Visual analog scale in hearing loss

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Abstract

Objective To determine if visual analog scale (VAS) that has been used to measure magnitude of internal states such as pain, mood and various functional capabilities can be applied for patients with hearing loss.

Materials and methods One hundred and sixty patients, aged 12–80 years with unilateral hearing loss were studied using a VAS (1–10) and pure tone audiometry (PTA) of responses to 500, 1,000 and 2,000 Hz to determine degree and type of hearing loss. The results of both were compared to determine if VAS can be used in measuring hearing loss.

Results Patients with mild, moderate hearing loss correlate well with corresponding VAS but other degrees of hearing loss (severe and profound) have poor correlation. The best correlation between PTA and VAS were found in conductive type of hearing loss.

Conclusion This study suggest that there may be a role for VAS in mild and moderate hearing loss. This may be more applicable in rural setting as a screening procedure when audiometry is not available and can enhance clinical hearing assessment especially in mild-to-moderate conductive hearing loss.

Keywords Visual analog scale · Hearing loss

Introduction

A visual analog scale (VAS) is a measurement that tries to measure a characteristic or attitude across a continuum of values that cannot easily be directly measured [1]. Operationally a VAS is usually a horizontal line, 100 mm in length, anchored by word descriptors at each end. The patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in millimeters from the left hand end of the line to the point that the patient marks. There are many other ways in which VAS have been presented, including points rating scale, numerical rating scale, vertical, horizontal and mechanical VAS [2].

Although, there have been studies in self reported hearing loss with questionnaire comparing to pure tone audiometry (PTA) [3, 4]. There is no study to establish VAS in hearing loss so far and hence this study.

A 5-point scale was used for VAS and for degree of hearing loss, the American Academy of Audiology Classification [5] in which has 5 types of degree of hearing loss was used:

- Normal range or no impairment = 0–25 db
- Mild loss = 26 d–40 db
- Moderate loss = 41–70 db
- Severe loss = 71–90 db
- Profound loss = 90 db or more.

Materials and methods

A total of 160 patients who attended otolaryngology clinic with complaint of unilateral hearing loss participated in this study. The normal ears were used as controls. The age varied from 12 to 80 years. Patients with congenital hearing loss and cognitive impairment were excluded from the study.

Data were gathered in two stages:

- VAS reading was by the patient who were asked to mark their hearing loss on the affected side as compared to the normal which was taken as 1.

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- Patients had an audiometry test to assess the degree and type of hearing loss.

VAS comprised of a 5 points rating scale from 1 till 5 as follows:

- 1 :normal hearing
- 2 :mild hearing loss
- 3 :moderate hearing loss
- 4 :severe hearing loss
- 5 :cannot hear at all

1	2	3	4	5
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Audiometry result are grouped into 5 categories of hearing loss; 0–25 db (normal), 26–40 db (mild), 41–70 db (moderate), 71–90 db (severe) and more than 91 db as profound hearing loss.

Pure tone average is defined as an estimate of patients ability to hear within the speech frequencies by averaging the air conduction hearing threshold at 500, 1,000 and 2,000 Hz [6, 7].

The average will determine the degree of hearing loss.

The final tabulation was as follows:

- VAS 1 = Normal hearing = 0–25 db (later described as **PTA 1**)
- VAS 2 = Mild hearing loss = 26–40 db (later described as **PTA 2**)
- VAS 3 = Moderate hearing loss = 41–70 db (later described as **PTA 3**)
- VAS 4 = Severe hearing loss = 71–90 db (later described as **PTA 4**)
- VAS 5 = Profound hearing loss = >91 db (later described as **PTA 5**).

Results

A total of 160 patients participated in this study. They consist of 57 Malays (38%), 64 Chinese (40%), 35 Indians (20%) and 4 of other race. Seventy-three male (46%) and 87 female (54%) were included in this study.

Age group were divided into 6 groups as following; 12–20 years (4), 21–30 years (24), 31–40 years (44), 41–50 years (29), 51–60 years (29) and >60 years (9).

Types of hearing loss among the study group included SNHL (sensorineural hearing loss) 71 patients (48%), followed by CHL (conductive hearing loss) 52 patients (28%) and mixed hearing loss 37 patients (21%).

On analyzing the VAS score as given by the patients on the affected ear compared to their normal control ear (VAS 1), 68 patients (40%) registered VAS 2, 57 patients

(38%) registered VAS 3, 23 patients (15%) registered VAS 4 and 11 patient (5%) registered VAS 5 (Table 1).

On analyzing the average PTA results, 83 patient (58%) fell into PTA 2, 51 patients (38%) PTA 3, 8 patients (5%) PTA 4 and 14 patients (10%) were in PTA 5 (Table 2 and 3).

Table 1 Distribution of patients with VAS

VAS	Patients	Percentage
VAS 1	0	0
VAS 2	68	40
VAS 3	57	38
VAS 4	23	15
VAS 5	11	5

Table 2 Distribution of PTA results in patients

PTA	Patients	Percentage
PTA 1	0	0
PTA 2	83	58
PTA 3	51	38
PTA 4	8	5
PTA 5	14	10

Table 3 VAS and PTA results in the study group

Audio	PTA 1	PTA 2	PTA 3	PTA 4	PTA 5
Patients	4	83	51	8	14
VAS results	0	68	57	23	11

On final analysis to determine the correlation between the subjective assessment by the patient via VAS compared to the objective PTA, it was noted that 91% patients who described themselves as being in VAS 2 is corresponded to PTA 2, 65% patients who described themselves as being in VAS 3 correspond to PTA 3, while 35% of VAS 4 correspond to PTA 4 and 78% of VAS 5 correspond to PTA 5. It was interesting to note that 48% who choose VAS 4 had actually PTA 3 (Table 4).

Table 4 Correlation between patients own assessment via VAS to objective test (PTA)

Correlation between VAS	Percentage corresponds and PTA
VAS 1 and PTA 1	Not applicable
VAS 2 and PTA 2	91%
VAS 3 and PTA 3	65%
VAS 4 and PTA 4	35%
VAS 5 and PTA 5	78%

When different types of hearing loss were studied as well and the accuracy of patients ability to score their VAS to correlate with PTA was analyzed, it was noted that in CHL, the accuracy is the highest with 62% (33 out of 53 respondent), followed by SNHL with 39% (28 out of 72 respondent) with mixed hearing loss the lowest accuracy with 36% (13 out of 36 respondents) (Table 5).

Table 5 The number and percentage of patients in different types of hearing loss whose VAS corresponded to PTA

Type of hearing Loss	No. of patient/percentage
Conductive hearing loss	33/53 (62%)
Mixed hearing loss	13/36 (36%)
Sensorineural hearing loss	28/72 (39%)

This suggests that patients with CHL were better able to relate the degree of their hearing loss to VAS.

There was no difference between the male and female responses.

The younger adults in the 21–30 years gave a more reliable correlation.

Discussion

Studies with comparing self-reported hearing loss with audiometry have been published before [3, 4]. Other studies with questionnaires of self-reported hearing loss that have been developed and validated have also been published [8–13]. They differ in number of questions, the age of the target population, and the purpose of the study.

Uchida et al. in a study of prevalence of self-perceived auditory problems and their relation to audiometric thresholds in a middle-aged to elderly population [14] concluded that the older group tended to underestimate their hearing difficulty in comparison with the younger group, and males tended to underestimate their hearing difficulty more than females.

In age effects on measures of hearing disability by Gordon-Salant [15] statistical analyzes revealed an interaction between age and hearing loss, in which younger subjects with hearing loss reported more handicapping effects of sensitivity loss than the elderly subjects with hearing loss.

The level of education to understand the scale with limited questionnaire for the scale may contribute to the results as we can see the adult group of age group 21–30 showed the best result. This study aims to compare the patient's perception of hearing loss compared to their normal ear and to correlate it to the PTA and objective assessment of hearing loss. The limitation of this study is the small sample. We may need larger sample to achieve more relevant results.

The other normal ear may help in contributing the supposed degree of hearing loss for the affected ear. As a result we get lower scale of VAS than it should be.

For type of VAS which has been used, 5 points rating scale has been used which is equal interval scale whereas the degree of hearing loss from PTA is unequal interval scale. This limit further statistical analysis due to two different data, i.e. VAS is data interval whereas PTA (audiometry) is nominal data with different interval.

For better results we may need VAS which give nominal data (as from linear VAS) comparing to audiometry in which further statistical analysis can be expanded. The other option is using interval VAS comparing to PTA who has degree of hearing loss which has more equal interval.

In this study we used single question for VAS as what Nondahl [16] had done, different from other studies which used elaborate questionnaire which may give better results like study of diagnostic performance of the hearing handicap inventory for the elderly against differing definitions of hearing loss by Lichtenstein [17] which stated that the HHIE-S (hearing handicap in elderly–S) [18,19] is a valid, robust test for identifying hearing-impaired elderly, irrespective of the audiometric definition used to finally diagnose hearing difficulties.

It also supported by a study by Voeks [20] that concluded that a set of specific questions significantly improved the identification of residents whose hearing loss affected their daily living activities compared with the use of a single hearing loss question.

Base on the study VAS with a single question can be used as a tool for assessment of hearing loss but with elaborate questionnaires and linear VAS and with larger samples better result may be achieved. Conductive hearing loss and mild-to-moderate hearing loss appears to correlate more to the VAS or patients perception as the difference from their normal ear isn't too vast for the patients to compare and quantify. In conductive hearing loss, the distortion in hearing of high frequency sounds that affect the speech perception hearing in SNHL is absent, thus the patient is able to perceive and quantify their hearing loss in a more reliable manner.

Conclusion

VAS can be used for assessment degree of hearing loss, i.e. mild, moderate hearing loss and may have a role in conductive type of hearing loss and best used in young adult age groups. This may be more applicable in rural setting as a screening procedure when audiometry is not available and can enhance clinical hearing assessment especially in mild-to-moderate conductive hearing loss. It also helps the clinician to gauge the patients perception of the degree of handicap the patient feels due to his hearing loss. Further

study with larger sample and better VAS may be needed in a future.

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