Wydawnictwo UR 2023
ISSN 2544-1361 (online)
doi: 10.15584/ejcem.2023.3.25

http://www.ejcem.ur.edu.pl
European Journal of Clinical and Experimental Medicine
Eur J Clin Exp Med 2023; 21 (3): 576–581

ORIGINAL PAPER

The effect of different blood groups on visual evoked potentials

Mehmet Tahir Eski [1], Ahmet Yabalak [2], Halime Şahan [2], Alper Aziz Hüdai Ayaslı [3], Taha Sezer [4]

[1] Department of Ophthalmology, Neon Hospital, Erzincan, Turkey
[2] Department of Neurology, Düzce University Faculty of Medicine, Düzce, Turkey
[3] Department of Neurology, Düzce Atatürk State Hospital, Düzce, Turkey
[4] Department of Ophthalmology, Düzce University Faculty of Medicine, Düzce, Turkey

ABSTRACT

Introduction and aim. Purpose of the study is to determine whether it is required to use different standards when evaluating visual evoked potential (VEP) measurements of healthy individuals with different blood groups.

Material and methods. The study consisted of healthy individuals with different blood groups who have applied to the ophthalmology and neurology outpatient clinic of Düzce University Medical Faculty from January to December 2022. The patients went through detailed ophthalmologic examination and VEP test and only the ones with normal results were included to the study.

Results. The study consisted of 119 individuals, with a blood group distribution of 30 A, 29 B, 30 AB and 30 O. VEP latency and amplitude changes were compared and no significant difference was observed within 4 groups in terms of P100 and N70 latency and amplitudes. There was N70 latency prolongation in Rh- group and this difference was found to be statistically significant (p=0.009). Rh+ group was found to be high in terms of P100 amplitudes and this was considered statistically significant (both p=0.023).

Conclusion. There was no statistically significant difference in the VEP parameters of the individuals with the ABO blood groups hence same VEP normal values can be used for ABO blood groups.

Keywords. blood groups, visual evoked potential, Rh factor

Introduction

ABO system which is known as Blood Group System is considered to be the most important system in our body, serving as the code of our body. Recognition of this importance is followed by amplified awareness and constantly increasing number of related studies.[1] Due to immunological barriers, ABO blood group system compatibility is required for all processes from blood transfusions to organ transplantation. Besides, blood group distribution is not similar in all societies. There are even studies suggesting that some conditions like tumors and infections and cardiovascular and gastroduodenal diseases are more prevalent in certain blood groups.[1–5] ABO blood group antigen exists in various tissues like erythrocyte, thrombocyte and endothelium. The effect of different blood groups on retinal nerve thickness was reported in a previous ophthalmological study.[6]

Pattern visual evoked potential (VEP) test is an important electrophysiological test commonly employed in neurology and ophthalmology clinics for the purpose of reinforcing the results of unexplained vision loss, neurological disorders or optic nerve damages. VEP test also provides quantitative data about optic tracts from reti-

Corresponding author: Ahmet Yabalak, e-mail: yabalakahmet@gmail.com

Received: 27.04.2023 / Revised: 7.07.2023 / Accepted: 12.07.2023 / Published: 30.09.2023

Eski MT, Yabalak A, Şahan H, Ayaslı AAH, Sezer T. *The effect of different blood groups on visual evoked potentials.* Eur J Clin Exp Med. 2023;21(3):576–581. doi: 10.15584/ejcem.2023.3.25.

na to brain through optic disc.[7] When literature is reviewed, various studies can be found on the relations between optic disorder and blood groups.[8–12] However, no previous study was found related to the effects of blood groups on VEP test.

Aim

Based on all being said and found, we established the hypothesis of a possible difference the blood groups might have on Pattern Visual Evoked Potential (pVEP) test also considering the intense antigen cells in the optic and brain tissues. Our purpose was to evaluate whether it is required to use different standards in the evaluation process of VEP measurements of healthy individuals with different blood groups.

Material and methods

The ophthalmology and neurology outpatient clinic of our hospital conducted this study in compliance with the Declaration of Helsinki principles and the approval of the institutional ethics committee (182/2022 – Clinical Trial Protocol). Our study was carried out in the VEP room of Düzce University, Faculty of Medicine, Neurology. First of all, the patients underwent eye examination. Considering the inclusion and exclusion criteria, VEP test examinations of the patients who were suitable for eye and neurologic examination were performed. The study covers the evaluation of healthy individuals within the age group of 18-50. Each patient has not only been informed on the protocols of the procedures as well as the purpose of the study itself but they were asked to submit their fully signed consent forms as well.

The participating patients were eliminated according to the following criteria: patients with addiction, drug use, alcohol and smoking history; patients with eye surgery history or high intraocular pressure, glaucoma or any kind of systemic disease like high blood pressure or diabetes; patients with neurological conditions or some kind of disorder that might reflect on optic disc, like papilledema, optic neuritis, sclerosis or similar; patients with eye conditions such as astigmatism of over 1D, anisocoria, pupil size of under 3 mm, amblyopia, diplopia, cataract, myopia or hyperopia of over 3D.

Several tests such as direct and indirect light reflexes, slit lamp biomicroscopy, best corrected visual acuity, Goldman Applanation Tonometry intraocular pressure measurement, eye movement test and fundus examination were performed for each patient. Considering any possible changes in the results after the dilation, VEP test was completed before the dilated fundus examination. The possibility of any diurnal difference was avoided by recording all measurements between 9:00–11:00 hours.

In our study, 4 different blood groups according to A and B antigens, namely A, B, AB and O as well as groups for Rh+ and Rh- according to RH factor were analyzed.

Keypoint (Dantec, Denmark) device and a 16-inch screen were used for VEP measurements. Pattern VEP (pVEP) test recording was performed by placing the three electrodes (active, reference, ground) such that active electrode was 2 cm above the protuberant occipitalis externa of occipital bone, reference electrode was on vertex and ground electrode was on the forehead, right at the hairline border. The patient was than seated in a dark room, 1 meter away from a screen with a moving board of chess designs and asked to stare at a fixed point on the board while his/her electrical potentials emerging in the bilateral occipital cortex were recorded. The recording was done for each eye separately, using the same procedure while keeping the unmeasured eye closed. The specifications of the screen were set to; 12*16 pieces of 2-inch equal-sized squares, 99% contrast based on Michelson constant, sweep rate of 30 ms/D and 5uV/D, sensitivity of 30 uV/D and filter of 1 Hz-200 Hz. Averaging was done by giving 250 stimuli and average measurements were calculated automatically. An experienced electrophysiology technician was accompanying the patient throughout the measurements in order to monitor his/her staring at the fixation point. Patients wearing glasses were measured with their glasses on. ISCEV publication on standardization criteria and detailed information of visual stimuli respond recording were taken as the base of measurements and all recordings of our study were done in compliance with the stated criteria.[8]

SPSS 21.0 (IBM Corp., Armonk, NY, USA) software was used to assess the findings. Numbers and percentages were used for categorical variables and average SD ± was used for countable variables. In order to evaluate the difference between countable variable groups, one-way analysis of variance (ANOVA) was employed for variables of normal distribution and Kruskal Wallis method was employed for variables of non-normal distribution. In cases of variables where a significant difference is determined between groups, Post Hoc analysis was employed for variables of normal distribution and Mann-Whitney U test was employed for non-normal distribution in order to determine which groups displayed that difference. $P<0.05$ was defined to be significant.

Results

The demographic specifications and the VEP latency and amplitude differences according to the ABO grouping were compared and the obtained results were analyzed in a table (Table 1).

Table 1. Comparison of demographic data and VEP results between groups[a]

Blood groups	A (30)	B (29)	AB (30)	0 (30)	p
Age	38.47±7.07	33.86±9.25	34.5±12.21	37.43±9.19	0.193*
Gender M/F	12/18	11/18	18/12	15/15	0.297[2]
L N70 (ms)	78.7±6.09	76.81±6.75	74.23±6.4	76.69±7.26	0.083*
L P100 (ms)	108.17±4.87	107.23±6.36	108.02±5.53	107.0±6.02	0.824*
R N70 (ms)	78.68±5.89	76.31±6.81	74.79±7.08	75.59±8.01	0.166*
R P100 (ms)	107.84±5.52	105.94±5.98	107.38±5.2	105.8±6.62	0.440*
LN70 amp. (μV)	2.23±2.59	1.91±3.13	1.6±1.68	1.11±1.72	0.453[1]
LP100 amp.(μV)	-6.18±2.61	-7.08±5.48	-7.33±3.4	-7.6±4.16	0.463[1]
RN70 amp. (μV)	2.62±2.79	2.33±3.41	1.57±1.55	1.01±1.75	0.058*
RP100 amp.(μV)	-6.96±2.17	-8.07±3.75	-7.99±3.43	-7.95±3.71	0.528*

[a] *One-way analysis of variance (Anova) test; [1] – Kruskal-Wallis test; [2] – Chi square test; M – male; F – female; L – left; R – right; amp – amplitude; ms –millisecond; μV – microvolt

119 individuals were included to the study out of which 30 were blood group A, 29 were blood group B, 30 were blood group AB and 30 were blood group O. Furthermore, the age average of the participating patients was similar among the study groups such as 38.47±7.07 for blood group A, 33.86±9.25 for blood group B, 34.5±12.21 for blood group AB and 37.43±9,19 for blood group O, hence the difference was found to be statistically not significant (p=0.193). Likewise, the study groups were similar in terms of gender distribution (M/F), such as 12/18 for blood group A, 11/18 for blood group B, 18/12 for blood group AB and 15/15 for blood group O, hence the difference was found to be statistically not significant (p=0.297).

Table 2. Comparison of data according to Rh blood groups[a]

Rh blood groups	Rh + (101)	Rh- (18)	p
Age	35.51±39.28	39.28±10.70	0.232[2]
Gender M/F	44/57	12/6	0.070[1]
L N70 (ms)	74.41±6.37	77.62±8.72	0.231[2]
L P100 (ms)	107.59±5.89	107.72±4.34	0.997[2]
R N70 (ms)	75.53±6.99	80.88±5.68	0.009[2]
R P100 (ms)	106.63±6.07	107.38±4.52	0.829[2]
LN70 amp. (μV)	1.65±2.41	2.08±2.08	0.417[2]
LP100 amp. (μV)	-7.33±4.21	-5.43±2.17	0.023[2]
RN70 amp. (μV)	1.80±2.55	2.34±2.46	0.436[2]
RP100 amp.(μV)	-8.04±3.28	-6.03±3.02	0.023[2]

[a] [1] – Chi square test; [2] – Mann-Whitney U test; M – male; F – female; L – left; R – right; amp – amplitude; ms – millisecond; μV – microvolt

According to our findings there was no statistically significant difference between the P100 and N70 latencies of both right and left eye of the participants in all four blood groups (p=0.440, p=0.166 right eye respectively and p=0.824, p=0.083 left eye respectively). Likewise, there was no statistically significant difference between the P100 and N70 amplitudes of all four blood groups (p=0.528, p=0.058 right eye respectively and p=0.463, p=0453 left eye respectively).

The demographic specifications and the VEP latency and amplitude differences according to the Rh classification were compared and the obtained results were analyzed in a table (Table 2).

The age average of the participating patients was similar among the study groups such as 35.51±39.28 for Rh+ blood group and 39.28±10.70 for Rh- blood group, hence the difference was found to be statistically not significant (p=0.232). Likewise, the study groups were similar in terms of gender distribution (M/F), such as 44/57 for Rh+ blood group and 12/6 for Rh- blood group, hence the difference was found to be statistically not significant (p=0.070).

According to our findings there was no statistically significant difference between the P100 latencies of both right and left eye of the participants in both groups (p=0.829, p=0.997 respectively). A prolongation of N70 latency was observed in the left eyes of Rh- group and the difference was found to be statistically significant (p=0.009). Furthermore, P100 amplitudes of both right eye and left eye of Rh+ group were found statistically high (p=0.023 both eyes). There was no statistically significant difference between the other parameters.

Discussion

In our study, we found that ABO/Rh blood groups had a statistically significant effect on some of the values related to VEP.

We know that blood groups have various effects on the body. There are studies showing that cancer cases are seen more frequently in certain blood groups.[13,14] There are also studies showing some effects of blood groups on vascular systems.[15–17] Furthermore, there are studies showing the effects of blood groups on brain and nerve systems.[15,18,19] Studies related to nerve system have also been detailed in terms of effects of blood groups on sense of pain, sense of taste and hearing (Cochlear nerve).[20–22] It is a known fact that there are studies related to the impact of blood groups on eye conditions.[6,8,9,23] In other words, there are studies covering the effect of blood groups on tissues starting from cornea and going onto brain. But there are no studies related to their effect on VEP. Comparison of data was not achieved since our study is the first study on this topic in literature.

When literature on the effects of ABO blood groups on eye conditions is reviewed, it can be seen that there is no consensus. Naderan et al. found no statistically significant correlation in their study of 626 individuals on blood groups and refraction errors relationship.[9] Furthermore, Leske et al. did not find any correlation between the ABO blood groups and primary open-angle glaucoma (POAG).[23] Yet in another study, it was con-

cluded that both zonular cataract and corneal dystrophy were seen more commonly among the people with blood group A whereas blood group B was found to have a correlation with zonular cataract and blood group O was found to have a correlation with myopia and nuclear cataract.[24] As a result of their study with POAG patients, Khan et al. found a correlation between the blood groups B and Rh-.[11] According to the study conducted by Garg and Pahwa, primary open angle glaucoma (POAG) and primary close angle glaucoma (PCAG) were more commonly seen in blood groups A and B compared to blood groups AB and O which were observed much less.[25] Additionally, Lavinsky et al. conducted a study with 16 patients who went through retrobulbar/peribulbar anesthesia due to cataract surgery where they performed VEP examinations 1 month prior and 1 month after the anesthesia and found no statistically significant difference.[26] In their blepharospasm study, Eski MT et al. showed that the decrease of the pressure on optic disc caused some changes on the VEP.[27] Teberik et al., in their blood group study including retina, choroid and optic nerve, found retina thickness were no statistically significant.[6] In similar to our study, there was no statistically significant difference in P100, P70 latency and amplitudes with respect to ABO phenotyping but there was prolongation in the N70 latencies of Rh- group and an increase in P100 amplitude in Rh+ group in terms of Rh phenotyping. Neuroophthalmological abnormalities like loss of visual field are where differential glycosylation patterns are most commonly seen. Earlier, the different features of these abnormalities have been proven to be the suppressed synthesis of some oligosaccharides portions of glycoproteins which were originating from the defects in genes that encode glycosyltransferases. Furthermore, glycosyltransferases enzymes have been shown to reflect the expression of carbohydrate markers of ABO/Rh blood groups. Therefore, the expressed glycosyltransferase in individuals with A/B or H antigen may indicate an eye disease.

On the other hand, we have not found any studies on blood groups and VEP in our literature review. It would be valuable to assess blood subgroups with regards to neuroophthalmological conditions. Further analyses ae highly recommended to get a better understanding the reasons underlying this relation.

Smith et al., conducted a study on taste bud in terms of the effects of blood groups on nerve systems and found that some senses are more dominant in certain blood groups.[22] Blood antigens which are developed either by adding N-acetyl galactosamine residue or galactose residue to H antigens of A- or B- positive individuals respectively, were only found in cell membranes of the granular cell layer. However, the relation between the antigen expression and epithelial cell differentiation is quite different with rats. That is, in case of rats, N-acetyllactosamine is in the upper spinous and granular cell layers whereas, B antigen is in the basal and parabasal layers and H antigen is in the spinous cell layer. Even though the sequence of the relation is opposite of what is observed in humans, the expression of molecules cross-reacting with ABO / H antigens of rats is related to nervous cellular differentiation. The H antigen was also observed on the surface of not only the nerve cells in the tongue epithelium but also on the majority of the nerve cells. This observation in the study suggests that carbohydrate structure can be considered as the feature of nerve cells at intermediate stage of differention.[22] We believe that there might be an effect on VEP through a similar mechanism of nerves.

Study limitations

There are some limitations to this preliminary study. First of all, it consists of relatively small sample quantity. Secondly, the lack of previous studies on VEP prevented any possible data comparison studies. Lastly, the study has been conducted with healthy patients, therefore, we do not know what the results would have been with cardiovascular patients. On the other hand, the strength of our study is the fact that it is the first and only study in literature. Hence, we do believe that this study will serve its purpose of providing a basic information of blood groups in healthy individuals, in the literature.

Conclusion

VEP test, with an ever-increasing importance, is a non-invasive measurement method which is being frequently used in neuro-ophthalmologic evaluations. On the other hand, various effects of blood groups on the body are observed with an elevating importance. Furthermore, it is highly important to know the normal values and the factors that might affect these normal values during the evaluation of VEP results. The elevating importance of the VEP test, when combined with the lack of sufficient blood group studies despite the current improvements driven us to the idea of pursuing this issue. In our study, we found statistically significant difference in VEP values related to Rh antigen. Therefore, it suggests that different VEP normal values can be used for patients according to the Rh group. Nevertheless, we do suggest to conduct further studies on a multi-centered level with a higher quantity of participants.

Declarations

Funding

There is no person or organization to support this work financially. The authors do not have a relationship with the sponsor or a commercial company regarding the study.

Author contributions

Conceptualization, M.T.E. and A.Y.; Methodology, M.T.E. and A.Y.; Software, A.Y.; Validation, M.T.E, A.Y., A.A.H.A, H.Ş. and T.S.; Formal Analysis, M.T.E, A.Y., A.A.H.A, H.Ş. and T.S.; Investigation, M.T.E, A.Y., A.A.H.A, H.Ş. and T.S.; Resources, M.T.E, A.Y., A.A.H.A, H.Ş. and T.S.; Data Curation, A.Y., A.A.H.A, H.Ş. and T.S.; Writing – Original Draft Preparation, M.T.E, A.Y., A.A.H.A, H.Ş. and T.S.; Writing – Review & Editing, M.T.E, A.Y., A.A.H.A, H.Ş. and T.S.; Visualization, M.T.E and A.Y.; Supervision, M.T.E. and A.Y.; Funding Acquisition, A.Y.

Conflicts of interest

The authors declare that they have no conflict of interest.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval

Ethics committee of Düzce University approved the study design (no. 2022-182) on 07/11/2022.

References

1. Pisk SV, Vuk T, Ivezić E, Jukić I, Bingulac-Popović J, Filipčić I. ABO blood groups and psychiatric disorders: a Croatian study. *Blood Transfus*. 2019;17(1):66. doi: 10.2450/2018.0266-17
2. Wang Y, Zhou BY, Zhu CG, et al. Distribution of ABO blood groups and coronary artery calcium. *Heart Lung Circ.* 2017;26(6):593-598. doi: 10.1016/j.hlc.2016.10.014
3. Shim HJ, Lee R, Shin MH, et al. Association between ABO genotype and risk of hepatocellular carcinoma in Koreans. *Asian Pac J Cancer Prev.* 2015;16(7):2771-2775. doi: 10.7314/apjcp.2015.16.7.2771
4. Pourafkari L, Ghaffari S, Ahmadi M, Tajlil A, Nader ND. Association of ABO blood types with the risk of in-stent restenosis. *Perfusion*. 2015;30(6):507-513. doi: 10.1177/0267659115573098
5. Franchini M, Favaloro EJ, Targher G, Lippi G. ABO blood group, hypercoagulability, and cardiovascular and cancer risk. *Crit Rev Clin Lab Sci.* 2012;49(4):137-149. doi: 10.3109/10408363.2012.708647
6. Teberik K, Eski MT. Association of ABO blood groups and Rh factor with retinal and choroidal thickness. *Eur J Ophthalmol.* 2019;29(2):234-238. doi: 10.1177/1120672118783629
7. Tamcelik N. *Ocular Electrophysıology.* 2011th ed. Istanbul: Turkish Ophthalmological Association Education Publications; 2011.
8. Chan JH, Dua HS, Powell-Richards A, Jones DRE, Harris IM. Effect of ABO blood group mismatching on corneal epithelial cells: an in vitro study. *Br J Ophthalmol.* 2001;85(9):1104-1109. doi: 10.1136/bjo.85.9.1104
9. Naderan M, Rajabi MT, Shoar S, et al. Distribution of ABO and Rh Blood Groups in Patients With Keratoconus: A Case–Control Study. *Eye & Contact Lens*. 2015;41(4):214-217. doi: 10.1097/ICL.0000000000000098
10. Ardjomand N, Komericki P, Klein A, Mattes D, El-Shabrawi Y, Radner H. AB0 blood group expression in corneal allograft failures. *Ophthalmologe* 2005;102:981-986. doi: 10.1007/s00347-005-1199-1
11. Khan MI, Micheal S, Akhtar F, Naveed A, Ahmed A, Qamar R. Association of ABO blood groups with glaucoma in the Pakistani population. *Can J Ophthalmol.* 2009;44(5):582-586. doi: 10.3129/i09-104
12. Dua HS, Chan J, Gomes JAP, Azuara-Blanco A. Adverse effect of blood group ABO mismatching on corneal epithelial cells. *Lancet*. 1998;352(9141):1677-1677. doi: 10.1016/s0140-6736(05)61448-1
13. Englisch C, Moik F, Nopp S, Raderer M, Pabinger I, Ay C. ABO blood group type and risk of venous thromboembolism in patients with cancer. *Blood Adv.* 2022;6(24):6274-6281. doi: 10.1182/bloodadvances.2021006283
14. Cote DJ, Downer MK, Zoltick ES, Smith TR, Stampfer MJ. ABO blood group and risk of glioma. *Neuro Oncol.* 2017;19(6):871-873. doi: 10.1093/neuonc/nox013
15. Lotz RC, Welter C da S, Ramos SA, Ferreira LE, Cabral NL, FRANÇA PHC de. ABO blood group system and occurrence of ischemic stroke. *Arq Neuropsiquiatr.* 2021;79:1070-1075. doi: 10.1590/0004-282X-ANP-2020-0219
16. Dentali F, Sironi AP, Ageno W, Crestani S, Franchini M. ABO blood group and vascular disease: an update. In: *Semin Thromb Hemost.* Thieme Medical Publishers; 2013:049-059. doi: 10.1055/s-0033-1363460
17. Huang X, Zou Y, Li L, Chen S, Hou J, Yu B. Relation of ABO blood groups to the plaque characteristic of coronary atherosclerosis. *Biomed Res Int.* 2017;2017:2674726. doi: 10.1155/2017/2674726
18. Richards O, Cromie KJ, Akhunbay-Fudge C, et al. ABO blood group in aneurysmal subarachnoid haemorrhage—a pilot study. *Acta Neurochir (Wien).* 2022;164(2):507-515. doi: 10.1007/s00701-021-05079-5
19. Kumarguru BN, Pallavi P, Manjunath GV, Vasan TS, Rajalakshmi BR. Histopathological study of central nervous system lesions: emphasizing association of neoplasms with ABO blood groups. *J Clin Diagn Res. JCDR.* 2017;11(4):EC15. doi: 10.7860/JCDR/2017/23863.9644
20. Simoni AH, Jerwiarz A, Randers A, Gazerani P. Association between ABO blood types and pain perception. *Somatosens Mot Res.* 2017;34(4):258-264. doi: 10.1080/08990220.2018.1425675
21. Yang Y, Hood LJ, McPherson B. Association between ABO blood group status and cochlear/neural function: auditory brainstem response findings. *Acta Otolaryngol.* 2021;141(3):273-278. doi: 10.1080/00016489.2020.1858236
22. Smith DV, Klevitsky R, Akeson RA, Shipley MT. Taste bud expression of human blood group antigens. *J Comp Neurol.* 1994;343(1):130-142. doi: 10.1002/cne.903430110

23. Leske MC, Nemesure BB, He Q, Mendell N, Polednak A. Open-angle glaucoma and blood groups: the Barbados Eye Study. *Arch Ophthalmol.* 1996;114(2):205-210. doi: 10.1001/archopht.1996.01100130199017
24. Padma T, Murty JS. Association of genetic markers with some eye diseases. *Acta Anthropogenet*. 1983;7(1):1-12.
25. Garg MP, Pahwa JM. Primary glaucoma and blood groups. *Indian J Ophthalmol*. 1965;13(4):127.
26. Lavinsky J, Gus PI, Ehlers JA, Roehe D, Nora DB. Visual-evoked potentials: assessment of retrobulbar and peribulbar anesthesia. *J Cataract Refract Surg*. 2000;26(10):1529-1532. doi: 10.1016/s0886-3350(00)00447-8
27. Eski MT, Teberik K, Sezer T, Ayasli AH, Ozturk A. Visual evoked potential changes following Botox administration in patients with blepharospasm. *Int Ophthalmol.* 2023:43(6):2101-2107. doi: 10.1007/s10792-023-02639-9