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Research paperr

Morphological Aspects of Absorption of Antibodies

Nikolay N. Shulga[1*], Nikolay M. Mandro[2], Galina A. Gavrilova[3], Alexey N. Chubin[4], Irina Yu. Sayapina[5], Yuriy A. Gavrilov[6], Lopsondorzho V. Hibchenov[7], Natal'ya V. Trush[8]

[1]*Department of Virology and Immunology, The Federal State Budget Scientific Institution "Far Eastern Zonal Research Veterinary Institute", 675000, North Street, 112, city of Blagoveshchensk, Amur Region, Russia*
[2]*Department of veterinary and sanitary examination, epizootology and microbiology, FGBOU VO Far Eastern State University, 675005, ul. Kuznechnaya, 95, city of Blagoveshchensk, Amur Region, Russia*
[3]*Department of Technology of Production and Organization of Public Catering, FGBOU VO Far Eastern State University, 675005, ul. Gor'kogo 90, city of Blagoveshchensk, Amur Region, Russia*
[4]*Veterinary Center, 354057, Tuapse, 5/1, Sochi, Russia*
[5]*Department of Histology and Biology, FGBOU V Amur State Medical Academy of the Ministry of Health of Russia, 675006, ul. Gorky 95, city of Blagoveshchensk, Amur Region, Russia*
[6]*Department of Ecology, Soil Science and Agrochemistry, FGBOU VO Far Eastern State University, 675005, ul. Politekhnicheskaya, 86, city of Blagoveshchensk, Amur Region, Russia*
[7]*Department of Anatomy, Physiology, Pharmacology, FGBOU VO Buryatskaya GSKHA im. V.R. Filippova, 670024, ul. Pushkina, 8, Ulan-Ude, Russia*
[8]*Department of Biology and Hunting, FGBOU VO Far Eastern State University, 675000, ul. Lenina, 180, city of Blagoveshchensk, Amur Region, Russia*
**Corresponding author evgenidementyev@gmail.com*

Abstract

Placenta, depending on the species histological features, may interfere or promote the transmission of antibodies in the mother-fetus system. There are several types of placentas: epithelial type (horses, donkeys and pigs), desmochoric type (cows, sheep and goats), endothelial type (rabbits, Guinea pigs), hemochorial type (monkeys and women). Desmochoric and epithelial type of the placenta block the transfer of circulating maternal antibodies to the fetus. In animals with these types of placentae transfer of maternal antibodies to offspring is carried out by colostrum. Hemochorionic and endothelial chorionic placentae provides active transport of antibodies from the mother's bloodstream into the bloodstream of the fetus. Therefore, newborns have a complete set of maternal antibodies. The aim of our study was to investigate the mechanism of absorption of antibodies from colostrum by the epithelial cells of the small intestine of newborn animals with epithelial and desmochoric types of placentas. The article presents the results of the absorption of antibodies by epithelial cells of the small intestine of newborn animals with colostrum - type transmission of immune proteins from mother-offspring. Thus, it was established that the absorption of antibodies by epithelial cells of the small intestine is limited in time (24-72 hours). The mechanism of absorption is the fetal structure of the epithelial cells of the small intestine with the ability to absorb antibodies, and the termination of antibody absorption is associated with the replacement of fetal enterocytes by postnatal ones.

Keywords: absorption, antibodies, small intestine, enterocytes, stem cell, villus.

1. Introduction

The mechanism for the transfer of maternal antibodies to offspring was begun to study immediately after Bering and Kitasato set their protective role. Placentae, depending on the species histological features, may interfere or promote the transmission of antibodies in the mother-fetus system [1; 2]. Thus, the placentae of horse, donkey and pig are epithelial type characterized in that the mucous membrane of the uterus retains all its histological elements. Therefore, nutrients and oxygen must pass through the endothelium of the mother's vessels, connective tissue of the mucous membrane of uterus, epithelium of the uterine mucosa, connective tissue and endothelium of blood vessels of allantochorion [3; 4]. As well as the placentae of cows, sheep and goats – desmochoric type characterized that after the introduction of the villi the epithelium of the mucous membrane of the uterus is destroyed by enzymes secreted by the villi [5; 6]. As a result, the villus with its epithelium touches directly with the connective tissue of the uterus. The way which nutrients and oxygen from the vessels of the uterine mucosa must go through to the vessels of the villus of the fetus is one link shorter in comparison with the epitheliochorial placenta [7; 8]. Desmochorionic and epitheliochorial placentae block the transfer of circulating maternal antibodies to the fetus. In animals with the aforementioned types of placentae the transfer of maternal antibodies to the offspring is carried out by colostrum. Colostrum antibodies are represented by immunoglobulins that migrate from serum to the mammary gland before delivery. The composition of immune proteins represents the entire immune history of mothers ' lives. [9; 10].

Placenta of rabbits, Guinea pigs – endothelial chorionic type of placenta characterized in that during its formation the enzymes of the villi destroying not only the epithelium, but the

connective tissue of the uterine mucosa, so that the epithelium of the villi is directly adjacent to the endothelium of blood vessels of the endometrium. Therefore, the way of nutrients and oxygen is shorter. The placentae of monkeys and are hemochoric type differing in that not only the epithelium and connective tissue are destroyed, but also the endothelium of the blood vessels, so that the villi are immersed in the mother's blood [11; 12]. The hemochorionic and endothelial chorionic placentae provide active transport of antibodies from the mother's bloodstream to the fetal blood flow [13; 14]. Therefore, newborns have a complete set of maternal antibodies [15; 16]. The purpose of our research was to study the mechanism of absorption of antibodies from colostrum by epitheliocytes in the small intestine of newborn animals with epitheliochorial and desmochorial types of placentae. [17].

2. Materials and Methods of Research

The material for the study was blood and colostrum of animals, from which sera were obtained. In cattle, blood was taken from the jugular vein, the site of the puncture was disinfected. The puncture was done with a sterile needle, in the middle third of the neck, the needle was inserted towards the head. Blood was taken into sterile 20 ml tubes. For better coagulation taken blood was placed in a warm room at a temperature of 22-25 ° C for 5-6 hours. After 6 hours the blood clot was surrounded with a metal flambed probe, then the blood was placed in a cool place, after settling the serum was drained into test tubes [18]. Blood of pigs was taken from the ear vein, similarly to cattle.

The colostrum serum was obtained by heating to 38 ° C in a water bath, an equal volume of 0.1 normal hydrochloric acid solution and one drop of a saturated solution of pepsin were added to 5 ml of the mixture. The contents were mixed, kept in a water bath for an hour, and then centrifuged at 5000 rpm for 10 minutes [19].

For the experiment, groups of cows and calves (n = 80), sows (n = 80), piglets (n = 486) were formed. Blood was taken from mothers every day for a week before and after labor, colostrum - every day for a week after labor. Blood was taken from descendants every day for a week after delivery. In the blood serum and colostrum, the total number of antibodies (immunoglobulins) was determined by the method of Chekishev VM, electrophoresis in agarose gel [20, 21]. The level of the total protein was determined - refractometrically and, based on it, the percentage of antibodies was calculated. As a result, reliably identical data were obtained, therefore, the digital material averaged for the two types was analyzed.

3. Results

Maternal antibodies, from the chemical point of view, are β- and γ-globulins, are absorbed by epitheliocytes of the small intestine of newborns, unchanged, during the first day of life. Regarding the time of absorption of antibodies by epithelial cells of the small intestine, there is no consensus, according to some researchers, the process ends within the first hours of life, others on the first day and up to one month. The results of our studies of the dynamics of the content of antibodies in blood serums and colostrum of mothers before and after delivery are presented in the table 1.

Table 1. The dynamics of antibodies (M ± m)

Day before and after delivery	Antibody content%		
	Serums of mothers' blood	Serum colostrum	Serums of offspring blood
7	31,5±0,4	-	-
1	24,9±0,5	-	-
delivery	22,3±0,4	56,8±1,1	-
1	27,2±0,6	48,8±0,9	38,4±0,7
2	28,0±0,7	45,2±0,7	36,2±0,6
3	30,9±0,5	38,4±0,2	32,8±0,8
4	31,7±0,8	38,2±0,4	32,6±0,7
5	31,6±0,4	38,1±0,8	32,3±0,8
6	31,5±0,2	38,0±0,7	32,4±0,4
7	31,3±0,8	38,0±0,9	31,3±0,6

A significant decrease in antibody levels by 29.2% in blood serum before delivery was established, and their maximum content in colostrums exceeding 50% of total protein after delivery. Then the level of antibodies in the colostrum decreased, and in the blood accordingly increased and stabilized to the third day after delivery, which in our opinion corresponds to the time of stopping the absorption of proteins by the epithelial cells of the small intestine of newborns (Fig.1)

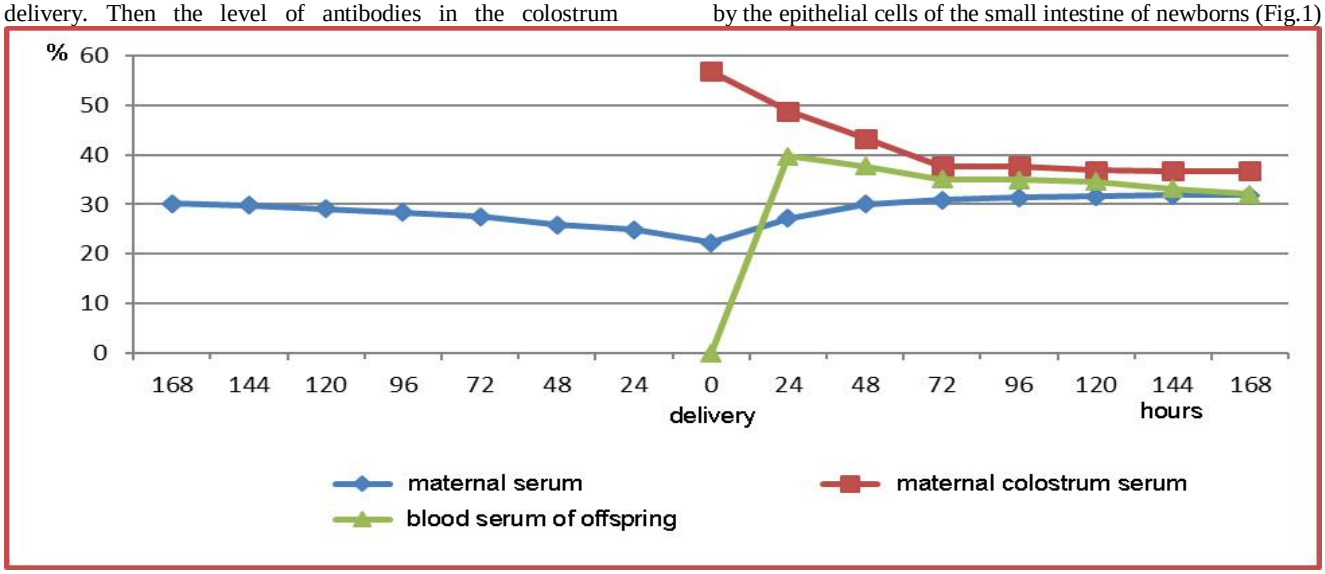

Figure 1. Dynamics of antibody levels

The process of absorption of proteins by epithelial cells of the small intestine of newborns is a fact established and not being questioned, which cannot be said about the mechanisms providing it. Concerning the mechanisms of protein absorption by epithelial cells of the small intestine, many opinions have been put forward that include low activity of the abomasum due to inadequate development of gastric lining cells that produce hydrochloric acid, the absence of enzymes that break down proteins, the presence of a trypsin inhibitor in colostrum, and others.

In our opinion, the process of absorption of antibodies is due to the fetal structure of the epithelial cells of the small intestine, and their replacement by postnatal causes the elimination of absorption and the beginning of the digestive process. According to the structure, the fetal wall of the small intestine is fingerlike protrusions-naps with microorganic structural formations, own blood circulation, innervation and contractible muscular apparatus, and tubular indentations-crypts, which are simple tubular unbranched glands. The epithelium of villi is represented by fetal epitheliocytes developing from poorly differentiated stem cells in the crypt (Fig. 2).

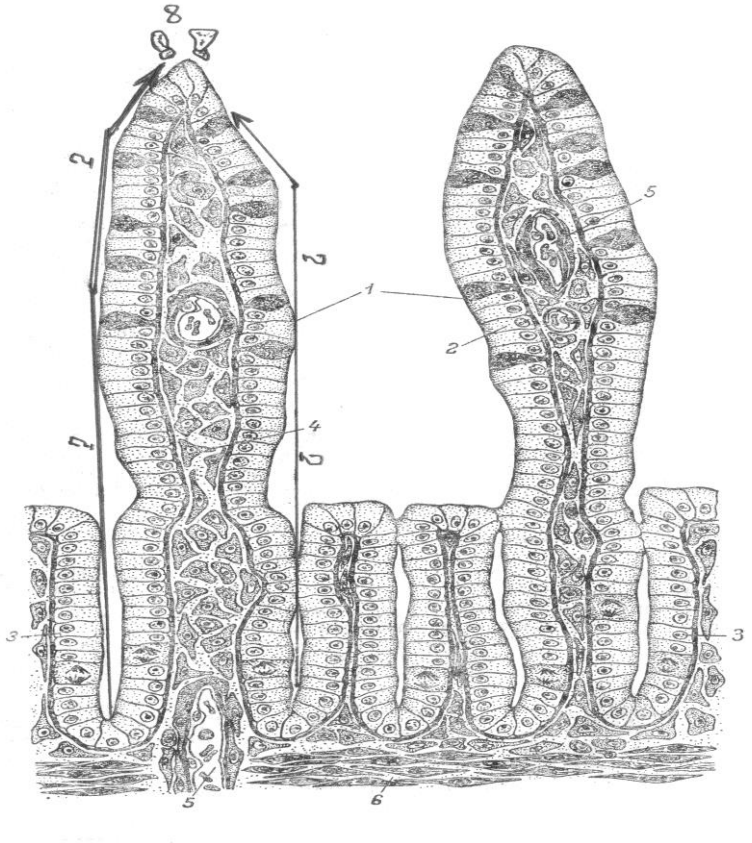

Figure 2. Scheme of the structure of the mucous membrane of the small intestine of newborns

1-villi, 2-epithelium, 3-crypt, 4-connective tissue, 5-blood vessel, 6-muscle layer of the mucous membrane, 7 - direction of differentiation and movement of stem cells, 8 – fusion of fetal epitheliocytes.

Fetal epithelial cells of newborns have a complex consisting of tubules, microbubbles and vacuoles associated with the intestinal cavity.

This structure of epithelial cells allows the absorption of unsplit protein molecules, in particular antibodies. Stem cells have the ability to mitotic division, polyentativeness and do not have structural signs of specific differentiation yet. As the stem cells are differentiated, the crypts located in the epithelium of the base, their progress along the side surface of the villi to the apex where their death and articulation from the epithelium occurs. As a result, fetal epitheliocytes are replaced by postnatal with loss of absorption capacity. The process of isolating fetal epitheliocytes into postnatal cells takes 24-72 hours, and it is strictly individual for each newborn.

4. Conclusion

Thus, the absorption of antibodies by epithelial cells of the small intestine of newborns is limited in time and amounts to 24-72 hours according to our data. The mechanism of absorption in our opinion is due to the fetal structure of the epitheliocytes of the small intestine, having the ability to absorb protein molecules without splitting into components. The termination of antibody absorption testifies to the replacement of fetal enterocytes by postnatal ones.

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