MORPHOMETRIC ANALYSIS OF VILLI IN SMALL INTESTINE OF NEONATAL PIGS

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Abstract

Optimal development of the digestive and immune system of neonatal pigs is connected with intake of colostrum. The immune system is not developed and the small intestine, in terms of transfer of immunoglobulins, is most active in the first 12 hours of piglet's life. In this work, we focused on morphometric express of the size of villi in the piglet's small intestine (duodenum, jejunum and ileum). The measurements were carried out on histological slides of the small intestine dyed by the hematoxylin-eosin method (clear dyeing) in the intervals before the colostrum intake (0 hrs.) and 3, 6 and 12 hours after the colostrum intake. The animals of experimental group were from holdings affected by PRRS syndrome (confirmed by SVFA), the control group: piglets from breeding free from PRRS infection. The evaluation of samples was performed under the microscope Olympus Provis AX program Image Pro Plus. We have discovered that size of villi was larger in the control group. It follows that the growth and development of mucosal layer of the small intestine in the experimental group was not uniform in comparison to control group. It could be that PRRS virus affected the growth of villi as well as the absorption of immunoglobulins from the small intestine into the blood of pigs.

Key words: morphometric, small intestine, neonatal piglets, intestinal villi, PRRS

Successful breeding of piglets depend on its genetic and biologic potential. Breeders have to create conditions for optimal utilization of this potential and only then is production of piglets profitable (Mlynek et al. 2012). Health status of pigs is in large rate limited by system of breeding and environment in which are the piglets housed (Václavková et al. 2008), then by nutrition (Hanušovský 2014) and by used additives or medicines (Schubertová et al. 2015; Brindza et al. 2015). Organism of neonatal piglets is susceptible besides environment on bacterial and viral diseases. Porcine reproductive and respiratory syndrome (PRRS) belongs between known and economical serious infection. PRRS presents a health problem for pigs, bud breeders sometimes paid no attention to this syndrome. PRRS could affect vitality of piglets in negative way and thereby even the development of digestive tract (Drábek and Bernardy, 2004). The absence of immunoglobulin intake via colostrum by piglets end in weakening of immune system, which is the main factor for defending against pathogens from environment (D'Inca et al. 2010). In term of colostral immunoglobulin resorption the mucous of small intestine has the main importance. Villi are parts of mucous membrane and affect directly the absorption process of immunoglobulin from colostrum (Deplancke and Gaskins 2001). In relationship to other assays at our workplace describing immunoglobulin concentration in sows colostrum and in blood of neonatal piglets the aim of this work is the morphometric characteristics of small intestine villi of piglets in two groups, one without PRRS and with presence of PRRS and in relation to time of colostrum intake.

Material and Methods

Eighty neonatal piglets F2 generation (Large white x Landrace) were used for this experiment. 40 piglets (experimental group) were from breeding with presence of PRRS. Other 40 piglets (control group) were from breeding without presence of PRRS. Sampling periods of small intestine were in both groups at same times: first, before colostrum intake; next 3rd, 6th and 12th hour after first colostrum intake by piglets. Colostrum intake by piglets was *ad libitum*. In every sampling period were 10 piglets euthanized (diethyl ether), then followed small intestine samples taking 5x5 mm (*duodenum, jejunum, ileum*), next washing and fixating in 10% formaldehyde, next elutriation, dehydrating, potting in paraffin, next cuting on 7-8 µm cuts (Microtom). Fitting of samples was as follows: 2 samples per 5 glass, 5 cuts on each glass. Microscopic preparation were colourized by comprendious colouring with hematoxilín-eozine method. Graphical evaluation was realised at microscope Olympus Provis AX and by programme for evaluation of individual morphologic structures Statgraphics ver.7, Image ProPlus (Spectra Services Inc,NY) and MS Excel 2000. Results were processed in programme SAS 9.2. (The SAS System V 9.2.). Statistical significance of differences in average values between experimental and control group was realized by ANOVA procedure (Tukey's Studentized Range / HSD/ Test).

Results and Discussion

Belák et al, (1990) published, that small intestine is the main absorptive area among the whole gastrointestinal tract. Intestine absorptive cells, enterocytes, has the surface enlarged with microvilli. Enterocytes are the most represented cells in villi (Junqueira et al., 1997). Bruininx et al. (2002) published, that microvilli present biggest enlargement of intestine surface. The size of microvilli depend on many factors. Xu et al. (2000) claiming that microvilli has an important physiological function, because they increased the junction between intestine and ingested feed. Buddle and Bolton (1992) published, that intestinal mucous is tissue with the quickest regeneration in the body. The most significant changes in mucous is during intake of colostrum by suckling of mammals (Toman et al., 2000). In our experiment, the morphometric parameters of villi were assayed. Development of mucous was to a great extent affected by time of first colostrum intake. Table 1 shows the development of villi in small intestine. Three to six hours after first colostrum intake was the time with the biggest changes in intestinal mucous. Before colostrum intake ($P<0.01$) at 6th ($P<0.01$) and 12th ($P<0.05$) hour after first colostrum intake were the sampling periods with statistical significant bigger villi size in the control group in comparison to experimental group.

Table1. Changes of average size of small intestine villi after colostrum intake by neonatal piglets (µm)

	Sampling period							
	Before colostrum intake		3 hours after first colostrum intake		6 hours after first colostrum intake		12 hours after first colostrum intake	
	control	experiment	control	experiment	control	experiment	control	experiment
Average	1.48**	1.18	2.33	2.26	2.74**	1.60	3.06*	2.85
S.D.	0.14	0.09	0.09	0.07	0.12	0.08	0.17	0.07
min	1.31	1.07	2.19	2.18	2.54	1.46	2.91	2.77
max	1.74	1.32	2.46	2.41	2.93	1.73	3.40	2.98

* ** Statistical significance between groups within sampling period; *$P< 0.05$, **$P< 0.01$.

Conclusions

The aim of this study was to compare the size of small intestine villi of neonatal piglets between breed with presence of PRRS and breed without presence of PRRS. In general we could say, that the size of villi increased with time from birth of piglets, after colostrum intake. Progressive increase of villi size was detected only in control group. Size of small intestine villi was in all sampling periods bigger in control group. In experimental group, interesting was the decrease of villi size from 3rd hour to 6th hour after first colostrum intake. Statistical significance of small intestine villi size between control and experimental group was detected before colostrum intake ($P<0.01$), at 6th hour ($P<0.01$) and at 12th ($P<0.05$) hour after first colostrum intake. According to these results we could say that firs colostrum intake affected markedly the development of small intestine villi. Differences between control and experimental group were probably caused by presence of PRRS in experimental group.

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