Acta Scientific Otolaryngology (ISSN: 2582-5550)

Volume 5 Issue 5 May 2023

Research Article

Blood Group O and its Potential Association with Sensorineural Hearing Loss

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DOI: 10.31080/ASOL.2023.05.0560

Received: February 13, 2023

Published: April 13, 2023

Abstract

Introduction: ABO blood group system and auditory function has been linked in the past. Individuals with O blood type are at a higher risk to develop noise induced hearing loss after industrial noise exposure. Also, O positive healthy individuals with normal hearing show reduced amplitudes in otoacoustic emission recordings. Whether blood group status increases the susceptibility of an individual with O blood group to develop sensorineural hearing loss or increases its severity is unclear.

Aim/Objectives: To analyse the association of O type blood group with sensorineural hearing loss.

Materials and Methods: 257 patients with SNHL were divided into group 1 (>7yrs) and group 2(<7yrs). Blood group analysis was carried out. Bera (group 1) and pure tone audiometry (group 2) were done in all patients. Chi square tests compared results across the ABO groups.

Results: On blood group analysis, blood group O (39.7%) was most commonly encountered. In both the groups O positive blood type had majority of the patients with severe degree of hearing loss with minimal cases falling into milder form. A statistically significant difference in the degree of hearing loss across the four ABO blood groups was found.

Conclusion: There was an increased incidence and severity of sensorineural hearing loss in patients with O positive blood group in both adults and children.

Keywords: WHO; Hearing; Sensorineural Hearing Loss (SNHL)

Introduction

According to the WHO report in 2021, it is reported that approximately 20% of the Indian population is affected by some degree of hearing loss. There has been a lot of research on the aetiology and pathophysiology of hearing loss but little is known about its association with ABO blood groups. Mollicone., *et al*. in his study on rat's inner ear observed the presence of B and H antigens on the primary sensory cells while the antigen A was absent, implying a potential association between ABO blood group system and auditory function [1]. The prevalence of different ABO blood groups varies among different populations. As per the available literature, O type blood group is most common in India [2]. Garg., *et al*. in his study calculated the frequency occurrence of different blood groups and Rh(D) factor in India, after selecting four different Indian epidemiological studies conducted in different timelines and derived an average percentage out of it (A-21.95%, B-34.38%, O-35.13%, AB-7.41%, Rh(D) +ve-94.60%, Rh(D) -ve-5.395%.) [3-6].

With the current understanding of association of O blood type with noise induced hearing loss and reduced otoacoustic emissions there is a chance to find out the susceptibility of an individual with

O blood group to develop sensorineural hearing loss [7-9]. With this aim our study was undertaken to analyse the association of O type blood group with sensorineural hearing loss.

Materials and Methods

All the patients attending ENT OPD with complaints of hearing loss from November 2021- November 2022 were initially enrolled in the study diagnosed on detailed history and clinical examination. Patients with sensorineural hearing loss (SNHL) were only included after thorough Oto-endoscopic and audiometric evaluation. Subjects with intact tympanic membrane and conductive hearing loss were excluded. A total of 257 patients in the age group of 7months-80years, either sexes with SNHL were selected. Depending on their age they were further distributed into group 1 (96; 37.4% patients) comprising of children aged less than 07 years and Group 2 (161; 62.6% patients) with patients aged 07 years and above. Audiometry was done in all patients as a baseline investigation in a sound treated, air-conditioned room. The patients of group 1 underwent Brain evoked response audiometry (BERA) using Integrity Vivosonic audiometer. The children were given general anaesthesia 30 minutes before commencing the test by an anaesthetist. Silver electrodes were placed over the vertex, mastoids and forehead. The click acoustic stimuli with a rate of 11-21/S rarefaction in polarity was used. We used 110dB sound pressure level as the threshold stimulus which was gradually decreased until the V wave was just identifiable with satisfactory morphology. If the waves were absent even at 120dB it was labelled as profound SNHL. The degree of hearing loss was evaluated accordingly [10].

Hearing threshold	Sound pressure levels
Normal hearing sensitivity	≤25 dB
Mild hearing impairment	30-45 dB
Moderate hearing impairment	50-65 dB
Severe hearing impairment	70-85 dB
Profound hearing impairment	90 dB and above

Table a

On the other hand, the patients of Group 2 underwent Pure tone audiometry to assess the degree and type of hearing loss. It was carried out with Harp Inventis audiometer, where minimum frequency was 250 Hz and maximum was 8000 Hz and from 5db to 100 db. The frequency dial was adjusted to 1000 Hz. WHO classification of hearing impairment was used to determine the degree of hearing loss. Also, the hearing thresholds at each frequency were documented properly.

WHO (1980) recommended classification [11]

Degree of hearing loss classified as

- Mild: 26 - 40 dB
- Moderate: 41 - 55 dB
- Moderately severe: 56 - 70 dB
- Severe: 71 - 91 dB
- Profound: More than 91 dB.

Blood group analysis was done as an essential work up and patients were further grouped according to their blood group type, A, B, AB and O as well as Rh positive and negative status. On review of literature O blood group has been linked with noise induced hearing loss and reduced otoacoustic emission markers, therefore blood groups A, B, and AB (Rh positive and negative) were clubbed together as "others" for further analysis and correlation. Chi square test was used for statistical analysis and P value of < 0.05 was considered significant.

Results

The present work was undertaken to study the potential association of O blood group with sensorineural hearing loss. The study comprised of 257 patients of SNHL further divided into group 1(33.8%) and group 2(66.2%) based on their age. The youngest patient in our study was 07 months old while the eldest was 80 years. The mean age of the patients in our study was 32.86 years with a SD of ±13.77 years. Maximum number of cases (26.2%) were in the age group of 60- 80 years followed by (16.2%) patients in age group of 02 years and below. In our study of 257 patients, females outnumbered the males. Male to female ratio of 1:1.25 was observed. On further subjecting the patients to blood group analysis, we found that blood group O (39.7%) was most frequent followed by B (31.2%). In group 1 majority of the children presented with non-syndromic congenital hearing loss. In group 2 most of the patients had hypertension and diabetes, followed by sudden sensorineural hearing loss.

SNHL was present in bilateral ears (84.0%) in majority of the patients in both the groups. But in unilateral cases the incidence of SNHL was almost double in the left ear (10.5%) than the right (5.5%). When children of group 1 underwent BERA we found out that most of the cases 18(51.4%) with O positive blood group had severe (90-120dB) degree of hearing loss. The incidence of mild degree of hearing loss was more common in the Non-O blood type. The P value being significant (< 0.05). In our study, all the patients of group 2 were subjected to pure tone audiometry and the pure tone average of both the ears were analysed. Majority of the patients with O positive blood group had moderate to severe (56-7-dB) degree of hearing loss (38.9%). While in the Non-O blood group, maximum 39(36.5%) cases of moderate degree(41-55dB) of hearing loss were witnessed. Also, the incidence of mild hearing loss was only 8.5% in patients with blood group O when compared to others with 16.8% cases. In patients with blood group O, higher frequencies were more involved, in both the groups. A statistically significant difference in the degree of hearing loss across the four ABO blood groups was found in both children and adults.

Distribution of patients according to ABO blood group system

Blood group type		Group 1	Group 2	Total
A	Rh Positisve	16(18.4%)	33(19.4%)	52(20.3%)
	Rh Negative	02(2.3%)	01(0.6%)	
B	Rh Positive	23(26.4%)	54(31.7%)	80(31.2%)
	Rh Negative	01(2.2%)	02(1.8%)	
AB	Rh Positive	06(6.8%)	16(9.4%)	23(8.9%)
	Rh Negative	00(0 %)	01(0.6%)	
O	Rh Positive	35(40.2%)	59(34.7%)	102(39.7%)
	Rh Negative	04(4.5%)	04(2.4%)	
Total	Rh Positive	80(92%)	162(95.3%)	242(94.2%)
	Rh Negative	07(08 %)	8(4.7%)	15 (5.8%)
	Total	87(33.8%)	170(66.2%)	257(100%)

Table b

Etiology of hearing loss in Group 1

Sr. no	Etiology	O Positive	O Negative	Others
1.	Syndromic	03(8.6%)	01(25%)	05(10.5%)
2.	Non syndromic (Congenital)	26(74.9%)	03(75%)	38(79.2%)
3.	Viral infection	03(8.6%)	00(0%)	03(6.3%)
4.	Ototoxic drugs	03(8.6%)	00(0%)	02(4.2%)
5.	Total	35(100%)	04(100%)	48(100%)

Table c

Etiology of hearing loss in Group 2

Sr. no	Etiology	O Positive	O Negative	Others
1.	Age related	13(22%)	01(25%)	28(26.2%)
2.	Autoimmune	02(3.4%)	00(0%)	03(2.8%)
3.	Hypertension	19(32.2%)	02(50%)	43(40.2%)
4.	Diabetes	12(20.4%)	02(50%)	34(31.8%)
5.	Exposure to noise	02(3.4%)	00(0%)	03(2.8%)
6.	Sudden hearing loss	06(10.2%)	01(25%)	03(2.8%)
7.	Viral infection	04(6.8%)	00(0%)	07(6.5%)
8.	Ototoxic drugs	04(6.8%)	00(0%)	06(5.6%)
9	Tumors	00(00%)	00(0%)	01(0.9%)
10.	Total	59	04	107

Table d

Distribution of patients according to laterality of hearing loss

Group 1				Group 2			Total
Laterality	O positive	O negative	Others	O positive	O negative	Others	
Right	01(2.8 %)	00(0%)	01(2.0%)	04(6.8%)	01(25%)	07 (6.5%)	14(5.5%)
Left	03(8.6%)	00(0%)	04(8.4%)	08(13.6%)	00(0%)	12(11.2%)	27(10.5%)
Bilateral	31(88.6%)	04(100 %)	43(89.6%)	47(79.6%)	03(75%)	88(82.3%)	216(84.0%)
Total	35(100%)	04(100%)	48(100%)	59(100%)	04(%)	107(100%)	257(100%)

Table e

Distribution of patients in Group 1 according to degree of hearing loss on BERA

Degree of hearing loss	O positive	O negative	Others
Mild (<70dB)	04(11.4%)	00(0%)	11(22.9%)
Moderate (70-90dB)	13(37.2%)	01(25%)	17(35.4%)
Severe (90-120dB)	18(51.4%)	03(75%)	20(41.7%)
Total	35(100%)	04(100%)	48(100%)

Table f

Distribution of patients in Group 2 according to degree of hearing loss on PTA

Degree of hearing loss	O positive	O negative	Others
Mild (26-40dB)	05(8.5%)	00(0%)	18(16.8%)
Moderate (41-55dB)	17(28.8%)	00(0%)	39(36.5%)
Moderately severe (56-70dB)	23(38.9%)	02(50%)	32(29.9%)
Severe (71-91dB)	08(13.6%)	01(25%)	11(10.3%)
Profound (>90dB)	06(10.2%)	01(25%)	07(6.5%)
Total	59(100%)	04(100%)	107(100%)

Table g

Discussion

The present study was undertaken to identify the potential association of blood group O with SNHL. A total number of 257 patients of SNHL were selected for this study and various parameters like age, sex, side, etiopathology, blood group and degree of hearing loss were studied. We found that individuals with blood group O were present in majority and exhibited significantly higher degree of hearing loss in both the groups when compared to the Non-O group.

Previously researchers have pointed out the probable association of blood group O with noise induced hearing loss (NIHL). Dogru., *et al*. in his study on 176 factory workers in Turkey concluded that people with blood group O are more prone to develop noise induce hearing loss when compared to non-O counterparts [12]. A similar study conducted an Indian IAF base to find out the prevalence and severity of NIHL observed an increased incidence of NIHL in Indian military personnel with blood group O [7]. From these studies we can hypothesize that ABO blood group system can play a role in predicting one's risk in developing NIHL but this can't explain the congenital differences. Chow., *et al*. in his study conducted on 60 young healthy Chinese women observed that there was a significant difference in the amplitude response of otoacoustic emissions (OAEs) amongst the four main blood groups. The females with O blood group exhibited fewer occurrences of SOAE and DPOAE amplitudes [8].

In a very similar study conducted by Chen., *et al*. in Hongkong on 60 young healthy Han Chinese males, had similar observations with blood group O individuals exhibiting lower OAE response amplitudes [13]. Li., *et al*. in his study on 80 full-term female neonates who passed the initial newborn hearing screening test concluded that babies with blood group O had lower otoacoustic emission values than the other blood groups. Thereby suggesting that individuals with O blood Group might be audiologicaly inferior

at a physiologic level supporting the theory that O blood group individuals might be at a greater risk to suffer NIHL [14]. Yang., *et al*. in his recent study conducted auditory brainstem response measurements and found a potential association between ABO blood group type and cochlear and neural function. They concluded that individuals with O blood group exhibited significantly lower cochlear microphonic and wave I amplitudes with prolonged wave I latency. Stating that due to the lower levels of certain protective glycoproteins blood group O individuals might be at a greater risk of cochlear and/or neural dysfunction. They also hypothesized that blood group status might as well influence the neural responses by affecting the function of the synaptic connection between hair cells of the cochlea and auditory nerve fibres [15]. In a study conducted by Bener., *et al*. they observed a statistically significant association between Rhesus-positive blood group and SNHL. They documented more hearing loss in Rhesus-positive babies then with Rhesus-negative ones. Due to the lack of historical research in this domain, they ended up concluding that this correlation required further research [16].

During the development of cochlea there is an initial appearance and progressive disappearance of human blood group B and H antigens on sensory and non-sensory hair cells of rats which has been thought to be under the influence of afferent nerve fibres. The immensely precise localization of H antigen temporally could also be associated with the differentiation of stereocilia in the developing hair cells of cochlea or could be a precursor of carbohydrates exhibited in the cochlear hair cells of an adult rat. Later, thyroxine was also implicated as a potential modulator of blood-group antigen expression in turn influencing the cochlear hair cell development [17-20].

Prabhu., *et al*. stated that individuals with O type blood group might not have many healthy outer hair cells (OHCs) or might have reduced activity [21]. Making these individuals a potential candidate for spontaneous hair cell loss at an early age [22]. These biological differences among blood groups can be an apparent disadvantage for blood group O individuals for their audiological status. Putting them at a risk and increasing their susceptibility to common life injuries like noise at an early age. Additionally, the biological distinction amongst different blood groups might explain the inherited audiological disadvantage for blood group O individuals. The lack of A and B transferases, the functional protein present in non-O blood group individuals may possibly be detrimental for people with blood group O [23].

Also, when microtissue damage occurs fewer amount of clotting factors (von Wille brand factor) in the blood of O group individuals, might as well have a dominant role to play in quick biological tissue repair mechanisms, like coagulation [24]. The blood vessels and capillaries, providing nutrition to cochlea are vulnerable to damage. The less efficient blood clotting in individuals with blood group O can lead to further damage to the tissues that are vulnerable to damage or have been already damaged due to lack of inhibition at an early stage, eventually resulting in less healthy outer hair cells [13]. Also, von Wille brand factor (vWF) interacts with thrombospondin which is another glycoprotein. Thrombospondin plays a vital role in human development and blood vessel formation. It modulates the development and function of cochlear synapses. In mice deletions of one or more thrombospondin genes lead to cochlear synaptic dysfunction, signifying its role in cochlear synapse development [25]. Moreover, due to lack of vWF levels in O blood group individuals, the function of thrombospondin might as well get restricted, in turn influencing the growth of the vasculature in the cochlea [15]. This physiology of the blood supply of cochlea and different levels of glycoproteins among blood groups has explained the potential susceptibility of blood group O persons to reduced cochlear/neural function. Cochlear energy and nutrition are supplied via the stria vascularis to convert acoustic signals into electrical potentials. The internal auditory artery supplies the stria vascularis, contributing to the production of the endocochlear potential in the endolymph of scala media. The maintenance of these endocochlear potentials is important for normal hair cell function [26].

The findings of our present study were in consensus with all other related studies. Generally, the cochlear performance in people with O blood group were lower when compared with non-O blood group individuals.

Conclusion

In our study we conducted the audiometric evaluation of patients with sensorineural hearing loss from blood groups A, B, O and AB and found a potential relationship between ABO

blood group type and SNHL. Blood group O positive was most frequently encountered followed by B positive. Bilateral hearing loss was more common but in unilateral cases the left ear was found to be more affected. There was an increased incidence of sensorineural hearing loss in patients with O positive blood group in both adults and children. Even the severity of hearing loss was significantly higher in them. However, much larger multicentric studies are needed to substantiate these findings. This knowledge can further help us in understanding the underlying pathogenesis behind association of SNHL and O blood group. Might as well help us in therapeutic planning, counselling of patients and providing therapeutic intervention at the earliest. To conclude, in future ABO blood group system might ascertain the risk of an individual to develop SNHL.

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