A AND B ANTIGENS IN THE CELLS OF TISSUES FROM GROUP SUBSTANCE SECRETORS AND NONSECRETORS

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It has been established [15,16,18,19,20] that all people, regardless of which blood group they belong to, can, in turn, be subdivided into two different subgroups: secretors and nonsecretors of group substances. In the majority (78%) the A and B group antigens are discharged into various secretions – saliva, gastric juice, bile – and are contained in them in very high titer. On the other hand, in individuals comprising the subgroups of nonsecretors (22%), these antigens are almost completely absent from the secretions, or are found in insignificant quantity. The concentration of group antigens in the secretions of secretors exceeds their concentration in the nonsecretors by hundreds, and even thousands, of times.

The capacity of the organism to produce group antigenic substances and discharge them with secretions or, on the other hand, not to secrete them, appears to be a constant physiological property, which does not change in the course of an entire lifetime. The capacity to produce active, specific, group, mucopoly-saccharide substances, and discharge them with secretions or, on the other hand, not to secrete them, is transmitted according to heredity, as proven by the large body of data from related investigations [6,17,23]. According to the hypothesis of Schiff and Sasaki, and also of other investigators [6,14,17,23], this capacity is determined by genotypic characteristics.

However, the question was not yet resolved as to whether the peculiarities of the secretor and nonsecretor were limited only to a differing concentration of the group mucopolysaccharides in their secretions and excretions, or whether they also extended to the concentration of group antigens in the organs. Some investigators [9,12,13] found that the tissues from organs of the nonsecretor contained group antigens in smaller amount than the tissues from the organs of secretors. Others [7,8], on the other hand, did not observe a specific difference in the concentration of group antigens A and B within the tissues from the organs of secretors and nonsecretors. No difference was noted in the concentration of group antigens A and B in erythrocytes.

Study of this question is not only of theoretical interest. Knowledge of the degree of expressivity in group antigen tissue differentiation is necessary for resolution of the problem of tissue and organ compatibility, and also in the practice of forensic medicine.

EXPERIMENTAL METHOD

As the subject of the comparative immunological study, we used tissue from the liver, kidney and cardiac muscle of 30 human individuals that had died of noninfectious diseases, 17 of which belonged to the subgroup of group substance secretors, and 13 – nonsecretors. The group classification was determined from the erythrocytes and serum, and classification as secretor or nonsecretor – on the basis of a study of the bile.

In the experiment, we used determined suspensions of tissues both in the native state and fixed with formalin (over a period of several weeks), and also lyophilized tissues, since we know that the A and B group antigens are resistant to low temperature, desiccation, and formalin.

We also studied the concentration of the group antigens of secretors and nonsecretors in aqueous-saline extracts of the organs preserved in formalin.

TABLE 1. Specific Adsorption of Isoantibodies by the Liver Tissue of Secretors and Nonsecretors (Type Protocols)

Specimen number	Group classification	Standard serum	Standard erythrocyte	Results of the reaction of hemagglutination in a serum dilution of			
				1 : 2	1 : 4	1 : 8	1 : 16
61	A Secretor	α	A	—	—	—	—
		β	B	+++	+++	++	+
	Serum control	α	A	+++	+++	++	+
		β	B	+++	+++	++	+
33	A Nonsecretor	α	A	+++	++	+—	—
		β	B	+++	+++	++	+
	Serum control	α	A	+++	+++	++	+
		β	B	+++	+++	++	+
34	B Secretor	α	A	+++	+++	++	+
		β	B	—	—	—	—
	Serum control	α	A	+++	+++	++	+
		β	B	+++	+++	++	+
65	B Nonsecretor	α	A	+++	++	+	+
		β	B	+++	++	+—	—
	Serum control	α	A	+++	++	+	+
		β	B	+++	++	+	+
45	A Secretor	α	A	+	—	—	—
		β	B	+++	++	++	+
	Serum control	α	A	+++	+++	++	+
		β	B	+++	++	+	+
78	A Nonsecretor	α	A	+++	+	+	—
		β	B	+++	+++	++	+
	Serum control	α	A	+++	+++	++	+
		β	B	+++	+++	++	+
67	AB Secretor	α	A	++	—	—	—
		β	B	—	—	—	—
	Serum control	α	A	+++	++	+	+
		β	B	+++	++	+	+
47	AB Nonsecretor	α	A	+++	++	+	—
		β	B	+++	++	+	—
	Serum control	α	A	+++	+++	++	+
		β	B	+++	+++	++	+

To determine the group antigens in the organs, we used the method of specific adsorption of normal antibodies by the tissues. This method has found wide application, both in the practice of forensic medicine, and in theoretical investigations [1,3,4]. The method of serial, fractional depletion of isoantibodies by standard sera, which we used for determining the group antibodies in the aqueous-saline extracts, has also been described [2,3,5].

EXPERIMENTAL RESULTS

As can be seen from Table 1, all the tissue specimens that we investigated, both from secretor and nonsecretor, possessed the capacity to extract specifically the corresponding antibodies from the standard sera. Liver tissue from group A individuals adsorbed α agglutins, tissues from the group B individuals—β agglutins, and tissues from the group AB individuals found both types of agglutinins—α and β, which testifies to group differentiation of the tissues of the secretor and nonsecretor. However, our investigations showed that the liver tissue of the secretor possesses the capacity to extract antibodies from standard sera to a significantly greater degree than does the liver tissue of the nonsecretor (Specimens No. 61 and 33, 34 and 65, et al.).

Analogous results were obtained for the tissues of the other organs—kidneys and cardiac muscle.

For a more graphic representation of the differences in adsorption capacity of the tissues from secretors and nonsecretors of group substances, we attempted to assign a quantitative expression to the obtained results. With this purpose, we considered the degree of antibody adsorption from the standard sera by the tissues of the secretor and nonsecretor.

Table 2 shows that the 17 specimens of native liver tissue from the group substance secretors lowered the titer of hemagglutinins in the standard sera by an average of 3.2°, and from the nonsecretors—by an average of 2°. The extent of hemagglutinin adsorption by the kidney tissues of the secretors was equal to 3.8°, while for the nonsecretors—2.3°.

TABLE 2. Differences in the Adsorption Properties of Tissues from Secretors and Nonsecretors of Group Substances

Investigation subject	Tissue state	Group classification	Number of specimens studied	Mean degree of adsorption	Statistical significance
Liver	Native	Secretor	17	3.2	P< 0.001
		Nonsecretor	11	2.0	
Kidney		Secretor	9	3.8	P< 0.01
		Nonsecretor	5	2.3	
Liver	Dessicated	Secretor	12	3.3	P< 0.001
		Nonsecretor	8	1.6	
Kidney		Secretor	6	3.6	P< 0.05
		Nonsecretor	2	1.8	

Analogous results, statistically significant, were obtained in studying the adsorption properties of tissues that were subjected to lyophilization.

Thus, the experiments showed the existence of definite, quantitative differences in the adsorption capacity of the tissues from secretors and nonsecretors of group substances. Whether or not this difference depends on the differing quantitative content of group antigens, however, or on the differing distribution of them in the cell–deeper in the nonsecretor and more superficial, and thus, also more accessible for antibodies, in the secretor–remains an unresolved question. According to the data [10,11] obtained by the use of fluorescing antibodies, in the nonsecretor the superficial epithelium of the stomach and duodenum does not contain group antigens, in contrast to the superficial epithelium of these organs in the secretor.

However, the possibility has not been excluded that there is also a quantitative difference in the concentration of group antigens within the tissues of the secretors and nonsecretors similar to that which is observed in connection with their secretions.

Investigation of the aqueous-saline extracts of the tissues supports this hypothesis to a certain degree.

Table 3 shows that, in the secretor, aqueous-saline extracts of the liver tissue fixed in formalin yielded a reduction in the hemagglutination reaction by an average of 2.7°, while aqueous-salin extracts of the liver tissue from nonsecretors lowered the titer of hemagglutinins by only 0.2°. The aqueous-saline extracts from the tissues of the other organs–kidneys and cardiac muscle–were also more active in the case of the secretors.

The formalin-fixed cells of the tissues from secretors were also more active in their specific adsorption properties than the tissues of the nonsecretors. However, this difference was less manifest than in the investigation with the aqueous-saline extracts. Other investigators [22] have noted that the difference in quantitative content of antigens within the organs of secretors and nonsecretors is not as significant as in the fluids and secretions.

TABLE 3. Group Antigens A and B in the Aqueous-Saline Extracts and Cells of Tissues Treated with Formalin

Investigation subject	Group classification	Aqueous-saline extract			Sediment of cells		
		number of cases (n)	mean degree of adsorption (M)	statistical significance of the results (P)	number of cases (n)	mean degree of adsorption (M)	statistical significance of the results (P)
Kidney	Secretor	9	2.7	< 0.001	9	4.4	< 0.02
	Nonsecretor	9	0.2		9	3.2	
Native	Secretor	9	2.7	< 0.001	9	4.7	< 0.02
	Nonsecretor	6	0.75		6	3.6	
Cardiac	Secretor	7	1.9	< 0.001	7	4.6	> 0.05
muscle	Nonsecretor	5	0.3		5	3.8	

Thus, the fixed cells of tissues from both secretors and nonsecretors of group substances are differentiated in terms of group antigen. However, in contrast to erythrocytes, the fixed cells of tissues from nonsecretors contain less of the A and B group antigens than do the tissues of the secretors. This fact must be considered when establishing group classification of tissues.

SUMMARY

This work was aimed at ascertaining whether there existed any differences in the content of group A and B antigens in the tissues of organs of secretors and nonsecretors of group substances. Tissues of the liver, kidney and cardiac muscle of 30 persons, dead of noninfectious diseases, served as the object of investigation. Seventeen of these were secretors, and 13 – nonsecretors of group substances.

A study was made of: 1) crude tissues of organs, 2) lyophilized tissues and 3) aqueous salt extracts from the formalin-preserved tissues.

All the samples of tissue investigated (both of secretors and nonsecretors) were capable of specific of specific extraction of corresponding antibodies from standard sera. However, this capacity was much more characteristic of tissues of secretors than of nonsecretors.

The greatest difference between the secretors and nonsecretors in the capacity to bind the antibodies of standard sera was noted in aqueous salt extracts from the formalin-preserved tissues of organs.

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