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Relationship between Blood Groups with Systemic and Gastrointestinal Diseases-A Short Review

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ABSTRACT

The human blood is classified under four different blood types namely, A, B, AB and O. These blood groups are based on the presence of blood antigens present on the surface of the red blood cells, leukocytes, platelets, plasma proteins and also present in soluble form in bodily secretions like saliva, breast milk, sweat, gastric secretions, and seminal fluid. These blood antigens are recognized at their attachment with N-acetylgalactosamine in α1-3 linkage to the terminal galactose residue of Type 1 and Type 2 chains with A and B alleles. Non-O blood groups have been greatly correlated with the incidence of vascular disorders like cerebral arterial ischemia, myocardial infarction venous thromboembolism, peripheral vascular disease. A and B blood types were protective for hyperlipdemia. High levels of vWF and FVIII in non-O blood group persons have been related with increased risk of cognitive impairment and dementia. Blood type A have a greater incidence cancer of salivary gland, ovary, colon /rectum compared to blood type B. This review explains the physiological and genetical reasons behind these correlates.

Key words: Blood groups, Blood antigens, Systemic diseases, Genetics

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INTRODUCTION

The human beings have four different blood groups namely A, B, AB and O types. These blood groups are based on the presence of blood antigens present on the surface of the red blood cells, leukocytes, platelets, plasma proteins and also present in soluble form in bodily secretions like saliva, breast milk, sweat, gastric secretions, seminal fluid, amniotic fluid and urine.

These blood antigens are different from HLA antigens. The difference is that one phenotype is related with HLA antigens, whereas three phenotypes are related with blood group antigens. The RBCs do not act as antigen-presenting cells. The blood group antigens present on red blood cells are generated before maturation but they lose their ability to generate new antigens [1]. Human blood group antigens can act as receptors by pathogens or mimicked by bacteria and even be recognized by the immune system that produces antibodies in self-defense [1-3].

A blood group contains N-acetylgalactosaminyl transferase expression with an A allele attached to N-acetylgalactosamine in α1-3 linkage to the terminal galactose residue of Type 1 and Type 2 chains. B blood group contains galactosyltransferase expression with a B allele added to galactose in α1-3 linkage to those residues. O blood group do not form A or B antigens because they lack both of the glycosyltransferase enzymes that attaches to final monosaccharide to the oligosaccharide chain [14,5].

Rh blood group system is a complex system, where 49 antigens expressed by RHD and RHCE genes in the RH locus. RhD-positive people possess this RHD gene, whereas RhD-negative people do not possess this RHD gene [4,6]. The presence of these Rh antigens can play a role in hemolytic reactions caused by immune activation following pregnancy or transfusion and autoimmune hemolytic anemia.

Associations between different blood types and systemic and specific disease have been studied around early 1900. Many researches have been attempted to find the correlation between the presence of a particular blood group with a specific disease. Recent research findings have clarified the functional blood group antigens, their determinants and their association with certain disease types.

BLOOD TYPES AND SYSTEMIC DISEASES

A Review study indicated that non-O blood groups have been greatly correlated with the incidence of vascular disorders like cerebral arterial ischemia, myocardial infarction venous thromboembolism, and peripheral vascular disease [1].

A research led by El-Sayed [7] found that the incidence of hypertension was higher in blood group B type, followed by blood group A type Whereas blood group AB had the lower rate of hypertension. Coagulation factor VIII and Von Willebrand factor are approximately 25%–30% low in the plasma of O blood group [8]. High levels of vWF and FVIII in non-O blood group persons have been related with increased risk of cognitive impairment and dementia [9].

Further research reported that A and B blood types were protective for hyperlipdemia with total cholesterol, triglycerides and LDL cholesterol were lower [7]. Research led by Fagherazzi, that there is no correlates between type 2 diabetes mellitus (T2DM) and Rh blood group, but B blood groups have highest risk followed by AB and A blood types whereas O blood type had a lower risk of T2DM [10].

Blood types and prevalence of infections

A blood group type individuals are under high risk of smallpox and Pseudomonas aeruginosa infections; B blood group type persons are under higher risk of tuberculosis, gonorrhea, *E. coli*, Streptococcus pneumoniae and salmonella infections; O blood group type individuals are highly associated with increased risk of tuberculosis, plague, mumps, cholera, and infections; AB blood group type individuals are highly associated with increased incidence of *E. coli*, smallpox, and salmonella infections [11].

Blood group antigens are involved in cell signaling, recognition, and adhesion and play an important role in tumorigenesis and metastasis. During pathological phenomena and carcinogenesis, such cellular development, differentiation and aging, expression of ABH and related antigens occur [8]. Deficiency of A and B antigens precedes metastasis, following down-regulated transcription of ABO which is associated with loss of A- or B-transferase activity, This increases the accumulation of other antigens which act as ligands for selectins and help the metastatic process [1].

Among the four blood types, group A people have a higher incidence of cancer with “A-like” properties of tumor antigens [11]. Most of correlates between tumor and blood antigens lie concentrated on the gastro intestinal system.

Because of these correlates, blood type A have a greater incidence salivary gland cancer (64%), Ovarian cancer (28%), stomach cancer (22%), colon/rectum (11%), uterus (15%), cervix (13%) compared to Blood type O. The tumor antigens would be recognized as foreign and would interact with anti-A antibodies, resulting in attack of the tumor.14 This may explain why blood group A people have a higher incidence of cancer than group O people [11].

Blood group A is highly correlated with breast cancer, pancreatic cancer and carcinoma of stomach. Blood group B is associated with heart disease and pancreatic cancer, Blood group O is associated with skin cancer and renal cancer and blood group AB is associated with blood clots and dementia [12].

This study focuses on the association between ABO blood group system and the risk of peptic ulcer and gastric cancers. Gastric cancer is one of the second most common causes of death worldwide. The prevalence of gastric cancers is about one million patients newly diagnosed each year and the death rate is 700,000 deaths each year. This cancer in stomach can be caused by the interaction between environmental factors and genetic factors. But under environmental factors, Helicobacter pylori (*H. pylori*) infection plays a very important role in the development of gastric cancer. A research led by Roberts et al found that blood group A are more prone to pernicious anemia and gatric cancer compared to non-A blood group types. Individuals because of altered gastric secretion.

Patients infected with *H. pylori*, there is an increase in chronic inflammatory cells in the lamina propria of the stomach with lymphocytes, monocytes, eosinophils, and plasma cells. The supernatants of gastric mucosal biopsy specimens of patients with H. pylori gastritis contained increased levels of tumor necrosis factor and interleukin 6. [13].

An adhesion molecule system of Helicobacter pylori helps the colonization of bacteria in gastric mucosa. This adhesion molecule is a blood group antigen-binding adhesion A in Blood type A (BabA). And also this Adherence by H. pylori increases the risk of gastric disease. The incidence of peptic ulcers (gastric and duodenal) due to Helicobacter pylori infection was 20% higher for blood type O individuals than blood type A and 35% higher in group O individuals than in group A, B, and AB individuals. Recent investigation of ABO blood groups and H. pylori found that Blood type A is at risk of advanced precancerous gastric lesions. This was caused by the presence or absence in the bacterial DNA of two SNPs in the cytotoxin-associated gene A which is distinguished as CagA positive and CagA negative strains [14]. The Non-O blood group type individuals infected with cytotoxin-associated gene A negative is associated with H. pylori and higher risk for pancreatic cancer [15].

Thus, the researchers confirm the finding that gastric cancer risk is increased in individuals with blood type A than non-A blood groups. Also that the individuals with blood type O showed a reduced risk of stomach cancer compared with other non O blood types.

CONCLUSION

Thus, the antigenic individuality in the individuals present on the surface of the red blood cells plays a very powerful role in development of certain specific and systemic diseases and infections. But a healthier life style with a balanced diet and exercise can prevent and reduce the incidence of such disease states.

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