

INTRAUTERINE DEVELOPMENT OF THE ISOANTIGENS OF HUMAN SERUM

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The present work is a continuation of our previous investigations of the serum antigens of adult man [3, 4], and we have report the results of a study of serum antigens during the human intrauterine period.

A number of investigators have described the difference in the antigenic properties of adults and embryos [1].

It has been shown that there is a great difference between the serum proteins of embryos of various ages and those of the adult [6], and also between proteins of newborn infants and adult subjects [2, 5, 9].

We have read no reports of the relative developments of serum antigens during intrauterine life. It was for this reason that we carried out the following investigations.

METHOD

We examined the blood sera taken from 21 human fetuses and 2 embryos; from the latter we prepared a homogenate of the whole embryo, and not blood serum. Blood from the fetuses was obtained from a cardiac puncture, after the thorax had been opened.

The fetuses and embryos were divided into groups as follows: II lunar months – 2 embryos, IV lunar months – 2 fetuses, V lunar months – 4 fetuses, VI lunar months – 8 fetuses, and VIII lunar months – 1 fetus.

In studying the serum antigens we used Oudin's method of precipitation in gel [8], as modified by Ouchterlony [7].

In the reaction with antigens we used immune precipitating sera (IPS) obtained from rabbits immunized by human blood serum. All the blood was taken from a single person. We used three different IPS, having a titer of 1:10,000.

In studying the antigens in the serum of each of the fetuses, as a constant control we used blood serum taken from an adult subject. In this way we were able not only to determine the absolute number of serum antigens of each fetus, but also to compare and identify the latter with the serum antigens of the adult.

In 5 of the fetuses we studied the reaction of the blood with IPS obtained with rabbits immunized with the serum of a horse, chicken, turtle, frog, or fish. In this way the antigens absent from adult man but present in the lower vertebrates could be revealed. This work followed on from the results which we had obtained in studying the phylogenesis of the serum antigens [5].

RESULTS

The results are shown in Tables 1 and 2, and in Figs. 1 and 2.

In order to reveal more precisely the ratio between the number of serum antigens of fetuses of a particular age and the number present in the control serum (taken from an adult subject) we made use of the index, which we have called the comparison index, and which represents the ratio of the arithmetic means of the quantities.

In this way, when studying fetal or control serum we eliminated the influence of the number of rabbits receiving IPS. The effect is clearly seen by comparing the curve of the comparison index (see Fig. 2) with the curve giving the mean number of fetal antigens at the corresponding age, and the number of antigens in the control serum (see Fig. 1).

TABLE 1. Antigens of Human Embryos

Age of fetus (in lunar months)	Number of experiment	Precipitation line														Arithmetic mean of no. of lines	Comparison index	Absolute difference
		1-я	2-я	3-я	4-я	5-я	6-я	7-я	8-я	9-я	10-я	11-я	12-я	13-я	14-я			
II	1 f	+	+	+	+	+	+	+	+	+						f-4,5	$\frac{4,5}{12}=0,38$ 7,5	
	2 f	0	0	0	+	+	+	+	+	+	+	+						
	3 c	+	+	+	+	+	+	+	+	+	+	+	+			c-12		
IV	4 f	0	0	0	0	0										f-6,5	$\frac{6,5}{12}=0,54$ 5,5	
	5 c	+	+	+	+	+	+	+	+	+	+	+	+			c-12		
V	6 f	0	0	0	0											f-6	$\frac{6}{10,75}=0,55$ 4,75	
	7 f	+	+	+	+	+	+	+	+	+								
	8 f	+	+	+	+	+	+	+	+	+	+	+						
	9 c	+	+	+	+	+	+	+	+	+	+	+	+			c-10,75		
VI	10 f	0	0	0	0											f-6	$\frac{6}{10,62}=0,56$ 4,62	
	11 f	+	+	+	+	+	+	+	+	+								
	12 f	+	+	+	+	+	+	+	+	+	+							
	13 f	+	+	+	+	+	+	+	+	+	+							
	14 f	+	+	+	+	+	+	+	+	+	+							
	15 c	+	+	+	+	+	+	+	+	+	+	+	+			c-10,62		
VII	16 f	0	0	0	0	0	0	0								f-9 $\frac{9}{12,8}=0,70$ 3,83 c-12,8		
	17 f	+	+	+	+	+	+	+	+	+	+	+						
	18 f	+	+	+	+	+	+	+	+	+	+	+	+					
	19 f	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
	20 f	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
	21 f	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
	22 f	+	+	+	+	+	+	+	+	+	+	+	+					
	23 f	+	+	+	+	+	+	+	+	+	+	+	+	+				
	24 f	+	+	+	+	+	+	+	+	+	+	+	+	+				
VIII	24 f	0	0	0	0	0	0	0	0	0	+	+				f-10 c-12 $\frac{10}{12}=0,83$ 2		

Note: f = fetus (experiment); c = control.

Figure 1 shows a slight drop of both curves. However, the curve of the comparison index rises continuously. The comparison index tends to unity, the value which we assumed for the index for adult human serum. The fact that the drop referred to above was the same for both curves indicates that it is the result of the influence of the quality of the IPS used. Evidence to this effect is given by the curves for the comparison index, and by the absolute difference between the mean number of serum antigens in fetuses of different ages and the mean number of antigens of the control serum.

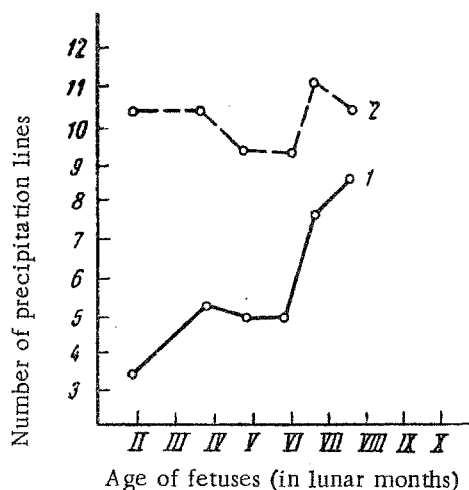


Fig. 1. Change in the number of antigens. 1) Experiment; 2) control.

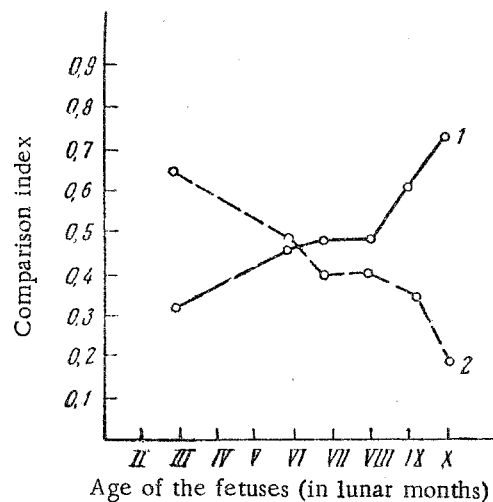


Fig. 2. Change of the comparison index (1), and of the absolute difference (2).

From Table 1 and from Fig. 1 it can be seen that with increase of age of the fetus there is an increase in the amount of serum antigens which approach the number of antigens characteristic of the parent. For example, in two-month-old fetuses we found 3 to 6 antigens, but in those eight months old 8-11 antigens were found.

TABLE 2. Serum Antigens of Fetuses Investigated with IPS Obtained from Rabbits Immunized with Blood from Animals of Different Ages

Age of fetus (in lunar months)	Human serum (control)	Horse	Chicken	Turtle	Frog	Fish
Number of precipitation lines						
V	7(12)	3	3	3	3	2
IV	8(12)	2	2	2	2	1
II	3(12)	0	0	0	0	0
VII	4(9)	1	1	1	1	1
VI	4(9)	2	2	2	1	1

Note. Numbers in brackets indicate the number of preparation lines obtained in the experiment with the control adult human serum.

The difference in the number of antigens in the serum of fetuses and adults is the result firstly of the absence in the fetus of those antigens which are present in the adult. The evidence is that precipitation bands are obtained with the adult serum, but cannot be identified with any of the precipitation bands of the fetus. Typically, when the precipitation bands are compared with those of the control, one band of the fetus merges with several precipitation bands of the control. We observed this effect in all the experiments. On the other hand, we found that the serum antigens of the fetus are less well differentiated than those of the adult. As the fetus develops, certain antigens become differentiated, and break up into new antigens.

Table 2 shows the results of an analysis of serum antigens made with the use of IPS obtained from rabbits immunized with blood from a horse, chicken, turtle, frog, or fish. It can be seen from Table 2 that the blood serum of the fetuses contains antigens resembling those present in the serum of all these different animals.

When studying the phylogenesis of the serum antigens [5], we established a relationship between the antigens of adult human blood serum on the one hand and those of horse, chicken, and turtle serum on the other. However, we failed to establish any such connection with the blood serum of the frog or fish.

As can be seen from Table 2, only in the two-month-old embryo were no antigens found resembling those from the vertebrate species we have mentioned.

Despite the restricted range of the experiment, the results we have obtained justify the conclusion that during the human intrauterine period antigens appear which are absent from the adult, and which correspond to those present in two lower vertebrates — the frog and fish. The result extends the "Law of Recapitulation" of human development to include the serum.

SUMMARY

Serum antigens were studied in 23 fetuses by precipitation in agar. There were fewer serum antigens in the human embryo than in the adult. The difference was in direct proportion to fetal age, and was due on the one hand to the absence in fetus of the antigens known to be present in the adult, and on the other to the increase in the number of fetal antigens during development, by differentiation of the serum antigens already present.

It was shown that during the intrauterine period, antigens were present in the human blood serum which were absent from the blood serum of adults. These antigens are also found in the serum of the frog and fish. This observation shows that the "Law of Recapitulation" applies also to the human blood serum antigens.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
