DOI: 10.7860/JCDR/2018/28260.11239

Original Article

Ear, Nose and Throat Section

The Effects of Rheumatoid Arthritis in Hearing Loss: Preliminary Report

MUHAMMAD EDY SYAHPUTRA NASUTION[1], TENGKU SITI HAJAR HARYUNA[2]

ABSTRACT

Introduction: Rheumatoid Arthritis (RA) is a chronic inflammation that can cause systemic manifestations. Auditory system can also be affected by this disease. Sensorineural and conductive hearing loss have been reported but the results remain controversial.

Aim: The aim of this study was to find out the correlation between RA and hearing loss.

Materials and Methods: This cross-sectional, analytical, and prospective study included 19 subjects with RA and 19 subjects with other joints disease as comparison from January to June 2015. Pure tone audiometry and tympanometry examinations were conducted for all subjects. Pearson Chi-square test was used to analyse the correlation between RA and hearing impairment as well as the correlation between diseases duration, Erythrocyte Sedimentation Rate (ESR), and platelet count; and hearing threshold. Independent samples t-test was used to analyse the difference in mean of air and bone conduction thresholds, air-bone gap values, as well as hearing thresholds in both groups.

Results: Hearing impairment was 78.9% in RA group and 21.1% in comparison group ($p<0.05$). Sensorineural hearing loss was the most common finding in RA (52.6%). There were significant correlations of disease duration and ESR with hearing loss degree in RA ($p<0.05$). The significant difference was obtained in air-bone gap values at 500 Hz to 4000 Hz ($p<0.05$).

Conclusion: Rheumatoid arthritis can cause hearing loss.

Keywords: Erythrocyte sedimentation rate, Pure tone audiometry, Sensorineural hearing loss, Tympanometry

INTRODUCTION

Rheumatoid arthritis is a chronic progressive autoimmune disease [1,2] that can cause articular, extraarticular and systemic effects [2]. Joints destruction due to RA leads to some malfunctions of the body, decreased quality of life, and disabilities of working performance [3]. Furthermore, RA also contributes to impairment of other organs such as eyes, heart, lung, and skin [4]. Auditory system can also be affected by the various pathologies that occur in this disease because incudomalleolar and incudostapedial joints are true diarthrosis that can be subjected to rheumatoid lesions [5,6].

Previous studies reported that RA is usually correlated with hearing impairment [5-8]. Impairment in ossicular joints in the middle ear, vasculitis, neuritis, and the effect of ototoxic drugs used could be the causes, although pathogenesis of hearing impairment is yet to be ascertained [5,8]. Ozcan M et al., found hearing impairment at 51.4% in RA group and only at 14.3% in control group. In RA patients who were suffering from Sensorineural Hearing Loss (SNHL) [4-10], Conductive Hearing loss (CHL) [4,8,9], as well as Mixed Hearing Loss (MHL) [4] had been reported [9]. SNHL was the most frequently reported; up to 72% and correlated with inner ear impairment [4]. CHL was reported at lower prevalence rate of 0-24.3% [8,9], meanwhile MHL was reported at 10.8% [7]. Previous study stated that SNHL in RA patients had significant correlation with ESR increased [10]. Dikici O et al., also reported that hearing impairment could correlate with increasing ESR, disease duration, and platelet count [5]. They found a concurrent in the hearing threshold increased with ESR increased as well as platelet count in patients with rheumatoid nodules.

The prevalence of RA in the world is very small (1% of the population) [4,5,8,10]. The same fact is also true in Indonesia where the prevalence of RA ranges from 0.2 to 0.3% [11]. Because of very little research on this disease due to the lack of prevalence, we would like to confirm the results of research that has been done about the relationship between RA with hearing loss. The hospitals we are conducting are tertiary referral hospitals from local hospitals so we hope this can give an idea of the condition of RA in some areas. In response to this, we performed this study to find out the correlation between RA and hearing loss.

MATERIALS AND METHODS

This cross-sectional, analytical, prospective study was carried out in Otorhinolaryngology-Head and Neck Surgery and Rheumatology Department of Adam Malik General Hospital, Sumatera Utara, Indonesia from January to June 2015. Based on consecutive sampling method, the number of subjects studied was as many as 38 subjects in the period of six months, consisting of 19 subjects as RA group and 19 subjects as non-RA group for comparison. Patients who met the ARA criteria [12] were included in the RA group. While other joints disease patients who did not meet ARA criteria were included in the non-RA group. This study has gained ethical clearance from the Health Research Ethical Committee of Sumatera Utara University and informed consent from all subjects.

Inclusion criteria: Patient's aged 16-50 years with no history of earache, congenital hearing loss, ear infections, ear trauma, acoustic trauma, etc., affecting the auditory function were included.

Exclusion criteria: Patient's diagnosed with systemic disease such as diabetes mellitus, hypertension, hyperlipidemia, etc., were excluded.

RA diagnosis was conducted by rheumatologist according to criteria of ARA. RA diagnosis can be confirmed if these four criteria were occurred and lasted for six weeks; stiffness of joints in the morning, arthritis of ≥3 joints, hand joints arthritis, symmetric arthritis, rheumatoid factor of serum, rheumatoid nodules, or radiographic changes. The subjects were recorded based on gender, age, disease duration and presence of rheumatoid nodule and then underwent laboratory evaluation of ESR and platelet count. In addition, clinical examination of ears, nose, throat, head, and neck was performed

by otorhinolaryngologist. Through this examination, it was found that all 38 subjects had normal tympanic membranes.

Audiological Evaluation

With respect to all study subjects, examination of pure tone audiometry and tympanometry were conducted by the same examiner in a soundproof chamber. The pure tone audiometry examination was conducted by using AD-28 Interacoustic Clinical Audiometer (Interacoustic, Assens, Denmark). The measurement was performed based on the ascending method (Hughson-Westlake, up 5, down 10 method) [13]. The air conduction thresholds were measured for 250-8000 Hz. The bone conduction thresholds were measured for 250-4000 Hz. Masked Pure Tone Audiometry was done if there was a difference of ≥40 dB between the air conduction threshold of the test ear and the bone conduction threshold of the opposite ear or when the air-bone gap of the poor ear which was under the test was ≥10 dB [14]. Hearing threshold was computed as the average of 0.5-4 kHz in dBHL. Audiograms are classified according to WHO criteria; normal hearing (≤25 dBHL), mild (26-40 dBHL), moderate (41-60 dBHL), severe (61-80 dBHL), and profound (≥81 dBHL) hearing loss [15]. Hearing loss was classified by SNHL if the air conduction and bone conduction >25 dBHL, CHL if obtained air-bone gap ≥10 dBHL at least two consecutive frequencies, or MHL if the air conduction and bone conduction >25 dBHL with air-bone gap ≥10 dBHL at least two consecutive frequencies [16]. The subject was deemed to have a hearing loss if one or both of his ears have a hearing loss. To assess the difference in the mean of air conduction, bone conduction, the value of air-bone gap, and the threshold was taken the highest threshold value between the two ears.

Tympanometry examination was conducted by interacoustics AA222 impedance audiometer (Interacoustic, Assens, Denmark). Tympanometry was conducted in auto tympo mode. The patient must swallow 8-10 times so the over or under pressure that the tympanic membrane caused in the middle ear is equalized. Different types of tympanogram were obtained by computing the compliance of tympano-ossicular system against various pressure changes [17]. Tympanogram was categorised based on A, As, Ad, B, or C type according to Jerger J [18].

STATISTICAL ANALYSIS

ESR, platelet count, rheumatoid nodule presence, the types and the degrees of hearing impairment, as well as the types of tympanogram were presented in description. The correlation of diseases duration, ESR, and platelet count and hearing threshold were analysed using Pearson's Chi-square test. The difference in the mean of air and bone conduction thesholds, air-bone gap values, as well as hearing thresholds were analysed using independent samples t-test. The correlation between RA and hearing impairment was analysed using Pearson's Chi-square test. Statistical test performed using SPSS (SPSS Inc., Chicago, IL, USA) version 17.0. A p-value <0.05 considered statistically significant.

RESULTS

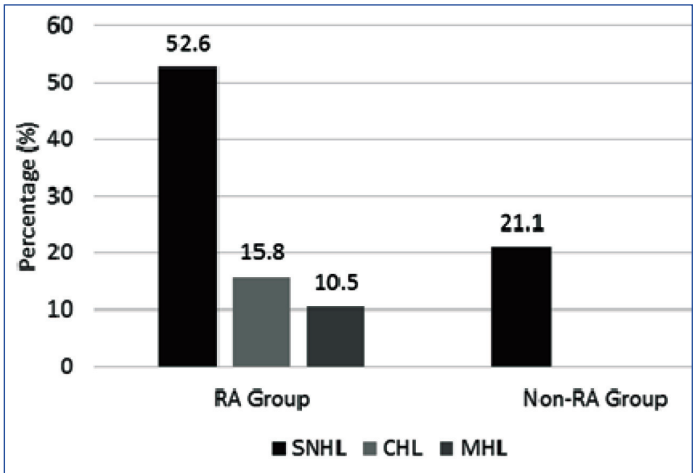
In this study, the mean age of RA group was 32.84±1.96 years old and non-RA group was 39.26±1.89 years old. Age and gender distribution in both groups were not significant (p>0.05). RA patients were undergoing treatment with anti inflammatory drugs. Steroids used were methylprednisolone or prednisone, while the non steroid drugs used were diclofenac sodium or paracetamol. In addition, patients also took Disease Modifying Antirheumatic Drugs (DMARDs) like chloroquine ormethotrexate. Non-RA patients were under ongoing treatment with Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) like diclofenac sodium, meloxicam, ibuprofen or acetaminophen. Patients in both groups consumed them in single dosage or combination. Sodium diclofenac was the major drug used in both groups. [Table/Fig-1] shows the subjects clinical characteristics.

Variables	RA group	Non-RA group	p-value
Sex			
Male	5 (26.3)	5 (26.3)	1.000
Female	14 (73.7)	14 (73.7)	
Age (years old)			
≤20	1 (5.3)	0	0.137
21-30	8 (42.1)	3 (15.8)	
31-40	5 (26.3)	5 (26.3)	
41-50	5 (26.3)	11 (57.9)	
Disease duration (year)			
≤5	15 (78.9)	16 (84.2)	0.890
6-10	3 (15.8)	2 (10.5)	
≥11	1 (5.3)	1 (5.3)	
ESR (mm/hour)			
Elevated	15 (78.9)	6 (31.6)	0.003*
Normal	4 (21.1)	13 (68.4)	
Platelet count (x10^3/mm^3)			
Thrombocytosis	3 (15.8)	1 (5.3)	0.174
Thrombocytopenia	2 (10.5)	0	
Normal	14 (73.7)	18 (94.7)	
Rheumatoid nodule			
Positive	13 (68.4)	0	<0.001*
Negative	6 (31.6)	19 (100)	

[Table/Fig-1]: Subjects clinical characteristics.
Values are presented as number (%). The p-value was tested using Pearson Chi-square test. RA, rheumatoid arthritis; non-RA, without rheumatoid arthritis; ESR, Erythrocyte Sedimentation Rate.*p<0.05.

Audiological Evaluation

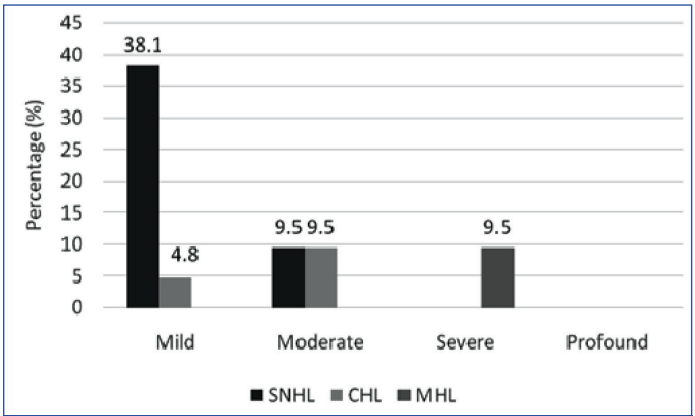
The most common type of hearing loss was SNHL which was 10 RA patients (52.6%), of which 7 were bilateral and 3 were unilateral. CHL was found in 3 patients (15.8%), of which 1 was bilateral and 2 were unilateral. MHL was only found in 2 patients (10.5%), both of which are bilateral. In addition, normal hearing was foundin 4 patients (21.05%) [Table/Fig-2].



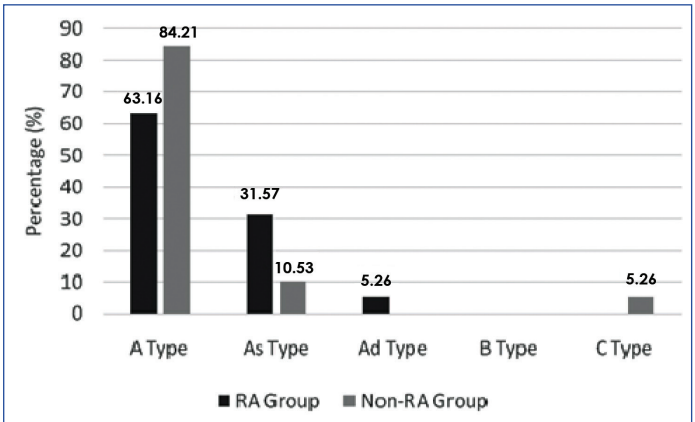
[Table/Fig-2]: Proportion of hearing impairment types in both groups.
The data are expressed as percentage (%).
RA-Rheumatoid Arthritis; non RA-without Rheumatoid Arthritis; SNHL-Sensorineural Hearing Loss; CHL-Conductive Hearing Loss; MHL-Mixed Hearing Loss

Mild SNHL was the most common finding in RA as many as 8 patients (38.1%), which of 5 were bilateral and 3 remaining unilateral. It was followed by moderate and severe degree [Table/Fig-3].

The most common type of tympanogram was type A in RA group, i.e., 12 patients (63.16%), and non-RA group were 16 patients (84.21%). As type tympanogram was found in 6 patients (31.57%) of RA group, of which 4 were bilateral and 2 were unilateral. While in the non-RA group, As type tympanogram was found in 2 patients (10.53%), where both bilateral. Unilateral Ad type tympanogram was found in 1 patient (5.26%) in RA group [Table/Fig-4].



[Table/Fig-3]: Proportion of hearing impairment degrees in RA group.
The data are expressed as percentage (%)
SNHL-Sensorineural Hearing Loss; CHL-Conductive Hearing Loss; MHL-Mixed Hearing Loss



[Table/Fig-4]: Proportion based on tympanogram types of both groups. The data are expressed as %. RA, rheumatoid arthritis; non-RA, without rheumatoid arthritis.

The Correlation of RA and Hearing Impairment

A significant correlation (p<0.05) of disease duration and ESR with hearing loss degree in RA group was obtained using Pearson's Chi-square test [Table/Fig-5].

Variables	Hearing loss degrees				p-values
	Mild	Moderate	Severe	Profound	
Disease duration (year)					
≤ 5	3 (15.8)	8 (42.1)	4 (21.1)	0	0.014*
6-10	0	1 (5.3)	0	2 (10.5)	
≥11	1 (5.3)	0	0	0	
ESR (mm/hour)					
Elevated	1 (5.3)	8 (42.1)	4 (21.2)	2 (10.5)	0.027*
Normal	3 (15.8)	1 (5.3)	0	0	
Platelet count (x 10^3/mm^3)					
Thrombocytosis	3 (15.8)	7 (36.8)	3 (15.8)	1 (5.3)	0.434
Thrombocytopenia	0	2 (10.5)	0	1 (5.3)	
Normal	1 (5.3)	0	1 (5.3)	0	

[Table/Fig-5]: The correlation of disease duration, ESR, and platelet count, with hearing lossdegrees in RA group.
Values are presented as number (%). The p-value was tested using Pearson Chi-Square test. ESR, Erythrocyte Sedimentation Rate. *p<0.05.

Mean of air and bone conduction thresholds as well as air-bone gap values in RA group was higher than those in non-RA group in all frequencies. A significant difference (p<0.05) was obtained in air-bone gap values at 500 Hz to 4000 Hz [Table/Fig-6].

For the purpose of investigating the correlation of RA and hearing impairment, statistical analysis was done. A p-value <0.05 was obtained by using Pearson's Chi-square test.

This showed a significant correlation of RA and hearing impairment [Table/Fig-7].

Frequency (Hz)	RA group	Non-RA group	p-value
Air conduction thresholds			
250	36.58±4.21	27.11±2.21	0.078
500	35.53±3.89	25.79±2.10	0.090
1000	32.11±3.32	23.16±2.46	0.190
2000	33.16±3.96	24.74±2.82	0.166
4000	35.53±4.87	23.16±3.63	0.114
8000	34.47±6.08	29.74±5.55	0.769
Bone conduction thresholds			
250	23.42±2.84	19.74±2.25	0.425
500	30.79±2.63	23.68±2.09	0.425
1000	26.84±3.27	20.53±2.39	0.120
2000	27.37±3.09	22.63±2.74	0.400
4000	27.11±3.63	20.79±3.43	0.441
Air-bone gap values			
500	4.74±2.69	2.11±0.79	0.014*
1000	6.32±1.79	2.11±0.88	0.003*
2000	5.79±2.71	2.11±0.58	0.014*
4000	9.47±2.67	3.16±0.87	0.003*
Hearing thresholds	34.08±3.75	24.21±2.50	0.061

[Table/Fig-6]: Mean of air and bone conduction thresholdsas well as air-bone gap values.
Values are presented as mean±SEM. SEM, Standard Error of the Mean. The p-values were tested using independent samples t-test. RA, rheumatoid arthritis; non-RA, without rheumatoid arthritis. *p<0.05.

Group	Hearing loss	No hearing loss	Total	p-value
RA group	15 (78.9%)	4 (21.1%)	19 (100%)	0.001*
Non-RA group	4 (21.1%)	15 (78.9%)	19 (100%)	

[Table/Fig-7]: The correlation of RA and hearing impairment.
Values are presented as number (%). The p-value was tested using Pearson Chi-square test. RA, with rheumatoid arthritis; non-RA, without rheumatoid arthritis. *p<0.05.

DISCUSSION

In this study, a significant correlation was obtained between disease duration increased and hearing threshold increased in RA group. This showed that the longer patients with RA have the disease, their hearing threshold is increased. Öztürk A et al., found that the longer disease duration, the higher stage of the disease [19]. Longer disease duration caused longer disease effect and ototoxic effect on the auditory system [5].

In this study, a significant correlation was found between increased ESR and increased hearing threshold in RA group. Dikici O et al., have reported that increase in ESR was correlated with disease duration, and that platelet count is correlated with hearing threshold [5]. Takatsu M et al., also found that increased ESR was significantly correlated with SNHL in RA patients [10]. Elevation in ESR and rheumatoid nodules often found in subjects of this study showed disease activity [5,8]. Hearing impairment was correlated with disease activity [5,10]. When the ESR increases, the more joints were involved [20]. The increased ESR was lead to vasculitis which is an extra-articular manifestation of RA [21]. However, contrast result found in platelet count. Normal platelet count, as substantially found in this study, was because of therapy performed. NSAIDs, DMARDs, and steroids consumed by the subjects of this study can reduce platelet count [22].

In this study, mild degree SNHL was most prevalent in the RA group. Based on the literature, SNHL is reported to be up to 72% [4]. The pathophysiology of hearing loss in RA patients is not fully known. Although retrocochlear involvement has been reported, most literature reports that cochlear pathology is the cause. The structure of the inner ear is disturbed by vasculitis, neuritis, and the ototoxic drugs used in treatment [5,8]. In a study conducted by Baradaranfar MH and Doosti A [7], there was a significant difference

of hearing threshold at the frequency of 8000 Hz among the RA patients with the comparison group. They claim that cochlear damage is the cause.

In this study, it was found that air conduction thresholds mean and bone conduction thresholds mean in RA group were higher at all frequencies. SNHL in RA is found to be heavier at lower frequencies [23,24] although some other researchers reported that the SNHL is found at high frequencies [7,19,25]. SNHL at lower frequencies is thought to be a manifestation of earlier hearing loss [24] which is not caused by outer hair cell dysfunction [25]. While SNHL at high frequencies can be caused by the influence of autoimmunity [26] as well as toxic effects of analgesic drugs consumed on the inner ear marked by partial loss of perception of high tone [27].

This study proves that hearing loss is often found in RA patients. In this study, significant correlation was found between RA with hearing loss based on statistical analysis. In this study, the study subjects in the RA group were undergoing treatment with NSAIDs, steroids, and/or DMARDs including methotrexate and hydroxychloroquine. Similarly, subjects in the non-RA group consisting of patients with other joints diseases are also undergoing treatment with NSAIDs or steroids. This suggests that the SNHL in the RA group as probably the vasculitis process due to the ototoxic drugs used in treatment. Although the ototoxic effects of immunosuppressive drugs and the anti inflammatory drugs used in RA treatment are rare, some cases have been published with respect to side effects of methotrexate, hydroxychloroquine, and salicylate [9,28]. In a prospective study, there was also reported a correlation between the use of non-steroidal anti-inflammatory drugs such as methotrexate, hydroxychloroquine, salicylate, and D-penicillamine with SNHL [5,8]. In addition, Choy E suggested that when rheumatoid ossicular joint fixation occurs, the inner ear protective mechanism is inhibited by intrinsic and extrinsic traumas [2]. A number of possible pathologies of SNHL have been described by previous studies mainly as auditory neuropathy and destruction of the cochlear hair cells or the inner ear due to immune complex deposition, and drug-induced ototoxicity [4].

In this study, CHL was the most common type of hearing loss after SNHL. The prevalence of CHL in RA patients was reported to be lower than that of SNHL, only up to 24.3% [9]. Damage to joints and ligaments of auditory ossicles has been reported as the cause. Incudomalleolar and incudostapedial joints are true diarthroses that have a risk of RA [4-6,23]. The As type tympanogram found in this study shows an increase in stiffness of ossicular joints. Inflammation in active disease and fibrosis in ossicular chain can reduce static compliance and cause conduction disturbance [5]. While Ad type tympanogram also found in this study can occur due to vasculitis which resulted in inadequate perfusion of the ossicles, especially in long process of incus. Necrosis in this structure can cause discontinuity [5,10]. RA can harm incudomalleolar and incudosetapedial joints so that it can change ossicular mechanics in responding the modification of static air pressure [5]. However, when these joints functionally fixed during sound transmission, this condition can occur with no clinical symptoms [4].

In this study, MHL was also found but with a lower porportion than other hearing loss. Previous studies have suggested that MHL was 10.8% [7]. The interactions of T cells, B cells, and proinflammatory cytokines are pathogenic in RA. Pannus as part of synovial membrane is rich in osteoclast degrading bones [2]. The A type tympanogram found in this study shows that damage to the middle ear is a relatively less common finding than damage to the inner ear. However, since significant differences in the mean air-bone gap at frequencies of 500 Hz to 4000 Hz, we believe that damage to the ossicular joints can progress more slowly than damage to the inner ear. This will lead to MHL.

LIMITATION

This study did not prove the exact cause of hearing loss in RA. Therefore, further studies should be conducted to investigate the role of various pathologies that occur in RA concerning the hearing loss and the effect of the drugs used in the treatment.

CONCLUSION

Rheumatoid arthritis can cause hearing loss. We suggest that the cause of hearing loss in this study is due to various processes that occur in the disease such as synovial destruction of incudomalleolar and incudostapedial joints, rheumatoid nodule, auditory neuropathy, destruction of the cochlear hair cells and drug-induced ototoxicity. We recommend regular evaluation of hearing impairment through clinical examination, pure tone audiometry, and tympanometry on patients that consumed ototoxic drugs. Patient's quality of life can be increased by early detection of hearing impairment and appropriate rehabilitation plan.

REFERENCES

[1] Soleimani A, Mobedi Z, Al-e-rasul M, Sharifi A, Vardanjani AK. Effect of anti-cyclic citrullinated peptide and HLA-DRB1 subtypes on clinical disease activity index in rheumatoid arthritis patients. Journal of Clinical and Diagnostic Research. 2017;11(3):OC09-OC12.

[2] Choy E. Understanding the dynamics: pathways involved in the pathogenesis of rheumatoid arthritis. Rheumatology. 2012;51:v3-v11.

[3] Mamehara A, Sugimoto T, Sugiyama D, Morinobu S, Tsuji G, Kawano S, et al. Serum matrix metalloproteinase-3 as predictor of joint destruction in rheumatoid arthritis, treated with non-biological disease modifying anti-rheumatic drugs kobe J Med Sci. 2010;56(3):E98-E107.

[4] Emamifar A, Bjoerndal K, Hansen IMJ. Is hearing impairment associated with rheumatoid arthritis? a review. The Open Rheumatology Journal. 2016; 10:26-32.

[5] Dikici O, Muluk NB, Tosun AK, Unlüsoy I. Subjective audiological tests and transient evoked otoacoustic emissions in patients with rheumatoid arthritis: analysis of the factors affecting hearing levels. Eur Arch Otorhinolaryngol. 2009;266(11):1719-26.

[6] Pascual-Ramos V, Contreras-Yáñez I, Rivera-Hoyos P, Enríquez L, Ramírez-Anguiano J. Cumulative disease activity predicts incidental hearing impairment in patients with rheumatoid arthritis (RA). Clin Rheumatol. 2014;33(3):315-21.

[7] Baradaranfar MH, Doosti A. A survey of relationship between rheumatoid arthritis and hearing disorders. Acta Med Iran. 2010;48(6):371-73.

[8] Arslan N, Cicek Y, Islam A, Ureten K, Safak MA, Oguz H. Involvement of ear in rheumatoid arthritis. prospective clinical study. Int Adv Otol. 2011;7(2):208-14.

[9] Ozcan M, Karakuş MF, Gündüz OH, Tuncel U, Sahin H. Hearing loss and middle ear involvement in rheumatoid arthritis. Rheumatol Int. 2002 Mar;22(1):16-9.

[10] Takatsu M, Higaki M, Kinoshita H, Mizushima Y, Koizuka I. Ear involvement in patients with rheumatoid arthritis. Otol Neurotol. 2005;26(4):755-61.

[11] Darmawan J, Muirden KD, Valkenburg HA, Wigley RD. The epidemiology of rheumatoid arthritis in Indonesia. British journal of rheumatology. 1993;32(7):537-40.

[12] Arnett FC, Edworthy S, Bloch DA, McShane DJ, Fries JF, Cooper NS, et al. The American rheumatism association 1987 revised criteria for the classification of the rheumatoid arthritis. Arthritis Rheum. 1988;31(3):315–24.

[13] Ballantyne D, Troisio R. Handbook of Audiological Techniques. Butterworth-Heinemann Ltd. London.1990; 68.

[14] Arlinger S. Manual of Practical Audiometry (Practical Aspects of Audiology). Whurr Publishers Ltd; London, England. 1991;46.

[15] World Health Organization. Prevention of Blindness and deafness: Grades of Hearing Impairment.http://www.who.int/pbd/deafness/hearing_impairment_grades/en/index. html 2002 (accessed 18th October 2016).

[16] Ukaegbe O, Ezeanolue B, Orji F. The influence of tinnitus on the audiometric threshold of sufferers. Int Arch Otorhinolaryngol. 2016;20(4):339–43.

[17] Chandran A, Aswath N. Assessment of function of eustachian tube in oral submucous fibrosis - a tympanometric study. Journal of Clinical and Diagnostic Research. 2016;10(9):ZC13-ZC15.

[18] Jerger J. Clinical experience with impedance audiometry. Arch Otolaryngol. 1970;92:311-24.

[19] Öztürk A, Yalçin A, Kaygusuz I, Sahin S, Gök Ü, Karlidag T, et al. High-frequency hearing loss and middle ear involvement in rheumatoid arthritis. Am J Otolaryngol. 2004;25(6):411-17.

[20] Shimada K, Komiya A, Yokogawa N, Nishino J, Sugii S, Tohma S. Impact of the size and number of swollen joints on serum C-reactive protein level and erythrocyte sedimentation rate in rheumatoid arthritis: a cross-sectional study in Japan. Clin Rheumatol. 2016 Nov.

[21] Makol A, Matteson EL, Warrington KJ. Rheumatoid vasculitis: an update. Curr Opin Rheumatol. 2015;27(1):63-70.

[22] Yazici S, Yazici M, Erer B, Calik Y, Ozhan H, et al. The platelet indices in patients with rheumatoid arthritis: Mean platelet volume reflects disease activity. Platelets. 2010;21(2):122–25.

[23] Raut V, Cullen J, Cathers G. Hearing loss in rheumatoid arthritis. J Otolaryngol. 2001;30(5):289-94.

[24] Bayazit YA, Yilmaz M, Gunduz B, Altinyay S, Kemaloglu YK, Onder M, et al. Distortion product otoacoustic emission findings in Behçet's disease and rheumatoid arthritis. ORL. 2007;69(4):233-38.
[25] Treviño-González JL, Villegas-González MJ, Muñoz-Maldonado GE, Montero-Cantu CA, Nava-Zavala AH, Garza-Elizondo MA. Subclinical sensorineural hearing loss in female patients with rheumatoid arthritis. Cirugía y Cirujanos. 2015;83(5):364-70.
[26] Gallo JR, Ortiz AC, Paira SO. IgG4-Related Disease and Sensorineural Hearing Loss. Clinical and Experimental Otorhinolaryngology. 2014;7(3):236-37.
[27] Jahan S, Milky MF. Prevalence of Analgesic Induced Deafness. Bangladesh Journal of Neuroscience. 2011;27(2):74-77.
[28] Salvinelli F, D'ascanio L, Casale M, Vadacca M, Rigon A, Afeltra A. Auditory pathway in rheumatoid arthritis. a comparative study and surgical perspectives. Acta Oto-Laryngologica. 2006;126:32-36.

PARTICULARS OF CONTRIBUTORS:
1. Lecturer, Department of Otorhinolaryngology-Head and Neck Surgery, Faculty of Medicine, University of Muhammadiyah Sumatera Utara, Medan, Indonesia.
2. Lecturer, Department of Otorhinolaryngology-Head and Neck Surgery, Faculty of Medicine, Universitas Sumatera Utara, Padang Bulan, Medan, Indonesia.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Mr. Muhammad Edy Syahputra Nasution,
Lecturer, Department of Otorhinolaryngology-Head and Neck Surgery, Faculty of Medicine,
University of Muhammadiyah Sumatera Utara, Medan-20217, Indonesia.
E-mail: muh.edyputra46@gmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Mar 10, 2017**
Date of Peer Review: **Apr 25, 2017**
Date of Acceptance: **Sep 06, 2017**
Date of Publishing: **Mar 01, 2018**