

TRANSPLACENTAL TRANSMISSION OF ANTITOXIC IMMUNITY TO TETANUS

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There are reports in the literature that in man, and also in animals with a hemochorial type of placenta, the transplacental transmission of agglutinins, opsonins, lysins, and complement-fixing and virus-neutralizing antibodies into the blood of the fetus may take place. It has been shown [3], for instance, that if pregnant women are immunized with typhoid vaccine, the agglutinin titer in the blood of the newborn infants is equal to the titer of antibodies in the maternal blood. In other experiments [2] rabbits were actively immunized before fertilization (to prevent the possibility of transmission of antigen through the placenta and intrauterine active immunization of the fetus) with a vaccine prepared from *Shigella flexneri* cells. Studies of the agglutinating properties of the serum of the newborn rabbits confirmed the hypothesis of the transplacental transmission of agglutinins from the blood of the females.

Several writers [5, 6] have reported the transmission of antitoxic immunity (tetanus, diphtheria) by the transplacental route. Other investigators [1, 4], however, consider that newborn animals obtain tetanus antitoxin with the mother's milk.

The solution of the problem of the transmission of antitoxic immunity to tetanus from mother to fetus by the transplacental route is of great practical importance from the point of view of the prevention of tetanus neonatorum. We have made an experimental study of the mechanism of transmission, and the duration of immunity in newborn animals, and of the role of the male in this process.

EXPERIMENTAL METHOD

Experiments were carried out on chincilla rabbits weighing 3.0-3.5 kg. Animals were chosen whose serum was found not to contain tetanus antitoxin before the experiment. Immunization was carried out by means of two injections, at an interval of 3 weeks, of tetanus toxoid obtained from Ufa I. I. Mechnikov Institute of Vaccines and Sera (Batch No. 132, control No. 1118). The toxoid used in the experiments had a residual useful life of not less than 6 months. The animals were mated 15 days after vaccination and again 5 days later (control). All the females became pregnant.

EXPERIMENTAL RESULTS

In the first experiment 6 females were investigated. Blood was taken from some of the young rabbits born to these animals (2-3 to each female) by cardiopuncture on the day of birth and also on the 5th, 10th, and 20th days of life, and from all the animals from the auricular vein on the 30th, 45th, and 60th days. The periodic investigation of the blood serum gave the following results. On the first day of life the antitoxin titer of the newborn rabbits was slightly below the maternal level. In one female, for example, it was 1.5 A.U. (mean titer in offspring $> 1.25 < 1.5$), in another female — > 0.5 A.U. ($> 0.25 < 0.5$), and in a third — 1.0 A.U. ($> 0.5 < 1.0$). Between the 10th and 20th days of life of the newborn rabbits a slight decrease was observed in the initial antitoxin level; on the 45th day in the majority it was 0.001 A.U., and on the 60th day the antitoxin had comparatively disappeared. Simultaneous investigation of the dynamics of the antitoxin titer in the females revealed a very slight lowering of the antitoxin titer in their serum during the period of observation. Similar results were obtained with the offspring of the other females (Table 1).

TABLE 1. Dynamics of Antitoxic Immunity to Tetanus in Immunized Females and Their Offspring

Female No.	Antitoxin titer (in A.U./ml)									
	in mothers			in newborn rabbits						
	1-2 days before parturition	on 30th day after parturition	on 60th day after parturition	1st day of life	5th day of life	10th day of life	20th day of life	30th day of life	45th day of life	60th day of life
1	≈ 1.5	≈ 1.5	≈ 1.0	$> 1.25 < 1.5$	≈ 1.25	≈ 1.25	≈ 1.0	≈ 0.25	≈ 0.001	< 0.001
2	≈ 0.5	≈ 0.25	≈ 0.1	$> 0.25 < 0.5$	≈ 0.25	≈ 0.25	≈ 0.1	≈ 0.1	≈ 0.001	< 0.001
3	≈ 1.0	≈ 0.5	≈ 0.25	$> 0.5 < 1.0$	≈ 0.5	≈ 0.5	≈ 0.1	≈ 0.01	≈ 0.001	< 0.001
4	≈ 2.0	≈ 1.5	≈ 1.0	$> 1.5 < 2.0$	≈ 1.5	≈ 1.5	≈ 1.5	≈ 0.5	≈ 0.01	≈ 0.001
5	≈ 2.0	≈ 2.0	≈ 1.5	≈ 2.0	≈ 2.0	≈ 2.0	≈ 1.5	≈ 0.5	≈ 0.01	< 0.001
6	≈ 1.0	≈ 0.75	≈ 0.5	$> 0.5 < 1.0$	≈ 0.75	≈ 0.75	≈ 0.25	≈ 0.1	≈ 0.001	< 0.001

TABLE 2. Dynamics of Antitoxin Titer in Rabbits Born to Immunized and Nonimmunized Females

Experimental conditions	Female No.	Antitoxin titer (in A.U./ml)					
		in mothers		in newborn rabbits			
		1-2 days before parturition	on 30th day after parturition	on 1st day of life	on 5th day of life	on 10th day of life	on 30th day of life
Nonimmunized females fed offspring of immunized mothers	14	< 0.001	< 0.001	≈ 1.5	≈ 1.5	≈ 1.5	≈ 0.5
	15	< 0.001	< 0.001	≈ 1.0	≈ 1.00	≈ 1.0	≈ 0.5
	14	< 0.001	< 0.001	≈ 1.0	> 0.75	≈ 0.75	≈ 0.25
Immunized females fed offspring of nonimmunized females	10	≈ 2.0	≈ 1.5	< 0.001	< 0.001	< 0.001	< 0.001
	11	≈ 1.5	≈ 1.5	< 0.001	< 0.001	< 0.001	< 0.001
	12	> 1.5	≈ 1.5	< 0.001	< 0.001	< 0.001	< 0.001

TABLE 3. Antitoxin Titer in Blood Serum of Male and Female Rabbits and Offspring

Male No.	Female No.	Antitoxin titer (A.U./ml)				
		in male rabbits before mating	in females		in newborn rabbits	
			before mating	after parturition	on 1st day of life	on 20th day of life
21	16	≈ 15.0	< 0.001	< 0.001	< 0.001	< 0.001
20	17	≈ 10.0	< 0.001	< 0.001	< 0.001	< 0.001
19	18	≈ 15.0	< 0.001	< 0.001	< 0.001	< 0.001

These results suggest that the passive transmission of antibodies takes place to the offspring of immunized female rabbits. To determine by what route — transplacental or through the maternal milk — the transmission of antitoxin takes place, a special experiment was carried out: immunized females were used to feed the offspring of nonimmunized females, and nonimmunized females to feed the offspring of immunized. The results in Table 2 show that practically no antitoxin was present in the blood serum of the newborn rabbits fed by immunized females but born from nonimmunized mothers. On the other hand, the antitoxin titer of the offspring of immunized mothers, fed by nonimmunized females, was approximately the same as that of the mothers. Consequently, natural feeding is not the source of the tetanus antibodies in the newborn rabbits.

To determine the part played by the male on the transmission of immunity to the offspring, 3 nonimmunized females were mated with immunized males. The results given in Table 3 show that the offspring of the immunized males and nonimmunized females possessed no immunity to tetanus.

SUMMARY

Antitoxic tetanus immunity is transmitted from immune females and is retained in the organism of neonatal rabbits up to the 45th day after birth; it practically disappears by the 60th day. Immunity is transmitted via the transplacental route. The mother's milk does not serve as the source of tetanus antibodies. The progeny of immune males and nonimmune females possessed no tetanus immunity.

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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.