Association of ABO phenotype, rhesus factor, platelet count and hemoglobin level with oral hygiene status and severity of chronic periodontitis

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ABSTRACT

Background: The development of periodontal diseases has multifactorial causes including genetic factors. Limited investigations have been conducted to explore the association between ABO blood groups and the development and progression of periodontal diseases.
Aim: To evaluate and assess the association of ABO Phenotype and Rhesus factor with oral hygiene status, severity of chronic periodontitis and blood parameters like hemoglobin level and Platelet count in localized and generalized chronic periodontitis.
Material and methods: Study was carried out on 100 patients, out of which 80 patients of Generalized Chronic Periodontitis and 20 patients of Localized Chronic Periodontitis. Patients were categorized into Mild, Moderate and Severe Periodontitis.
Result: A highly significant association was found between severity of periodontitis and blood groups with blood group B and O were found to be at a greater risk to develop moderate to severe form of chronic periodontitis. Also subjects with blood group B and O showed worst oral hygiene among all the blood groups. Also patients suffering from chronic periodontitis showed a general trend towards lower limit of both hemoglobin level and platelet.
Conclusion: Genetic factors such as ABO blood group antigens may act as a risk influencer that plays a role in progression and severity of the chronic periodontitis, with blood group B and O being worst affected. Another observation was that a long standing case of chronic periodontitis can lead to anemia thus having systemic implications.

1. Introduction

Chronic periodontitis is characterized by the rapid destruction of both soft and hard tissues.[1] Chronic periodontitis is a prevalent disease affecting large population of the world.[2,3] Even though bacteria is thought to be the primary cause of periodontal disorders, various studies have demonstrated that chronic periodontitis has a number of underlying factors, including smoking, diabetes, and genetics, all of which are significant contributors to the development of the disease.[4]

The incidence and severity of plaque-induced periodontal diseases may vary depending on an individual's systemic health, inflammatory response and several local variables that encourage plaque build-up.[5] These host based risk factors can influence how the disease develops.

The balance between destruction of the periodontal tissues and body's homeostasis is reflected by the onset and progression of the disease. However, bacteria is crucial for development and progression of periodontal diseases.[6]

Genetic differences might enhance or reduce the likelihood of developing chronic inflammatory diseases. Microorganisms have surface lectins that they employ to adhere to bodily surfaces that are frequently ABO specific, the secretion of ABO blood group antigens in saliva prevents them from adhering to the surface of a tooth. As a result, genetic variations in immune response and antigen presentation may affect oral ecology and reflect a person's vulnerability to infectious and periodontal illnesses.[7]

In 1901, Karl Landsteiner introduced the ABO blood grouping

system. Karl Landsteiner divided individuals into three categories 'A', 'B', and 'O'. Later on, another blood group, 'AB' was found. Karl Landsteiner and Alexander S. Wiener developed the Rh system in 1937 based on the presence or absence of the Rh antigen [D antigen].[8]

The rationale for this study is rooted in the potential relationship between blood group characteristics, such as ABO phenotype and Rhesus factor, and the prevalence and severity of chronic periodontitis. Additionally, blood parameters like hemoglobin levels and platelet count, which reflect the body's overall health and capacity for tissue repair, might also correlate with the severity of chronic periodontitis. By investigating both localized and generalized chronic periodontitis in relation to these factors, the study aims to provide insight into whether specific blood types or variations in key blood parameters are linked to poorer oral hygiene and more severe periodontal outcomes. Understanding these relationships could contribute to better-targeted preventive and therapeutic strategies for individuals at higher risk based on their blood group or hematological profiles.

2. Material and methods

Before initiating the study each participant who satisfied the inclusion and exclusion criteria, were informed about the study protocol. A thorough medical and dental history was taken and a written consent was obtained from all participants before clinical periodontal examination and blood sampling. Ethical clearance was obtained from the institutional Ethical review committee for human subjects and the study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000. Blood grouping was done using DIAGAST® QWALYS EVO blood analyzer and complete blood count [CBC] using Automated CBC Analyzer in all the participants.

The present study consisted of 100 participants divided into two major Groups, Localized Chronic periodontitis [20 patients] and Generalized Chronic periodontitis [80 patients] based on extent of distribution of chronic periodontitis and three sub-groups on the basis of severity of chronic periodontitis. Complete oral examination was carried out using mouth mirror and UNC-15 periodontal probe. The Oral Hygiene Index Simplified [OHI-S Index] was recorded to assess hygiene. Four sites were examined for each tooth [mesio-buccal, buccal, disto-buccal and palatal/lingual]. Probing Pocket Depth and clinical attachment loss[CAL] was measured using UNC-15 periodontal probe.

Patients suffering from mild, moderate and severe chronic periodontitis who met Armitage criteria (1999) for chronic periodontitis and with following inclusion criteria were selected for the study-[9]

- Patient's age ranging from 18 years to 65 years
- Subjects who had at least 20 teeth, excluding the third molars were included in the study
- Patients suffering from mild to severe form of chronic periodontitis
- Systemically healthy patients
- Patients who were willing to participate

Whereas patients with following criteria were excluded from the study-

- Patients unable to perform routine oral hygiene
- Chronic Smokers
- Chronic Alcoholics
- Any previous history of antibiotic therapy
- Any periodontal treatment within 6 months prior to examination
- Individuals suffering from any systemic diseases or systemic conditions
- Patients lacking manual dexterity
- Patients suffering from any mental illness
- Pregnant women and lactating mothers

Subjects were divided into following groups based on Clinical Attachment Loss [CAL] according to Armitage criteria for chronic periodontitis 1999.[9]

- Group 1[Mild Chronic periodontitis] - Subjects having CAL 1–2 mm.
- Group 2[Moderate Chronic periodontitis] - Subjects having CAL 3–4 mm.
- Group 3[Severe Chronic periodontitis] - Subjects having CAL ≥5 mm.

3. Result

In this study, SPSS version 26 was utilized for statistical data analysis. SPSS provided a robust platform for performing descriptive statistics, correlational analysis, and other advanced tests to determine the significance of the associations across the different variables. A value of less than 0.01 was considered as highly significant, and the p value was set at 0.05 to be significant.

In our observation, no significant finding was observed in localized chronic periodontitis group [No. of participants 20] with severity of chronic periodontitis, OHI-S, and blood group. However, many significant observations in generalized chronic periodontitis group [No. of participants 80] were observed.

A highly significant association was seen between level of severity of chronic periodontitis[Generalized Chronic periodontitis] and blood groups. Participants with blood group O showed a higher incidence of moderate to severe form of chronic periodontitis followed by blood group B [Tables 1 and 2].

A highly significant association was seen between OHI-S [Generalized Chronic periodontitis] and blood groups. Participants with blood group O showed a higher incidence with poor oral hygiene followed by blood group B [Table 3 and Table 4].

On comparison of Haemoglobin level and platelet count with severity of chronic periodontitis and OHI-S we observed a significant finding that both parameters were towards the lower limit of the normal range and this predilection was observed to be in correlation with the severity of the disease [Tables 5 and 6].

4. Discussion

Chronic periodontitis is an inflammatory disease associated with bacterial infection that is, however regulated by environmental and genetic variables.[10] It's multifactorial etiology prompted researchers to look for risk factors that predispose to chronic periodontitis and various risk factors that may predispose to different clinical manifestations of chronic periodontitis.[2] Kaslick et al. observed that those with chronic

Table 1
Association of blood group and severity of chronic periodontitis in the study participants with generalized chronic periodontitis using Chi square test.

Blood Groups		Level of severity			Chi square value	P value
		Mild	Moderate	Severe		
A	Count	11	5	3	26.139	**0.000****
	%	61.11 %	16.66 %	9.37 %		
B	Count	2	10	18		
	%	11.11 %	33.33 %	56.25 %		
AB	Count	3	3	1		
	%	16.66 %	10.00 %	3.12 %		
O	Count	2	12	10		
	%	11.11 %	40.00 %	31.25 %		
Total	Count	18	30	32		
	%	100.0 %	100.0 %	100.0 %		

P value or probability value less than 0.05 is considered statistically significant*.

Table 2

Pair-wise comparison of blood group and severity of chronic periodontitis in the study participants with generalized chronic periodontitis using Mann Whitney *U* test.

Blood group	N	Mean Rank	Sum of Ranks	P value
A	19	15.74	299.00	**0.000****
B	30	30.87	926.00	
A	19	13.08	248.50	0.608 (NS)
AB	7	14.64	102.50	
A	19	15.68	298.00	**0.002****
O	24	27.00	648.00	
B	30	21.00	630.00	**0.019***
AB	7	10.43	73.00	
B	30	29.63	889.00	0.211 (NS)
O	24	24.83	596.00	
AB	7	10.57	74.00	0.050*
O	24	17.58	422.00	

P value or probability value less than 0.05 is considered statistically significant*. NS= Not statistically significant.

Table 3

Association of blood groups and OHI-S in the study participants with generalized chronic periodontitis using Chi square test.

Blood Group		OHIS Grade			Chi square value	P value
		Fair	Poor	Total		
A	Count	10	9	19	7.852	**0.049***
	%	52.6 %	47.4 %	100.0 %		
B	Count	7	23	30		
	%	23.3 %	76.7 %	100.0 %		
AB	Count	3	4	7		
	%	42.9 %	57.1 %	100.0 %		
O	Count	4	20	24		
	%	16.7 %	83.3 %	100.0 %		
Total	Count	24	56	80		
	%	30.0 %	70.0 %	100.0 %		

P value or probability value less than 0.05 is considered statistically significant*, OHI-S =Oral hygiene index-simplified.

Table 4

Association of severity of chronic periodontitis and OHI-S in the study participants with generalized chronic periodontitis using Chi square test of chronic periodontitis and OHI-S.

Level of severity (Periodontitis)		OHI-S		Total	Chi square value	P value
		Fair	Poor			
Mild	Count	15	3	18	33.61	**0.000****
	%	83.3 %	16.7 %	100.0 %		
Moderate	Count	7	23	30		
	%	23.3 %	76.7 %	100.0 %		
Severe	Count	2	30	32		
	%	6.2 %	93.8 %	100.0 %		
Total	Count	24	56	80		
	%	30.0 %	70.0 %	100.0 %		

P value or probability value less than 0.05 is considered statistically significant*, OHI-S =Oral hygiene index-simplified.

periodontitis were more likely to have blood groups 'A' or 'B'.[11] Similar observations were made by few other researchers.[12–14] They found significant correlations between the severity of chronic periodontitis and blood group 'A'.

In our study a statistically significant correlation was observed between severity of chronic periodontitis and blood group 'B' and 'O'. However, blood group 'B' showed higher level of significance in moderate and severe chronic periodontitis whereas blood group 'O' revealed moderate level of significance with severe form of chronic periodontitis. These finding were further confirmed by another result from our study that indicate a highly significant association between blood group 'B' and 'O' with mean probing pocket depth [PPD] and clinical attachment level [CAL] that was seen to be higher in blood group 'B' and 'O' compared to the other blood groups.

Results of our study was in conjunction with the previous researches, who also found that subjects with blood group 'B' were found to be at greater risk of developing more severe form of chronic periodontitis.[11,12,15] Contrary to our observations, few other previous studies observed that subjects with blood group 'O' showed marked predilection for chronic periodontitis.[16–19] While on the other hand some researchers did not find any association between ABO blood group and chronic periodontitis.[20,21,22] However in our study, no significant association was seen between presence or absence of Rhesus factor and severity of chronic periodontitis that was in accordance with the previous studies.[23–25,26] Contrary to our findings, a positive correlation between presence of Rhesus factor and severity of chronic periodontitis was reported by other researches.[15,17–19]

According to Hendrik L. Blum 1969 there are several factors like environmental factors, behavioral factors, health care and hereditary factors that can affect an individual's health.[27,28,29] Poor hygiene can predispose to development and progression of chronic periodontitis. Plaque reduction lowers the incidence, severity, and recurrence of chronic periodontitis according to the findings of Hujoel et al.[30] In our observations a highly significant positive association exist between severity of chronic periodontitis and oral hygiene status. Mild but significant correlation was observed between ABO blood groups and OHI-S grade. Patients with blood group 'B' and 'O' had worst oral hygiene followed by blood group 'A' and 'AB'. However, no significant association was seen between Rh factor and OHI-S grade. These finding were in partial conjunction with the previous study by Deradjat AP et al.[31] who conducted a study on dental students and found that blood group 'O' had the best oral hygiene status and blood group 'B' with the worst oral hygiene status. Thus clearly indicating individuals with poor oral hygiene are more prone to develop severe form of chronic periodontitis.

Sulcular epithelium that acts as a protective barrier, that is put at risk by the abundance of microorganisms which are typical of chronic periodontitis. Sulcular epithelial ruptures allowing bacterial irritants to penetrate connective tissue and consequently into the systemic circulation. In turn, the host reaction stimulates C-reactive proteins [CRP], Interleukin 6 [IL-6] and Tumor Necrosis Factor [TNF-α], all of which can suppress erythropoietin synthesis, ultimately leading to anemia. Anemia of chronic disease that is the most common form of anemia. It is described as anemia that occurs as a result of persistent infections, inflammatory disorders, or as a neoplastic disorder and is not caused by marrow inadequacies or other diseases. It occurs despite the existence of appropriate iron reserves and vitamins.[32,33] Gayatri et al. in their study did not find any correlation between periodontal disease and anemia; however, a definite link between anemia and persistent chronic periodontitis was observed by Lowe and Patel et al.[12,28,29] Anemia was assumed to be a cause of chronic periodontitis rather than a result of it.[34] In our study, no significant relation was observed between CBC and severity of chronic periodontitis. However, values of hemoglobin and platelet count were seen to be on the lower side of normal range that can be attributed as a possible risk indicator for the progression of the disease. This indicates that chronic periodontitis can be an etiological factor for anaemic state in the body. Similar observations were made by previous studies.[35–37]

5. Conclusion

The following conclusions can be drawn from this study.

Table 5

Comparison of Hemoglobin [Hb] level of study participants depending on the levels of severity of chronic periodontitis.

Hb		N	Mean	Minimum	Maximum	P Value
Severity of Periodontitis	**Mild**	18	12.6500	10.00	14.60	0.313 (NS)
	Moderate	30	12.1500	7.40	14.50	
	Severe	32	12.0438	8.50	14.80	
	Total	80	12.2200	7.40	14.80	
OHI-S Grade	**Fair**	24	12.2292	10.00	14.60	0.969 (NS)
	Poor	56	12.2161	7.40	14.80	
	Total	80	12.2200	7.40	14.80	

P value or probability value less than 0.05 is considered statistically significant*, NS= Not statistically significant.
OHI-S =Oral hygiene index-simplified.

Table 6

Comparison of platelet count of the study participants depending on the levels of severity of chronic periodontitis and OHI-S grade.

Platelet Count		N	Mean	Minimum	Maximum	P Value
Severity of Periodontitis	**Mild**	18	1.8800	1.02	2.98	0.633 (NS)
	Moderate	30	1.7880	0.85	14.50	
	Severe	32	1.7388	0.90	14.80	
	Total	80	1.7890	0.85	14.80	
OHI-S Grade	**Fair**	24	1.9712	1.02	2.83	**0.041***
	Poor	56	1.7109	0.85	2.98	
	Total	80	1.7890	0.85	2.98	

P value or probability value less than 0.05 is considered statistically significant*, NS= Not statistically significant.
OHI-S =Oral hygiene index-simplified.

1. A significant association exist between the ABO blood group and the severity of chronic periodontitis, with blood groups 'B' and 'O' being more affected than other blood groups.
2. No significant association was seen between the Rhesus factor and severity of periodontitis, even though the incidence of Rh positive individuals was seen to be higher.
3. No association was seen between the Rhesus and oral hygiene status.
4. Highly significant association was seen between the severity of periodontitis and oral hygiene status, thus confirming the fact that poor oral hygiene can lead to the development of chronic periodontitis.
5. Long standing cases of chronic periodontitis showed a definite association between chronic periodontitis and the development of anemia as the hemoglobin count was observed to be on the lower side of the normal range.
6. Platelet count of patients suffering from chronic periodontitis was seen to be on lower side of normal range. Thus we can state that chronic periodontitis can not only have an impact on their oral health but also have systemic implications.

6. Limitations

This study faced several limitations, including a small sample size, which may have affected the generalizability and statistical power of the results. Operator bias could have influenced the accuracy of the clinical assessments, potentially skewing the association between blood phenotypes, oral hygiene, and chronic periodontitis. Additionally, the presence of multiple confounding factors for chronic periodontitis, such as genetic predisposition, lifestyle habits, and environmental influences, complicates the establishment of direct causality between the variables studied.

Moreover, the study was conducted in a limited geographic area, restricting its applicability to broader populations. This highlights the need for future research in the form of larger case-control and multi-centric studies. Such studies would not only include a more diverse sample but also allow for better control of confounding variables, ultimately helping to confirm and validate the associations observed in this study.

Ethical clearance

Ethical clearance was obtained from the Ethical Committee, King George's Medical University, U.P., Lucknow Subjects in all defined groups were referred to the Department of Transfusion Medicine, King George's Medical University, U.P., Lucknow. **(Ref code: III-PGTSC-IIA/P36)**

Declaration of competing interest

None to declare.

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