

*Research Article***Audio-vestibular affection in rheumatoid arthritis****Hanaa A. Sadek\* Samar A. Mahmoud\* Reham G. Abdullah\*\* and Omnia A. Shawqi\***

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**Abstract**

**Background:** Recently there is growing interest for inner ear involvement in systemic autoimmune diseases. Several studies showed inflammatory cells in the inner ear, describing the presence of resident cochlear macrophages in animal models and the recruitment of inflammatory macrophages to the cochlea.<sup>(1)</sup> **Method:** 16 rheumatoid arthritis patients were enrolled in this study. Audiological assessment was done using pure tone audiometry (PTA). Vestibular assessment for lateral semicircular canal was done by video head impulse test (VHIT). **Results:** 50% of rheumatoid arthritis patients were discovered to be suffering of hearing loss of all types and degrees detected by pure tone audiometry, VHIT was normal in all patients. **Conclusion:** Hearing impairment is not uncommon finding in rheumatoid arthritis patients. It can have a negative impact on a patient's quality of life. So, audiological assessment and follow up are necessary for rheumatoid arthritis patients.

**Keywords:** Rheumatoid arthritis, hearing loss, PTA, VHIT, vestibular affection.

**Introduction**

The ear is an accurate, powerful and reliable instrument of perception. From the evolutionary standpoint, the ear represents the most important warning sensor of the body, a function which it combines with its fundamental role in social communication. In addition to the acoustic function, it also houses the equilibrium organ and thus forms the basic human sensory systems. Next to the sense of sight, the sense of hearing is our most important biological source of information.<sup>(2)</sup>

The inner ear has been considered for a long time an immune-privileged site, and rarely involved in systemic autoimmune diseases thanks to the blood-labyrinthine barrier. Lehnhardt 1958 was the first to hypothesize that sudden or rapidly progressive sensorineural hearing loss (SNHL) could be a result of an autoimmune process against the inner ear.<sup>(3)</sup>

Several systemic autoimmune disorders may be associated with vertigo, either at presentation or during the course of the disease, with different clinical presentation and elevate inter-individual variability. The most relevant syndromes include Cogan's Syndrome, Bechet's Disease, Vogt-Koyanagi-Harada Syndrome, Systemic

Lupus Erythematosus, Susac's Syndrome, Multiple Sclerosis, and Autoimmune Thyroid Diseases.<sup>(4)</sup>

The most accepted mechanisms of audio vestibular affection are vasculitis, immune complex-mediated damage, and sometimes antiphospholipid antibodies.<sup>(5)</sup>

Rheumatoid arthritis (RA) is a chronic inflammatory disease that affects primarily the peripheral diarthroses. It affects up to 1% of the worldwide population.<sup>(5)</sup> Even though RA is predominantly known for its articular features, it is also associated with several non-articular manifestations which may affect up to 40% of RA patients, conveniently labeled as extra-articular manifestations (EAMs).<sup>(6)</sup>

**Aim of the work**

To assess the audio-vestibular manifestations in rheumatoid arthritis patients this can help in early detection and management of this type of comorbidity and also to correlate the disease duration and activity with audio-vestibular test results.

**Patients and methods**

Sixteen rheumatoid arthritis (14 females and 2

males) patients who fulfilled the 2010 ACR - EULAR classification criteria for RA<sup>(7)</sup> were enrolled in our study.

Patients with history of congenital hearing loss, anatomical abnormalities, trauma of the head and neck or skull Middle ear surgery, Otorrhea and Meniere's disease were excluded from our study.

Informed consent was taken from all participants in the study. The study was approved by the ethics committee of the Faculty of Medicine. All patients were subjected to full medical history, clinical examination. Auditory assessment was done by pure tone audiometry (PTA), acoustic reflex, tympanometry and speech recognition threshold. Pure Tone Average (PTA) refers to the average of hearing threshold levels at a set of specified frequencies: typically 500, 1000, 2000 and 4000 H, Normal PTA is <25 dB, so if patient has elevated hearing threshold higher than 25 dB is considered to have hearing impairment. Vestibular assessment for lateral semicircular canal was done by video head impulse test (VHIT). By recording the eye and head velocities with high speed cameras and computational software, saccades both overt and covert can be detected and the vestibulo-

ocular gain can be calculated. (Halmagyi et al., 2017)

### Statistical analysis

Analysis of data was done by personal computer using SPSS (Statistical program for social science) version 19. The data of all software patients and controls were fed into an IBM personal computer. Data were expressed as mean  $\pm$  SD for parametric variables and as number and percent for non-parametric variable. Comparison between groups for parametric data was done by independent samples t-test (unpaired t-test). Chi - square (X<sup>2</sup>) test was used to compare qualitative variables. The difference was expressed as probability of value (P value). The difference was considered significant if  $P < 0.05$ . Pearson and Spearman correlation coefficients (r) were calculated for detection of parametric and non-parametric correlations respectively.

### Results

Sixteen rheumatoid arthritis (RA) patients (87.5% females and 12.5% males). Their age ranged from 25 to 45 years with a mean of  $35.7 \pm 5.9$  years and duration of illness ranging from 1 to 15 years with a mean  $7.71 \pm 5.35$  years. Table1

**Table1: Demography of the studied population**

Characteristic	patients (n =16)
Age (years) Mean $\pm$ SD	35.7 $\pm$ 5.9
Gender N (%)	
• Male	2(12.5%)
• Female	14(87.5%)
Marital status N (%)	
• Single	6(37.5%)
• Married	10(62.5%)
Disease duration(years) Mean $\pm$ SD	7.71 $\pm$ 5.35

Hearing impairment was found at frequencies 250, 500, 2000, 4000 and 8000 HZ but hearing was found to be more affected at high frequencies (4000 and 8000 HZ)

**Table 2: PTA findings in RA patients**

PTA frequencies		RA (n=16)
250	RT	25.94±8.98
	LT	28.44±9.25
500	RT	24.38±6.021
	LT	26.56±7.00
1000	RT	24.69±8.65
	LT	23.44±10.119
2000	RT	28.13±12.230
	LT	28.44±13.256
4000	RT	35.00±17.12
	LT	33.44±17.67
8000	RT	42.81±21.44
	LT	41.88±24.005

Among rheumatoid patients 50% of patients had hearing loss , 12.5% was unilateral and 25% bilateral 6.2% had slight, 12.5% to 25% mild, 12.5% moderate and 6.2% severe degree.18.8% to 25% of patients had SNHL, 12.2% to 18.8% had CHL and 6.3% had MHL. Table2

**Table 3: Hearing loss among RA patients**

Characteristic	Patients (n =16)	
<b>Incidence of hearing loss</b>	8(50%)	
<b>Side of hearing loss</b>	Unilateral	3(18.8%)
	Bilateral	5(31.3%)
<b>Degree hearing loss in right ear</b>		
• Slight	1(6.2%)	
• Mild	2(12.5%)	
• Moderate	2(12.5%)	
• Severe	1(6.2%)	
<b>Degree hearing loss in left ear</b>		
• Slight	0(0.00%)	
• Mild	4(25%)	
• Moderate	2(12.5%)	
• Severe	1(6.2%)	
<b>Type of hearing loss in right ear</b>		
• SNHL	3(18.8%)	
• CHL	2(12.5%)	
• MHL	1(6.3%)	
<b>Type of hearing loss in left ear</b>		
• SNHL	4(25%)	
• CHL	3(18.8%)	
• MHL	0(0.0%)	

*SNHL: sensorineural hearing loss*

*CHL: conductive hearing loss*

*MHL: mixed hearing loss*

- Both age and sex were not found to be correlated with intensity of hearing threshold in decibels (dB) through all frequencies bilaterally. Table 3
- The duration of the disease was found to be positively correlated with hearing affection at high frequencies (4000 HZ ; p=0.048) (8000 HZ; p=0.020) bilaterally. Table 3 figure 1.B,C
- Hearing affection was found to be positively correlated with ESR at frequencies 250, 500 and 8000 (p= 0.002, 0.009, and 0.008 respectively) and DAS28ESR (P=0.004). Table 4 figure 1A,D

**Table (3): Correlation between PTA findings and demographic data of patients group**

		Frequency in HZ					
		250	500	1000	2000	4000	8000
Age	r	-0.062	0.012	-0.221	-0.207	-0.134	-0.132
	p-value	0.620	0.932	0.280	0.101	0.290	0.297
Sex	r	-0.147	-0.200	-0.240	-0.006	-0.116	-0.068
	p-value	0.452	0.552	0.734	0.893	0.857	0.493
Disease duration	r	0.251	0.452	-0.153	-0.854	0.501	0.985
	p-value	0.524	0.092	0.425	0.741	<b>0.048*</b>	<b>0.020*</b>

*By Spearman correlation*

\*: Significant P- value < 0.05

\*\*: Significant P- value < 0.01

\*\*\*: Significant P- value < 0.001

**Table (4): Correlation between PTA findings and clinical characteristics in RA patients**

		Frequency in HZ					
		250	500	1000	2000	4000	8000
No of tender joints	r	0.005	0.024	-0.412	-0.542	-0.125	0.241
	p-value	0.521	0.125	0.248	0.098	0.221	0.458
No of swollen joints	r	0.521	0.214	-0.158	0.321	-0.145	-0.112
	p-value	0.258	0.421	0.072	0.142	1.000	0.412
Rheumatoid nodules	r	0.152	-0.241	0.145	-0.212	0.421	0.853
	p-value	0.321	0.425	0.928	0.851	0.145	0.421
DAS28-ESR	r	0.503	0.524	0.126	0.541	0.241	0.895
	p-value	<b>0.047*</b>	0.985	0.421	0.984	0.521	0.842
ESR	r	0.701	0.520	0.521	-0.115	0.478	0.636
	p-value	<b>0.002**</b>	<b>0.009*</b>	0.320	0.874	0.245	<b>0.008**</b>

*By Spearman correlation*

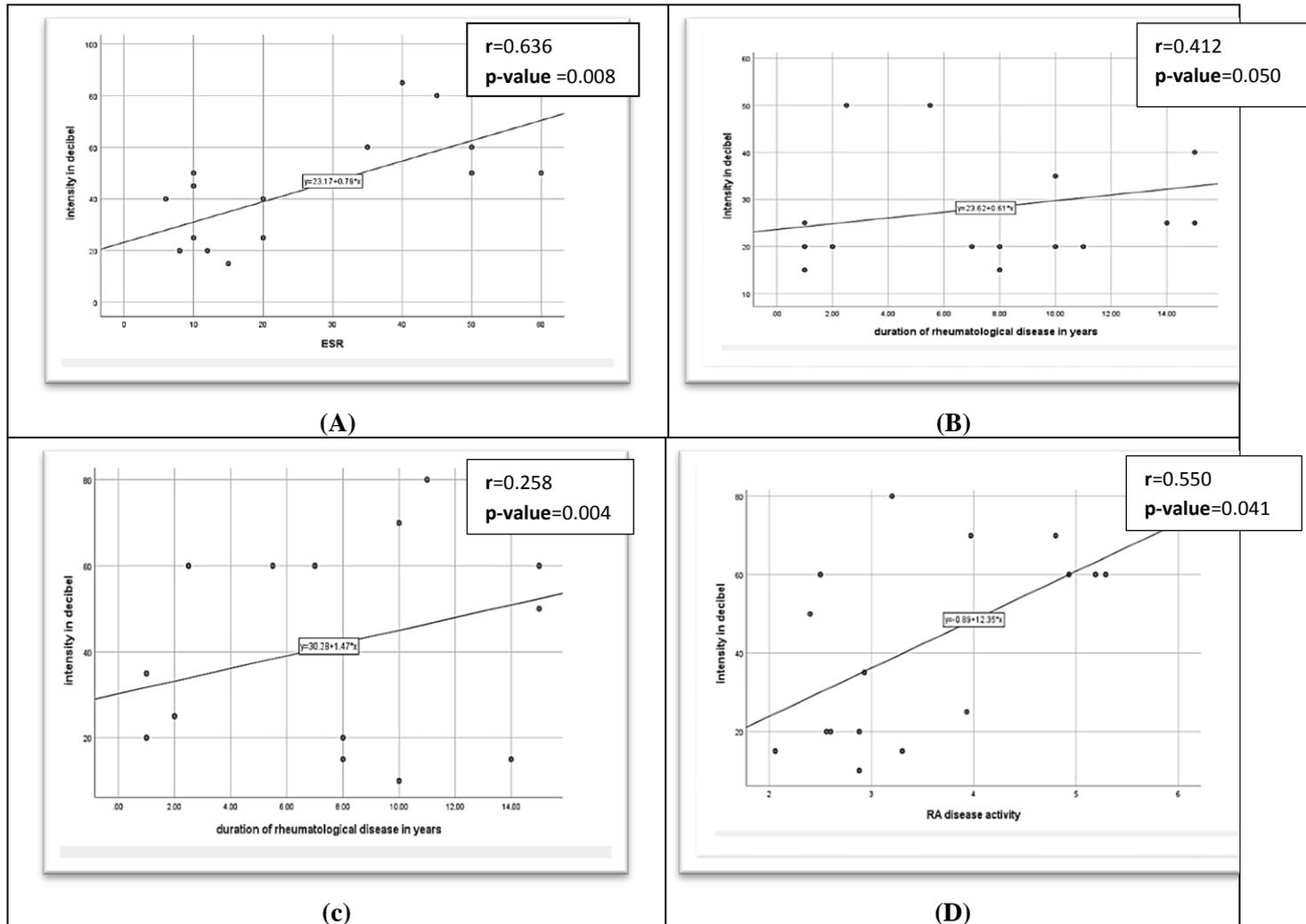
\*: Significant P- value < 0.05

\*\*: Significant P- value < 0.01

\*\*\*: Significant P- value < 0.001

*ESR: erythrocyte sedimentation rate, DAS: disease activity score*

Figure 1



- A: Correlation between intensity of hearing thresholds with ESR level at frequency of 8000 HZ.
- B: Correlation between intensity of hearing thresholds with disease duration at frequency of 2000 HZ in rheumatoid arthritis patients.
- C: Correlation between intensity of hearing thresholds with disease duration at frequency of 8000 HZ in rheumatoid arthritis patients.
- D: Correlation between intensity of hearing thresholds with DAS28-ESR at frequency of 8000 HZ.

Table (5): SRT, tympanometry and acoustic reflex in RA patients

Auditory test		Patients (n = 16)
SRT (abnormal)	RT	10(20.4%)
	LT	8(16.3%)
Tympanometry (Type A)	RT	16 (100%)
	LT	16(100%)
Acoustic reflex (absent)	RT	1(2.0%)
	LT	2(4.0%)

RA: rheumatoid arthritis, SRT: speech reception threshold, RT: right, LT: left

**Table (6): VHIT in RA patients**

VHIT parameters		Patients (n = 16)
Gain (Mean ± SD)	RT	1.00 ± 0.19
	LT	0.95 ± 0.18
Covert grade N (%) (abnormal)	RT	0(0%)
	LT	0(0%)

*VHIT: video head impulse test*

**Discussion**

Patients with rheumatoid arthritis were shown to have all types of hearing loss in this study. In agreement with other researches<sup>(7), (8), (9), and (10)</sup> sensorineural patients and conductive hearing loss were both found in RA, others<sup>(11), (12), and (23)</sup> only documented the existence of SNHL in rheumatoid arthritis patients.

Hearing impairment was observed in up to 50% of patients with RA in a study that was matched with our findings<sup>(7)</sup>. However, according to another study<sup>(10)</sup>, 70 to 80 percent of the individuals in their study were suffering of hearing loss. Sensorineural hearing loss (SNHL) was observed in 18.8% to 25% of patients, according to our findings<sup>(11) and (12)</sup>.

One of the most widely accepted theories proposes vascular inflammation of epineural small vessels or “vasa vasorum” and/or vasa nervosum (vasculitis or neuritis arteritis ) as a part of mononeuritis multiplex may be the origin of sensorineural component of hearing impairment by causing auditory neuropathy. Not only has the cochlear hair cells injury been hypothesised as a probable site of lesion resulting in hearing loss in RA population. But also there is a study suggests that the site of lesion may also involve the lower brainstem.<sup>(10) and (24)</sup>

As regard conductive hearing loss it was found in about 12.5% to 18.8% of our patients. In the study of<sup>(12)</sup> reported only five (11.11%) cases with CHL in his study. In addition, another study<sup>(13)</sup> reported that CHL is also present in patients with RA with prevalence between 0% and 13%.

Only one RA patient was found to have mixed type of hearing loss. This type of hearing loss

was an uncommon finding in the literature. In study done by<sup>(8)</sup> reported one out of 25 RA patients (4%) with mixed hearing loss. Four patients (10.8%) had a mixed type of hearing loss in the RA group in a study done by<sup>(14)</sup>. This finding may suggest a multifocal involvement of the auditory system in RA.

Tympanometry of RA patients in our study was of type A which means normal pressure of middle ears. Some studies<sup>(14) and (12)</sup> reported that 60.2% of patients had type A tympanometry and this can be attributed to the wider range of age of the cases included in their studies and the potential confounding effects of presbycusis. In a study carried out by<sup>(10)</sup>, normal tympanograms were obtained for (90%) to (92.5%) in both case and control group. The use of a different probe tone for impedance measurement can be the reason for disagreement with our study. Another explanation that the exclusion criteria of the selected patients in our study included external factors Which may be involved in affecting the function of the ear other than rheumatological diseases such as infection, surgery, etc...to reach more accurate data about the relationship between the rheumatological disease and audiological affection. On the other hand, our study still in accordance with those studies regarding that there was no significant difference between rheumatoid arthritis patients and healthy ones as regard tympanometry findings.

The presence of CHL in normal middle ear pressure patients can be attributed to that it occurs due to synovial destruction of incudostapedial (IS) and incudomalleolar (IM) joints by an inflammatory and increased laxity of the middle ear transducer mechanism (because of the synovial joints between the ossicles in the

middle ear) which is not role affect inner ear pressure.

As regard our results of speech recognition threshold, it was within abnormal range which is in accordance with <sup>(11), (16) and (14)</sup>. Acoustic reflex was absent in 2% of RA patients and this can be attributed to decrease sound energy transmission due to hearing loss.

During vestibular assessment of lateral semicircular canal, patients in the current study all patients had normal vestibular assessment findings by video head impulse test. This is in disagreement with <sup>(18)and (8)</sup> that used other older methods of vestibular assessment as electronystagmography (ENG) this also due to that vestibular affection is more common to occur as a result of acute insult rather than chronic affection which is the feature of the autoimmune diseases including RA.

Age and sex were not found to be related to hearing loss which is consistent with <sup>(19) and (20)</sup>.

The relation between hearing loss and the autoimmune disease duration is not well established. The current study revealed a relationship between disease duration and prevalence of hearing loss at high frequencies (4000 and 8000 HZ) which is in accordance with <sup>(9), (21) and (22)</sup>. However, another research <sup>(14)</sup> did not find correlation between them in his study.

### In conclusion

Hearing impairment is not uncommon comorbidity in rheumatoid arthritis. It has a negative impact on patient's quality of life and can impair daily activities.

We recommend that, audiological assessment, regular follow up and history taking for audiological symptoms in rheumatoid arthritis patients should be considered.

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