

THE INTERACTION BETWEEN HUMAN BLOOD-GROUP (ABO) SUBSTANCES AND ENTEROPATHOGENIC BACTERIAL AGENTS*

*Necla Çevik MD**, Benal Büyükgebiz MD****

Key words: human blood-groups (ABO), enterobacterial infections

The interaction between human blood-group (ABO) substances and some microorganisms leading to diarrheal disorders has been subject to several investigations during the second half of the century¹. Many bacteria, especially Gram-negative enteric ones, causing fatal ending infections during the first year of life², possess antigens which cross-react with ABO blood-group substances^{2,3}. Vogel et al⁴ postulated that present-day blood gene frequencies might be related to the epidemics which occurred in the past. The relevant studies were mainly conducted in two phases; one on the zygotic and prezygotic factors, and the other on conditions occurring late in the reproductive life which however seemed to have little influence on gene frequency⁵. Further studies revealed that the blood group of an individual might be a significant factor in the host-response to bacterial invasion and influence the development of infection with certain Gram-negative bacilli⁶. Those with certain blood groups seem to have a definite propensity to develop an infectious status when coming in contact with certain microorganisms. The various host-responses to different bacterial agents in certain countries prompted inquiry into this relationship.

A similar study was conducted in the "Diarrheal Diseases and Oral Rehydration Therapy Research and Training Center" of the Hacettepe University Institute of Child Health between May 1, 1986 and January 1, 1987 to detect the interaction between blood-group (ABO) substances and the enteropathogenic microorganisms isolated from the stools of patients with diarrheal disorders.

* From the Department of Social Pediatrics, Hacettepe University Institute of Child Health, Ankara.

** Associate Professor of Pediatrics, Hacettepe University Institute of Child Health.

*** Assistant Professor of Pediatrics, Hacettepe University Institute of Child Health.

Material and Methods

A total of 592 patients with various diarrheal disorders aged between 0-15 years were the subjects of this study. Blood group determinations could only be performed on 547 (92.39%) patients since 45 patients (7.60%) had refused to have their blood tested.

The controls were selected from among the infants and children who had either come to the Well Baby Clinic or the Healthy Child Division of the Department of Social Pediatrics at the Hacettepe University Institute of Child Health during the same time period for vaccination or a general check-up. These 237 children, aged between 0-15 years, were completely free of any kind of infection.

Blood samples were obtained at the first visit to the clinics and blood typing was done by the standard tube method using the standard commercial blood-group antisera on the same day.

Bacteriological determinations were performed on the stool cultures or rectal swabs obtained from the patients with diarrhea and on rectal swabs from the controls using standard techniques in use at our pediatric bacteriology laboratory. Statistical analysis was carried out by the X^2 method.

Results

The distribution of the study and control groups according to sex, age and blood group are shown in Tables I-III.

TABLE I: Sex Distribution of Study and Control Groups

Sex	Study Group		Control Group	
	Number of cases		Number of cases	
Male	341	(62%)	157	(66%)
Female	206	(38%)	80	(34%)
Total	547	(100%)	237	(100%)

$X^2 : 0.93 \quad p > 0.05$

TABLE II: Age Distribution of Study and Control Groups

Age groups (yrs)	Study Group		Control Group	
	Number of cases		Number of cases	
0 - 2	416	(76%)	171	(72%)
2 - 15	131	(24%)	66	(28%)
Total	547	(100%)	237	(100%)

$X^2 : 1.34 \quad P > 0.05$

TABLE III: Blood Group Distribution of Study and Control Groups

Blood groups	Study Group		Control Group	
	Number of cases		Number of cases	
A	244	(44.6%)	96	(40.5%)
O	177	(32.5%)	76	(32.0%)
B	92	(16.8%)	44	(18.7%)
AB	34	(6.1%)	21	(8.8%)
Total	547	(100.0%)	237	(100.0%)

$X^2 : 2.59 \quad P > 0.05$

Using the X^2 method of analysis, no significant difference in age, sex or blood group distribution was found between the study and control groups.

Enteropathogenic microorganisms were isolated from only 57 patients (10.4%) out of 547. Table IV lists the number and percentage of culture positive patients. *Shigella* was isolated from 21 (36.8%) patients, and both *Salmonella* and enteropathogenic *E.coli* from 18 patients (31.8%).

Table V illustrates the distribution of culture positive patients and the controls according to blood group. No significant relationship could be found between the distribution of the culture positive patients and the controls according to blood group.

TABLE IV: Number and Percentage of 57 Culture Positive Patients

Isolated pathogenic bacteria	Number of cases	
Shigella	21	(36.8%)
Salmonella	18	(31.6%)
Enteropathogenic E. coli	18	(31.6%)
Total	57	(100.0%)

TABLE V: Blood Group Distribution of Culture Positive Cases and Controls

Blood groups	Culture Positive Group		Control Group	
	Number of cases		Number of cases	
A	24	(42.1%)	96	(40.5%)
O	17	(29.8%)	76	(32.0%)
B	11	(19.3)	44	(18.6%)
AB	5	(8.8%)	21	(8.9%)
Total	547	(100.0%)	237	(100.0%)

$\chi^2 : 0.12 \quad P > 0.05$

The distribution of blood groups according to the isolated enteropathogenic microorganisms are illustrated in Table VI.

In order to make an exact analysis new groups were formed based on the information obtained from studies where the individuals of blood groups B and AB showed a significantly increased susceptibility to Gram-negative enteric pathogens other than *Shigella* (Table VII).

TABLE VI: Distribution of Blood Groups According to Microorganisms

Blood groups	Shigella		Salmonella		E.Coli	
	Number of cases		Number of cases		Number of cases	
A	9	(42.9%)	8	(44.4%)	7	(38.9%)
O	7	(33.3%)	5	(27.8%)	4	(22.2%)
B	2	(9.5%)	4	(22.2%)	6	(33.3%)
AB	3	(14.3%)	1	(5.6%)	1	(5.6%)
Total	21	(100.0%)	18	(100.0%)	18	(100.0%)

TABLE VII: Redistribution of Blood Groups of Culture Positive Cases

Blood groups	Shigella		Salmonella		E.Coli	
	Number of cases		Number of cases		Number of cases	
A + O	16	(76.2%)	13	(72.2%)	11	(61.1%)
B + AB	5	(23.8%)	5	(27.8%)	7	(38.9%)
Total	21	(100.0%)	18	(100.0%)	18	(100.0%)

$\chi^2 : 0.43 \quad p > 0.05$

Discussion

The interaction between human blood-group (ABO) substances and several pathologic status prompted investigators to search for the origin of this relationship^{1,2}.

Springer et al^{1,3} reported that Gram-negative bacteria demonstrated a definite tendency towards some specific blood groups. However, a seven-year study carried out on 282 patients with infections caused by Gram-negative bacteria revealed that blood groups AB and O activities were not confined to a particular genus of Gram-negative bacteria. They found that while individuals with blood group B were more prone to developing urinary tract infections, those with blood groups AB had a relatively increased number of *Escherichia coli* and *Klebsiella pneumonia* infections. Since many of the bacteria causing enteric infections in infancy have been shown to possess antigens which cross-react with ABO blood groups, the possible association between various bacteria and these blood groups in the pediatric age-group has been investigated by many authors^{2,3}.

Robinson², Vogel⁴, and Springer³ stated that individuals of blood groups B and AB have a significantly increased susceptibility to Gram-negative pathogens including

Salmonella and *E.coli*. Vogel⁴ discovered that individuals with blood group A were at a higher risk for *E.coli* diarrhea but out of the 135 strains of *E.coli* studied by Springer et al³, 64 were found to have blood group activity, 31 of these cross-reacting with blood group B and 12 with blood group A. Sacha et al⁷ found that blood group B infants had an eighty percent greater chance of developing severe diarrhea due to *E.coli* than blood group A patients and a thirty-five percent greater probability than all non-B patients. Robinson's studies revealed that regardless of ethnic background, children with blood group B and AB had a fifty-five percent greater chance of developing *E.coli* infections than the patients with blood group A and O². Meanwhile, Robinson², in her investigations involving 944 infants and young children, in which pathogenic microorganisms could be isolated from only 338 subjects (35.8%), concluded that individuals of blood-groups B and AB had a significantly increased susceptibility to Gram-negative enteric pathogens excluding *Shigella*.

Our preliminary studies did not reveal any significant difference among blood groups, although the relevant literature suggests a significantly increased susceptibility of blood groups B and AB to Gram-negative enteric pathogens, other than *Shigella*.

Summary

A total of 592 patients with diarrheal disorders, aged between 0 and 15 years, seen at the "Diarrheal Diseases and Oral Rehydration Therapy Research and Training Center" of the Hacettepe University Institute of Child Health between May 1, 1986 and January 1, 1987 were studied to determine the interaction between human blood-group (ABO) substances in infants and young children and enteropathogenic bacterial agents. The controls consisted of 237 healthy infants and children without any diarrheal disorders. 244 (44.6%) patients and 90 (40%) controls had blood group A, 177 (32.5%) patients and 76 (32%) controls blood group O, 92 (16.8%) patients and 44 (18.7%) controls blood group B and 34 (6.1%) patients and 21 (8.8%) controls blood group AB. *Shigella* was isolated from 21 (36.8%) patients and both *Salmonella* and enteropathogenic *E.coli* from 18 (31.8%) patients. While the related literature indicates a significant increased susceptibility of blood groups B and AB in regard to Gram-negative enteric pathogens (except *Shigella*), our preliminary study did not reveal any statistical significant difference between the blood groups.

REFERENCES

1. Springer GF. Importance of blood-group substances in interactions between man and microbes. *Ann N Y Acad Sci* 169:134, 1970.

2. Robinson MG, Tolchin D, Halperin C. Enteric bacterial agents and the AB0 blood groups. *Am J Hum Genet* 23:135, 1971.
3. Springer GF, Williamson P, Brandes WC. Blood group activity of gram-negative bacteria. *J Exp Med* 113:1077, 1961.
4. Vogel F, Pettenkofer HJ, Helmbold W. Über die Populationsgenetik der AB0 Blutgruppen. 2. Genhäufigkeit und Epidemische Erkrankungen. *Acta Genet (Basel)* 10:267, 1960 (Ger).
5. Ratner JJ, Thomas VL, Forland M. Relationships between human blood groups, bacterial pathogens, and urinary tract infections. *Am J Med Sci* 292:87, 1986.
6. Kay LA. Cellular basis of immune response to antigens of AB0 blood group system. *Lancet* 2:1369, 1984.
7. Socha W, Bilinska M, Kaczera Z, et al. Escherichia coli and AB0 blood groups. *Folia Biol (Krakow)* 17:259, 1969.