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RESEARCH ARTICLE

Comparing the quick speech-in-noise test results in migraineurs without aura and normal subjects

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Abstract

Background and Aim: Migraine is a relatively common neurovascular disease. Audiology studies have shown some ways of influencing migraine by the auditory pathways from cochlea to the auditory cortex. Considering that one of the most important functions of the central auditory system is speech perception in challenging conditions, the purpose of this study was to evaluate the ability to understand speech in noise in migraineurs without aura, and compare it with normal subjects.

Methods: In this cross-sectional study, 30 migraineurs without aura aged 17 to 41 years (mean=31.9, SD=6.89) and 30 normal individuals who were matched for age and sex with the migraine group were evaluated by quick speech-in-noise test (Q-SIN). The correlation between duration of the disease and the frequency of attacks per month and signal-to-noise ratio (SNR) loss, as well as the role of headache severity on the scores were assessed.

Results: In Q-SIN test, the mean SNR loss in migraineurs without aura was greater than that in controls ($p<0.05$). But this ability did not differ between males and females ($p>0.05$). There was no correlation between the duration of migraine, frequency of attacks per month and the severity of headache with SNR loss ($p>0.05$).

Conclusion: Migraineurs without aura sometimes have difficulties in speech perception in noise which is not affected by duration of disease, its frequency and the severity of the attacks.

Keywords: Migraine without aura; speech perception in noise; quick speech in noise test; central auditory processing

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Introduction

Migraine is a disabling neurovascular disorder that affects about 18% of women and 6% of men regardless of race or geographical location [1]. The incidence of migraine is higher between the ages of 20 and 35, and family history was commonly reported in interviews for migraineurs. Migraine is divided into two main categories: migraine without aura (common migraine), with the highest prevalence, and migraine with aura (classic migraine) that includes a 15-20 minutes period of visual or sensory aura.

Migraine headache is a one-side pulsatile headache that can occur with increased sensitivity to movement, touch, light, sounds, smells, and even food, which can last for 4-72 hours [2]. This neurological disease has a genetic predisposition and is caused by functional changes in the brain. The exact etiology of migraine headache is unclear, but several theories have been assumed and the latest and most prestigious one, considers it as a neurochemical disorder related to the serotonergic system. Serotonergic system plays an important role in the pathophysiology and pharmacology of migraine [3]. The most common migraine auditory symptom is phonophobia, and other auditory symptoms such as auditory hallucination, hearing loss, tinnitus, and low frequency fluctuating hearing loss are reported, too. It is also known as a common cause of sudden hearing loss [4]. The effect of this disease on the peripheral and central hearing paths has been identified, as follows: different auditory thresholds, significant decreased amplitude of transient evoked otoacoustic emissions (TEOAE) at some frequencies, deficit in otoacoustic emissions (OAE) suppression, abnormalities of auditory brainstem responses [5], middle latency responses [6], and late latency responses [7]. Varying degrees of anomalies in these tests have been seen in many patients both with and without aura. In addition, poor performance in a number of central auditory tests has also been reported in people with migraine.

One of the most important features of the auditory system is the speech perception ability in noise. The individual's amplification requirements under real-world simulated conditions can be measured by speech-in-noise tests [8]. Several tests are used to assess speech perception in noise, such as speech-in-noise test (SINT), words-in-noise test (WINT), hearing in noise test (HINT), and quick speech-in-noise (Q-SIN) test [9]. The Q-SIN is a quick test to measure auditory perception in noise. High accuracy and speed, the variable signal-to-noise ratio (SNR), possibility to test by headphones, and gaining valuable information over a short period of time are among the advantages of this test [8,9].

Considering the role of the auditory efferent system, as well as the main role of the auditory cortex in speech perception in noise, and given that one study showed deficits in the auditory efferent system of people with migraine, it is unclear whether people with migraine have problem with speech perception in noisy environments (which is important in everyday life) or their auditory efferent system impairments compromised by the main areas are involved in auditory processing, or the main areas involved in this process are also impaired?

Regarding the limited studies on speech perception in noise among adult migraineurs as well as the possible effect of this disease on the central auditory system and the high prevalence of common migraine compared to other types, this study aimed to assess the results of Q-SIN test in migraineurs without aura and normal subjects.

Methods

This cross-sectional study included 30 migraineurs without aura (12 males and 18 females) aged 17 to 41 years (mean=31.9 and SD=6.89) and 30 normal subjects (14 males and 16 females) aged 21 to 40 years (mean=31.06 and SD= 5.48). The severity of headache differed among the participants and was categorized as per following: grade 1) the patient is able to perform daily activities in spite of the headache, grade 2) the patient is unable to perform daily activities but does not need bed rest, and grade 3) severe headache forces patient to bed rest [10] (Table 1).

The samples were selected by the convenience sampling method and patients were referred to the Audiology Clinic of Tehran University of Medical Sciences affiliated with the Tehran University of Medical Sciences. The cases and controls were matched with age and gender. The inclusion criteria consisted of migraine sufferers of 17 to 41 years of age, a history of two or more attacks per month (according to ICHD-3 beta, 2013) [11], normal hearing (auditory thresholds of 25 dB HL or less, tympanogram type An, word recognition score (WRS) of 90% or above), not taking migraine prevention drugs

Table 1. Demographic and clinical characteristic of groups (n=60)

	Normal group (n=30)	Migraine group (n=30)
Male/Female	14/16	12/18
	Mean (SD)	
Age (y)	31.06 (5.48)	31.9 (6.89)
Duration of illness (y)		11.86 (8.24)
Frequency of attacks (number per month)		6.23 (4.43)
Severity of headaches		Grade 1= 5 (16.7%)
		Grade 2= 4 (13.3%)
		Grade 3= 21 (70%)

(samples were selected from people who at the time of the study for reasons such as lack of respond to medications, drug side effects, lack of specialty referral, few frequencies or less severity of attacks, etc. did not take prevention drugs), no symptoms of neurological or cognitive dysfunction, no history of dizziness and imbalance, no alcohol consumption and smoking, and right handedness according to the Edinburgh scale. Patients were told that they should not have had a headache at least during three days before the appointment (in order to minimize the possible impact of a headache attack, as well as the possible effect of taking analgesic drugs on test results), and test was postponed to another day, in case of incidence of headache [12]. Exclusion criteria included unwillingness to continue the test, tiredness, dissatisfaction with the environment or the test, and the family's unwillingness to continue the test.

Each person completed the consent form. The ICHD-3 beta scale was then presented to ensure that the inclusion criteria were met. Edinburgh's laterality inventory [13] was presented and right-handed people were selected, subsequently. The demographic questionnaires were completed by the participants. The external ear and eardrum were then examined by an otoscope. The 260 Hz tympanometry and the ipsilateral and contralateral reflexes at frequencies of 0.5, 1, 2, and 4 kHz were performed by tympanometer (Madsen Zodiac 901, Denmark). Also, by using the two-channel audiometer (AC40, Denmark), air-conduction audiometry at 0.25, 0.5, 1, 2, 4 and 8 kHz frequencies, WRS, speech reception threshold (SRT) and bone-conduction audiometry at frequencies of 0.25, 0.5, 1, 2 and 4 kHz have been done.

Before performing the Q-SIN test, the device was calibrated in intensity. The study procedure was described to the subjects [14]. Each patient was placed in an acoustic room and the Persian Q-SIN test materials, previously recorded on a computer file, were played for the subjects by a laptop (Asus, connected to the AC40 audiometer) via the TDH-39 earphones. Initially, a training list was introduced to familiarize samples with the test process. Then the validated list 3 of Q-SIN test (Persian version), developed by Shayanmehr et al. as a bilateral mode, 50 dBSL level was presented. In this test, a series of sentences is presented simultaneously to both ears, at the same time several speakers babble noise is presented to both ears and the person's task is to repeat the complete sentence afterwards. In other words, noise competes with the signal [14]. In the Q-SIN test, the patient's performance is compared with the normal hearing subject. The difference in performance between these two is SNR loss. A person with normal

Table 2. Results of quick speech-in-noise test in migraine group and control group (n=60)

	Normal group (n=30)				Migraine group (n=30)				
	N	Mean	Median	SD	N	Mean	Median	SD	p
SNR loss (dB)									
Male	14	−0.57	−0.5	1.54	12	1.25	0.5	1.86	0.01
Female	16	-1.37	-1.5	1.02	18	1.38	0.5	2.34	<0.001
Total	30	-1	-1	1.33	30	1.33	0.5	2.13	<0.001

SNR; signal to noise ratio

hearing needs about +2 dB SNR loss to recognize up to 50% of the words in the Q-SIN test. The SNR loss quantity results from the signal-to-noise ratio required to achieve a 50% score (SNR-50). For example, in this test, if a hearing-impaired person wants to get 50% of the score, he needs that 10 dB speech be louder than noise, in fact, he has 8 dB SNR loss [9]. The Persian version of the Q-SIN test consists of 5 lists, each including 6 sentences and every sentence contains five keywords. Sentences are chosen to have the least sign of the sentence's context or conjecture from similar words. These sentences are grammatically correct and meaningful, but guessing the keywords is hard in the context. Used keywords are common words and of everyday conversation. These sentences are presented by a female speaker in a babble noise background with four speakers (one man and three women), which continues through the list. The level of the babble noise in each list varies, and the SNR changes from +25 to 0. These lists can be used individually or together and because of the validity and reliability of list 3 and its equivalent to other lists, this list has been used [15]. The amount of SNR loss in Persian speaking population is obtained by subtracting the number of correct words given by the person from 27.5 [14].

The Kolmogorov-Smirnov test was used to test normality of data distribution. For the comparison of results of SNR loss between the two groups of migraine and control as well as comparisons between men and women in each group and between normal and migraine men and also between normal and women with migraine, the independent t-test was used. To evaluate the correlation between duration of illness and the mean results of the SNR loss due to the normal distribution of the data, the Pearson correlation coefficient was applied. Moreover to evaluate the correlation between the frequency of migraines per month (abnormal distribution) and the mean results of SNR loss test, the Spearman correlation coefficient was used. Also, to investigate the role of headache severity on SNR loss, 1-way ANOVA was used. Statistical calculations were performed by SPSS 20 (significance level was set at 0.05).

Results

First, in order to evaluate the gender effect on the Q-SIN test, the results were compared between men and women of each group. There was no significant difference between men and women in each of the affected and normal groups ($p>0.05$). To investigate the effect of migraine on central auditory processing, Q-SIN test results were compared between migraineurs without aura and normal subjects. Mean SNR loss in Q-SIN test showed a significant difference between the two groups ($p<0.05$). There was a significant difference between males of the control and experimental groups, and the same was correct for females ($p<0.05$) (Table 2).

Table 3. The correlation between the percent of correct answers in quick speech-in-noise test and the duration of illness and frequency of attacks in normal and patients with migraine (n=30)

	Sex	N	r (p)
Duration of illness(y)			
	Male	12	0.265 (0.404)*
	Female	18	0.204 (0.418)*
Frequency of attacks(number per month)			
	Male	12	0.150 (0.642)**
	Female	18	-0.379 (0.121)**

*Pearson
**Spearman

The mean (SD) duration of the disease in migraine sufferers was 11.86 (8.24) years and the mean (SD) frequency of migraine attacks was 6.23 (4.43) attacks/month. The Pearson correlation coefficient showed no significant correlation between SNR loss and duration of the disease in subjects with migraine regardless of gender (p>0.05). That means the increase in the duration of the disease did not affect the SNR loss in the Q-SIN test. Also, the Spearman test showed no significant correlation between SNR loss and frequency of migraine attacks in migraineurs and in each of the men and women groups (p>0.05) (Table 3). According to the headache severity category, 5 subjects (16.7%) were categorized in grade 1 headache, 4 subjects (13.3%) in grade 2 and 21 subjects (70%) in grade 3. Grade 3 had the highest frequency and the frequency of the other two groups were almost equal. No significant differences were found between SNR loss in different headache severity groups and within each gender group (p>0.05, Fig. 1).

Discussion

In the present study, the mean SNR loss in the

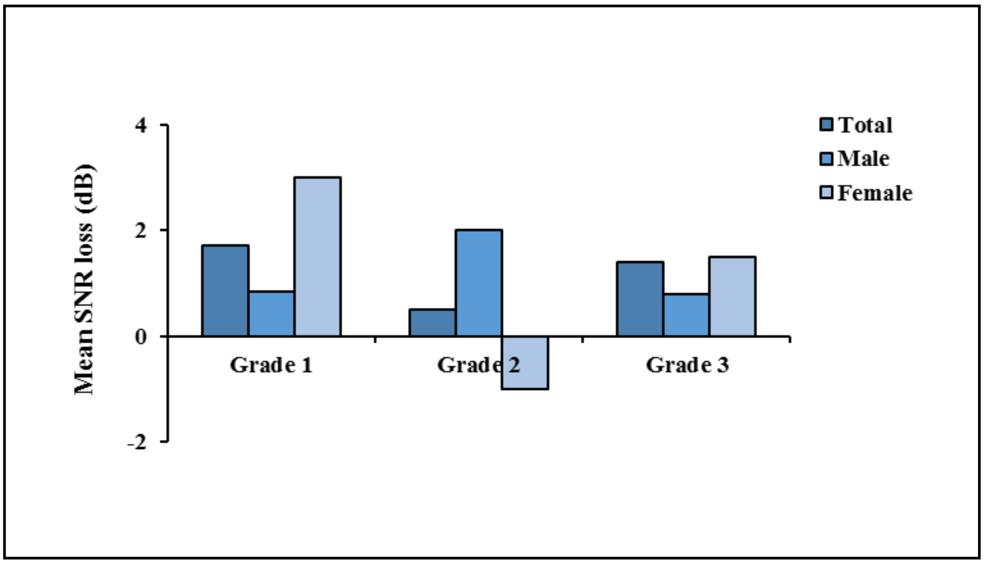

Fig. 1. Mean values for signal-to-noise ratio loss in three groups based on the headache severity (n=30). SNR; signal-to-noise ratio.

Q-SIN test was statistically significant between migraine and normal groups. This difference was seen among normal females and females with migraine as well as normal males and men with migraine.

Research studies show that the auditory cortical regions play an important role in speech identification and perception in noise. Auditory brainstem and subcortical regions also play a role in representing fundamental frequency of speech among other sounds [16]. Evidence suggests that part of the auditory attention filter is due to the efferent medial olivocochlear (MOC) system activity, which plays an important role in speech perception in noisy conditions [17]. One of the requirements for speech perception in noise is the ability of temporal processing [18] and the role of the auditory cortex (and to a lesser extent, the auditory brainstem) in the process of temporal processing have been known [19]. Cognitive skills and auditory system are also highly interrelated. The most important cognitive functions include attention, short term and working memory. These cognitive activities act as compensatory mechanisms of the auditory system in cases such as lack of temporal encoding. In several studies, the relationship between attention and auditory memory with speech perception in noise is noted [20]. On the other hand, in people with migraine, the serotonin fluctuation involved in serotonergic innervation of the auditory system in the brainstem and auditory cortex and inadequate inhibition of the various brainstem nuclei causes problem in their auditory system [21]. Structural and functional changes including the presence of white matter lesions under the cortex and thickening of the cortical regions involved in the processing of sensory information, including auditory sense, have been confirmed with imaging studies in people with migraine [22]. In a study, people with migraine in auditory gap detection (detection of short and long distances) and auditory resolution and ordering, which are the components of auditory temporal aspects, were poor compared to the normal group [12]. People with migraine show a defect in OAE suppression at some frequencies that indicates damage to the efferent MOC system [23]. According to studies, in migraine sufferers, absolute and interwave latency of the auditory brainstem response (ABR) has abnormalities that may indicate a change in neurotransmitters or low level secretion in the midbrain and the impact of migraine attacks on brain stem function [5]. Also, the problem of auditory selective attention during the nonverbal dichotic test (NVDT) and abnormal N1 peak related to attention in the long latency response test were observed in people with migraine [7].

The reduction of correct answers in the Q-SIN test can be related to anomalies in these areas, due to the migraine effect. It should be noted that the precise physiological and anatomical mechanism of migraine is still unclear, so it is not possible to certainly relate the anomalies in the cortical and under the cortical regions due to migraine to the inability to speech perception in noise. The results of the Q-SIN test were consistent with the results of Ciriaco et al. which conducted a computerized test battery to assess speech perception in silence and noise in children with migraine headache [24]. The results show that SNR loss is not different between normal men and women as well as between men and women with migraine. According to the studies, structural differences between normal men and women as well as men and women with migraine have not been reported so far in the regions involved in the auditory processing. However, indirect effect of sex hormones in men and women on neurotransmitters such as serotonin and gama-Aminobutyric acid (GABA) has been identified, and no difference in their effects on auditory performance has been reported. Shayanmehr et al. [14], Gheissi et al. [25] and Bockowski et al. [26] also achieved the same result in normal individuals, and declared that gender had no effect on the results.

Another purpose of this study was to investigate the correlation between the duration of the disease and the frequency of migraine attacks per month and the results of the Q-SIN test. This correlation was also examined on the basis of gender. The results show no significant correlation between duration of disease (as well as frequency of attacks per month) and SNR loss. The relationship between headache severity and SNR loss was also examined and the results showed no significant relationship between headache severity and SNR loss. This insignificance was evident in each of the groups of affected men and women. The mentioned results are consistent with the results of Bockowski et al. on cortical event related potentials (CERP) in children with migraine headaches. Their study results show no significant correlation between CERP parameters and duration of disease as well as gender in migraineurs [26].

Conclusion

The present study indicates that migraineurs without aura have difficulty in speech perception in background noise, and their SNR loss in Q-SIN test shows an increase compared to the control group. There is no difference in this ability between males and females. There is no correlation between the duration of disease and the frequency of attacks per month, as well as the severity of headaches and SNR loss. These results indicate the importance of improving speech perception in challenging environments using central auditory rehabilitation programs in patients with more problems.

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Conflict of interest

The authors declare that they have no conflict of interest.

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