marital status, occupation, cohabitants, smoking, presence of chronic disease, (acute) disease within the last month, medications used, duration of hearing loss, how the SHL complaints started, whether the patient received any other treatment for hearing loss other than HBOT and level of SHL.

Post-test: This form included questions on whether the patient received any treatment other than HBOT, the number of HBOT sessions, the level of SHL, the persistence of symptoms, and whether the patient continued smoking after treatment.

World Health Organization quality of life instruments (WHOQOL-BREF-TR)

WHOQOL-BREF has been developed for practical use, considering the field study data of WHOQOL-100. WHOQOL-BREF-TR comprises 27 questions, 26 global and one national question. Since it shows the highest correlation with the environmental domain, the 27th question is named Environment TR.

Two of the 26 questions in the scale assess the quality of life in general. One of these questions affords the health score as a whole, and the other affords the quality of life score as a whole. Questions were asked to be answered while considering the last 15 days. The evaluation comprises a 5-point Likert-type scale. The WHOQOL-BREF subscales are as follows: Physical Domain, Psychological Domain, Social Domain, Environmental Domain.

The validity and reliability study of the Turkish form was conducted by Eser *et al*. (1999).[25] The domain scores of the scale are obtained by multiplying the average score of the items that make up that domain by four. Domain scores range from 4 to 20. The higher the domain scores, the higher the quality of life. A total score is not calculated for the scale.

Pure tone threshold audiogram

Functional defects in the corti organ and central nervous system connections in the inner ear cause sensorineural hearing loss. Hearing loss can be mild, moderate, severe, or severe/total. The degree of hearing is measured by pure tone audiometry. The loudness, or intensity, of the sound, is expressed in decibels (dB), which is the physical measurement unit. In audiometry, the sound heard at different frequencies is recorded according to the dB scale, with 'O' for the right ear and 'X' for the left ear. Classification of hearing loss according to pure tone audiometry is as follows: 20–40 dB, mild hearing loss; 41–60 dB, moderate hearing loss and 61–80 dB, severe hearing loss.[13]

Intervention

The physician makes the decision to take HBOT for patients who have SHL. The nurse provides information before the treatment, guides and monitors the patient during the session, and provides the transfer of the patient after the session.

The patient who came to the center for the first session of HBOT was greeted by the nurse and dressed in cotton clothes specially prepared for the treatment. Afterward, the patient was trained by the nurse. In the training, what HBOT is and the purpose of its application, the cabin in which HBOT is applied and its features, what to pay attention to in the cabin (no metal objects, not smoking, not using the phone, etc.) and how to do ear equalization were explained. Since the hearing loss is usually unilateral in the patients, education was given by speaking aloud. In only one patient, training was given by using the writing method as well as verbal narration.

A total of 12 patients and a nurse responsible for these patients took part in each session. During the first 20 minutes of the two-hour sessions, two-three ATA pressure was applied to the cabin. In the meantime, the nurse made the patients do the Valsalva maneuver, swallowing, and yawning so that the patients could do the ear equalization. Afterward, 100 percent oxygen was administered to the patients by the nurse for 25 minutes through a mask, hood, or if the patient was intubated, by means of a ventilator, and then a five-minute break was given. This circulation was repeated three times and the session was ended by exiting in the last 15 minutes. In addition, during the session, the nurse monitored the symptoms such as respiratory distress, oxygen toxicity, hypoglycemia, numbness in the hands, and fatigue in the patients and checked the cabin for fire. Patients receiving treatment with the diagnosis of AIK are given a hearing test every five sessions, and the treatment process is decided as a result of the physician's evaluation. Patients participating in this study received HBOT between 10 and 20 sessions.

Collection of data

Before collecting the research data, the patients were provided with the necessary explanations, and their written and verbal consent were obtained. Then, the questionnaire form was filled in by the patients. Right before the first HBOT session, the pre-test information form and the WHOQOL-BREF-TR were given to patients diagnosed with SHL and that planned to receive HBOT. Similarly, the post-test information form and WHOQOL-BREF-TR were applied after the last HBOT session. The audiogram results before and after treatment of the individuals were obtained from the patient file by the researcher and recorded in the data collection form.

Ethical considerations

Ethics committee approval was obtained from a university hospital's Drug and Non-Medical Device Research Ethics Committee (2018/1445), and institutional permission was obtained from the hospital where the study was conducted. Permission to use the form was obtained from the author of the scale. In addition, the participants were informed about the research, and their verbal and written consents were obtained.

Evaluation of data

SPSS 22 (Statistical Package for Social Sciences) package program was used to evaluate the data. Data were presented as number, percentages, and mean. Dependent samples t-test, skewness, and kurtosis test, Wilcoxon signed rank test, and Mann–Whitney U test were used to analyze the data. Independent variables that had an effect on the quality of life scores in primary analyses were re-evaluated using simple and multiple regression analyses. $P < 0.05$ was considered to be significant.

Results

The mean age of patients was 43.97 ± 15.64 years. 52.9% were male, 41.2% of them started treatment

Table 1: Sociodemographic characteristics of the patients

Characteristics	Minimum–Maximum	x̄±SD
Age	18-75	43.97±15.64
	n	%
Gender		
Female	16	47.1
Male	18	52.9
Educational level		
Primary school	15	44.1
Middle School	5	14.7
High school	5	14.7
University and above	9	26.5
Marital status		
Married	24	70.6
Single	10	29.4
Employment Status		
Employed	18	52.9
Unemployed	16	47.1
Cohabitants		
Living Alone	5	14.6
Living with spouse	11	32.4
Living with spouse and children	14	41.2
Living with parents	4	11.8
Smoking		
Yes	13	38.2
No	21	61.8

Table 2: Disease characteristics of the patients

Characteristics	*n*	%
Chronic Illness		
Yes	13	38.2
No	21	61.8
Existing Chronic Disease[1]		
Diabetes Mellitus	9	69.2
Hypertension	8	61.6
Coronary Artery Disease	2	15.4
Other[2]	4	30.8
Acute Disease in the Last Month		
Yes	11	32.4
No	23	67.6
Acute Disease in the Last Month		
URTI	6	17.6
Trauma/loud noise	4	11.9
URTI and trauma	1	2.9
No	23	67.6
Starting Treatment After SHL		
Within 0-7 days	14	41.2
Within 8-14 days	7	20.6
After 15 days or more	13	38.2
Number of HBOT Sessions Received		
10 sessions	18	53
13 sessions	2	5.9
15 sessions	6	17.6
20 sessions	8	23.5
Persistence of SHL Symptoms		
Yes	15	44.1
No	19	55.9
	Min-Max	**x̄±SD**
Onset of Hearing Loss (Days)	0-30	13.44±10.00

[1]More than one chronic disease options have been marked. [2]One person each; Goiter, SVO, FMF and Reflux

Table 3: characteristics of patients before and after treatment

Characteristics	Before Treatment		After Treatment	
	n	%	*n*	%
SHL Onset Symptoms[1]				
Tinnitus	29	85.3	14	41.2
Buzzing	28	82.4	14	41.2
Nausea and vomiting	8	23.5	3	8.8
Ear-headache	7	20.6	2	5.9
Dizziness	3	8.8	1	2.9
Level of Hearing Loss in the Right Ear				
Mild (20–40 dB)	20	58.8	27	79.4
Moderate (41–60 dB)	7	20.6	4	11.8
Severe (61–80 dB)	6	17.6	2	5.9
Severe/total hearing loss (>80 dB)	1	2.9	1	2.9
Level of Hearing Loss in the Left Ear				
Mild (20–40 dB)	18	52.9	25	73.5
Moderate (41–60 dB)	7	20.6	3	8.8
Severe (61–80 dB)	5	14.7	4	11.8
Severe/total hearing loss (>80 dB)	4	11.8	2	5.9

[1]More than one option has been marked

within 0–7 days after the development of SHL, 52.9% received 10 sessions of HBOT and 55.9% did not have SHL symptoms after treatment [Tables 1 and 2].

Tinnitus was observed at a rate of 85.3% before treatment, which reduced to 41.2% after treatment. Mild (20–40 dB) hearing loss in the right ear was observed at a rate of 58.8% before treatment, which increased to 79.4% after treatment. Similarly, mild (20–40 dB) hearing loss in the left ear was observed at a rate of 52.9% before treatment, which increased to 73.5% after treatment [Table 3].

Table 4 shows the comparison of the patients' mean WHOQOL-BREF-TR scores before and after HBOT. WHOQOL's 'How would you rate your quality of life?' (2.59 ± 0.86–3.68 ± 0.59), 'How satisfied are you with your health?' (2.65 ± 0.69–3.62 ± 0.60), physical domain (11.58 ± 2.08–14.84 ± 2.38), psychological domain (12.80 ± 2.21–15.82 ± 2.26), social domain (14.63 ± 3.09–16.78 ± 2.67), and environmental domain (14.25 ± 2.55–16.34 ± 2.60) mean scores significantly increased compared to pre-treatment scores ($p < 0.001$, Table 4).

In the multiple regression analysis conducted to evaluate the effect of independent variables that were determined to have an effect on WHOQOL-BREF sub-dimension scores of individuals suffering from SHL;

'Level of hearing loss in the left ear' was excluded from the regression model because it did not have a sufficient effect on the 'How would you rate your quality of life?' score ($p > 0.05$). Moreover, the 'persistence of SHL symptoms' and 'having an acute illness within the last month' variables that remained in the model had a 46% effect on the item score [Table 5].

'Level of hearing loss in the left ear' was excluded from the regression model because it did not have a sufficient effect on the 'How satisfied are you with your health?' item score ($p > 0.05$). Furthermore, the 'persistence of SHL symptoms' explained 27% of the change in the subscale score ($p < 0.001$) [Table 5].

'Level of hearing loss in the left ear' was excluded from the regression model because it did not have a significant effect on the physical domain score ($p > 0.05$). In addition, the 'persistence of SHL symptoms' ($p < 0.001$) and 'chronic disease status' ($p < 0.05$) variables that remained in the model explained 32% of the change in the physical domain score [Table 5].

Simple regression analysis was performed to evaluate the effect of the variable 'persistence of SHL symptoms' on the psychological domain score, and it was found that

Table 4: WHOQOL-BREF score distributions with respect to HBOT affecting quality of life

World Health Organization Quality of Life Instruments Items and Domains		Before Treatment x̄±SD	After Treatment x̄±SD	*t*	*P*
Item[1]	1. How would you rate your quality of life?	2.59±0.86	3.68±0.59	8.421	<0.001
	2. How satisfied are you with your health?	2.65±0.69	3.62±0.60	6.783	<0.001
Domain[2]	Physical	11.58±2.08	14.84±2.38	8.172	<0.001
	Psychological	12.80±2.21	15.82±2.26	8.782	<0.001
	Social	14.63±3.09	16.78±2.67	4.515	<0.001
	Environment	14.25±2.55	16.34±2.60	5.535	<0.001

t: *t* test for dependent groups, df: 33. [1]Possible score range 1-5 points. [2]Possible score range of the domains 4-20 points

Table 5: The effect of independent variables on WHOQOL-BREF score: Multiple regression analysis results

Independent variables	B	S. Error	β	*t*	*P*	95% Confidence Interval for B	
Quality of Life (Item 1)							
(Constant)	2.07	0.31		6.759	<0.001	1.44	2.69
Persistence of SHL symptoms	0.69	0.15	0.59	4.624	<0.001	0.39	1.00
Having an acute illness in the past month	0.40	0.16	0.32	2.509	0.018	0.07	0.72
R: 0.70 Adjusted R^2: 0.46 F: 15.27 *P*:<0.001 Durbin Watson: 1.54							
Health Status (Item 2)							
(Constant)	2.64	0.30		8.944	<0.001	2.04	3.24
Persistence of SHL symptoms	0.63	0.18	0.52	3.483	0.001	0.26	1.00
R: 0.52 R^2: 0.27 *F*: 12.13 *P*:<0.001 Durbin Watson: 1.69							
Physical Domain							
(Constant)	8.90	1.48		6.026	<0.001	5.89	11.91
Persistence of SHL symptoms	2.03	0.69	0.43	2.948	0.006	0.63	3.43
Presence of chronic illness	1.72	0.70	0.36	2.442	0.020	0.28	3.15
R: 0.60 Adjusted R^2: 0.32 *F*: 8.64 *P*:<0.001 Durbin Watson: 1.59							
Psychological Domain							
(Constant)	11.73	1.05		11.129	<0.001	9.58	13.88
Persistence of SHL symptoms	2.63	0.64	0.58	4.078	<0.001	1.31	3.94
R: 0.59 R^2:0.34 *F*: 16.63 *P*:<0.001 Durbin Watson: 1.53							
Social Domain							
(Constant)	9.86	1.45		6.787	<0.001	6.90	12.82
Persistence of SHL symptoms	2.98	0.71	0.56	4.187	<0.001	1.53	4.43
Having an acute illness in the past month	1.72	0.75	0.31	2.285	0.029	0.19	3.26
R: 0.67 Adjusted R^2:0.41 *F*: 12.56 *P*:<0.001 Durbin Watson: 2.19							
Environmental domain							
(Constant)	11.59	1.20		9.648	<0.001	9.14	14.04
Persistence of SHL symptoms	3.05	0.73	0.59	4.150	<0.001	1.55	4.54
Continued smoking	1.40	0.75	0.27	1.866	0.072	-0.13	2.94
R: 0.59 R^2:0.35 *F*: 17.22 *P*: <0.001 Durbin Watson: 2.51							

the variable explained 34% of the change in the domain score ($p < 0.001$) [Table 5].

'Level of hearing loss in the left ear' and 'smoking status' were excluded from the regression model because they did not have a sufficient effect on the social domain score ($p > 0.05$). The remaining two variables in the model (persistence of SHL symptoms and having an acute illness in the last month) explained 41% of the change in the social domain score [Table 5].

'Smoking status' was excluded from the regression model because it did not have a significant effect on the environmental domain score ($p > 0.05$). 'Persistence of SHL symptoms' explained 35% of the change in the environmental domain score ($p < 0.001$) [Table 5].

Discussion

In this study, the quality of life increased and the hearing loss decreased after HBOT in patients with SHL compared to pre-treatment levels. To the best of our knowledge, no study in the literature has evaluated whether HBOT affects the quality of life in individuals with SHL. In addition, studies evaluating the effect of HBOT in patients with SHL have reported a decrease in patients' complaints and an improvement in hearing

levels.[1,15,18-20] Based on these findings, we can conclude that the quality of life of individuals increases with the decrease in complaints and the increase in hearing level, as they start to communicate better. In addition, studies examining the quality of life in other patient groups receiving HBOT exist. Harding *et al*.[26] found that HBOT increased the quality of life in patients with radionecrosis, and Löndahl *et al*.[27] and Kavurmacı *et al*.[28] found that HBOT increased the quality of life in patients with diabetic foot.

In the present study, the persistence of SHL symptoms was found to be the only variable that was effective on all sub-dimensions of the quality of life scale. Bogaz *et al*.,[29] Chin *et al*.[30] and Zivaljevic *et al*.[31] reported that the most common symptom accompanying SHL was tinnitus. Persistence of SHL symptoms, such as tinnitus and humming, causes the patients to experience communication and sleep problems in their daily life and negatively affects their quality of life.

'Having an acute illness in the last month' was the variable with the second highest effect on the quality of life of patients with SHL receiving HBOT. Viral infections and acute diseases in the last month are risk factors for SHL of unknown cause.[2,11] Findings such as aural fullness, tinnitus, humming, and dizziness experienced in SHL are often thought to be caused by diseases such as upper respiratory tract infection and delay in the diagnosis of SHL, which result in late initiation of treatment. One of the most important factors that increase recovery for SHL has been stated to be early initiation of treatment.[13,24] The difference in the present study can be attributed to the quicker admission of these patients to health institutions and early initiation of treatment.

Quality of life is adversely affected in patients with SHL receiving HBOT due to both hearing loss and problems related to HBOT. Nurses working with this patient group contribute to patient care by evaluating and monitoring the quality of life and determining appropriate interventions. Although nurses are very knowledgeable and experienced in caring for patients with hearing problems, HBOT is a fairly new field of study for them. Baromedical Nurses Association (BNA) provides guidance for nurses in the Guidelines of Nursing Care for the Patient Receiving HBOT, which was revised in 2018.[21] However, no national care guidelines are present in Turkey that hyperbaric nurses can use in patient care. The creation of HBOT-specific nursing care guidelines and specialization of nurses in this field through certification will be effective in improving the quality of life of patients.

Conclusion

The quality of life increased and the hearing loss decreased at the end of nurse-led HBOT in patients with SHL, and the factors affecting the quality of life were 'having an acute illness in the last month', 'persistence of SHL symptoms', 'level of hearing loss', 'presence of chronic disease' and 'smoking'. Although nurses are quite knowledgeable and experienced in the care of patients with hearing problems, HBOT is a relatively new therapy for them. The effects of nursing interventions and guidance during HBOT on quality of life are not clearly defined. Care guidelines for nurses should be developed in HBOT units and the effects of these on patient care should be evaluated in future studies.

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Conflicts of interest

There are no conflicts of interest.

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