Cattle buxtonellosis in Kaluga region in the Russian Federation

Original Article

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ABSTRACT

Background: Buxtonellosis is a disease caused by the ciliated protozoan *Buxtonella sulcata*.
Objective: This study was conducted to investigate the seasonal and age dynamics of the prevalence and intensity of buxtonellosis in cattle in Kaluga region of central Russia.
Material and Methods: A total of 476 fecal samples were collected from cattle of different age groups. Data for various seasons, obtained from different regions, varied within the temperature range from 20±5°C in summer to -12±5°C in winter. *Buxtonella* cysts were isolated by sedimentation technique and counted by the McMaster method.
Results: The highest prevalence rate of cattle buxtonellosis was observed in winter and the infection rate decreased in the warm season. Infection up to 545 cysts/g stools was recorded in a group of young animals up to one year old, coinciding with a prevalence peak up to 95% in autumn.
Conclusion: The results showed seasonal and age dynamics of cattle buxtonellosis in Kaluga region in the Russian Federation. The highest prevalence was observed in adult calves during winter. This finding contributes to the existing knowledge about the etiopathogenesis of cattle buxtonellosis in this area.

Keywords: *Buxtonella sulcata*; protozoa; ruminant; Russia; zoonosis.

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INTRODUCTION

Animals' gastrointestinal tracts hold a broad range of parasitic protozoa and helminths that cause subclinical and clinical infections. Some of these parasites adversely affect the animal health causing high economic losses in livestock industry[1]. Despite the presence of stringent hygienic measures in industrial cattle farms, diarrheal parasites continue to be a major cause of morbidity and mortality in the world. Neonates and young calves are highly susceptible to enteric infections by various pathogens, including bacteria, viruses, fungi, protozoa, and helminths[2]. The most commonly identified parasitic agents responsible for diarrhea are *B. sulcata*, *Cryptosporidium* spp., *Eimeria* spp., *Giardia* spp., and *Toxocara vitulorum*[3]. The prevalence rate of diarrhea was substantially higher in calves passing *B. sulcata* cysts than in those without the cysts[4]. Notably, *B. sulcata* is a protozoan ciliate with two stages: trophozoites and cysts. Trophozoites colonize the colonic wall of cattle and cause diarrhea in calves[5].

As a cause of diarrhea, buxtonellosis was reported in Turkey[6], Poland[7], Italy[8], Middle East[9,10], North Africa[11,12], and Taiwan[13]. Other authors described the pathological effects of other ciliates in cattle such as *Balantidium coli*[3,4], whose cysts have a great morphological resemblance to *B. sulcata*. The differences between the two ciliates was described[14]. Pomajbíková *et al*.[15] found morphological and genetic similarity of *Balantidium coli* cysts from monkeys and *Buxtonella* cysts from cattle, and so did not exclude the pathogenicity of the latter for humans.

In the present study, we estimated the prevalence and intensity of buxtonellosis in cattle according to season and age in Kaluga region in the Russian Federation. From the aspect of human-medicine and public health, the issue about the possible spectra of hosts of *B. sulcata* and the possibility of humans as hosts, raises the significance of this research.

MATERIAL AND METHODS

Study area and experimental design: From January to December 2019, the seasonal dynamics of buxtonellosis in cattle were studied in cattle-breeding farms in Kaluga region in the Russian Federation. Cattle aged between 1 day and 5 years. The temperature in the study region ranged from 20±5°C in summer to -12±5°C in winter. In total, 116; 120; 120 and 120 fecal samples were examined in winter; spring; summer and autumn, respectively.

Parasitological examination: *Buxtonella* cysts were isolated by sequential sedimentation technique[16]. Approximately 3 g of feces were placed in a 400 ml beaker containing 50 ml of water, and stirred with a glass rod until a homogeneous mass was obtained.

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While stirring the mass, water was added in portions to the full volume of the glass. The suspension was filtered into another glass through a metal strainer or gauze and allowed to stand until a precipitate was formed. The upper layer of the liquid was poured or sucked off the sediment with a syringe (in this case, the tip of the syringe was lowered at least 1.5-2 cm from the bottom of the glass). The same amount of water was again added to the precipitate and the mixture was allowed to stand for 5 min, after which the overlaying liquid was again poured off down to the precipitate. Washings were repeated until the supernatant was clear. The latter was decanted, and a drop (0.3 ml) of the precipitate was applied to a glass slide and examined microscopically at x100 magnification. The number of cysts was counted by the modified McMaster method[5]. The number of cysts in one g (CPG) of feces was calculated by the formula: CPG = (Number of cysts in both squares of the McMaster chamber/5) X 100.

RESULTS

The highest prevalence was observed in winter with a slight decrease in spring, and the lowest was in summer with another increase towards autumn. A consistently high prevalence was recorded throughout all seasons of the year in young animals up to 1 and up to 2 years. It was consistently low in young animals up to 6 months with a range of 10-20% in spring, summer and winter respectively, while the highest record in this age group was 95% in autumn. The infection rate in cattle decreased in the warm season, starting from spring and in autumn it rose again, reaching a peak in winter (Table 1). The highest intensity of cattle buxtonellosis was noted in summer and autumn. Accordingly, a group of young animals up to one-year old stand out with indicators of up to 545 cysts/g coinciding with a peak prevalence of 95% in autumn. The intensity of infection increased with rise of air temperature in all groups and peaked in summer. Calves up to 10 days old were free from infection in all seasons (Table 1).

Table 1. Seasonal and age dynamics of cattle buxtonellosis.

Age	Winter		Spring		Summer		Autumn		Annual	
	EI%	II%	EI%	II%	EI%	II%	EI%	II%	EI%	II%
Calves (1 M)	0	0±0	0	0±0	0	0±0	0	0±0	0	0±0
Calves (6 M)	20	77.8±21.4	10	32.5±5.4	20	296.6±23.3	5	134.4±22.8	13.7	135.3±18.2
Calves (1 Y)	60	91.8±18.4	60	111.4±15.7	36.8	645.4±54.7	95	545±45.7	62.9	348.4±33.6
Calves (2 Y)	60	44.5±12.9	70	325.4±36.4	60	210.8±21.4	50	66.4±7.9	60	161.7±19.6
Cows and heifers (<2 Y)	85	257.7±32.8	35	241.7±16.7	40.9	98.7±12.4	65	136.7±10.3	56.4	183.7±18
Overall	**45**	**110.7±11.7**	**41**	**155.9±12.2**	**31.5**	**274.4±18.8**	**43**	**288.7±20.7**		

EI: Extent of invasion; **II:** Intensity of invasion; **M:** Month, **Y:** Year.

The cysts of *B. sulcata* were oval or round in shape, yellowish-green in color and measured 54.8–96.2 µm in diameter with a mean of 67.3±11.1 µm. These cysts were surrounded by a double-layered capsule, showing macronucleus and contractile vacuoles (Figure 1). The trophozoites of *B. sulcata* appeared oval in shape and covered by clear long cilia (Figure 2).

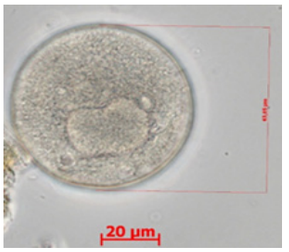

Fig. 1. Cyst of *B. sulcata* (x 100).

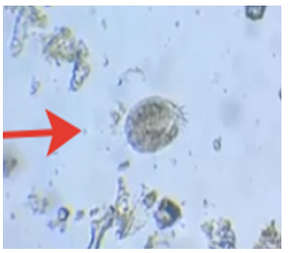

Fig. 2. Trophozoite of *B. sulcata* (x 100).

DISCUSSION

It is known that some ciliates host in the alimentary tract of ruminants, but their effects have not been exactly explained[13]. *Buxtonella sulcata* is considered as a commensal of intestinal tract of ruminants and helps in the digestion of plant materials and therefore, it is common to find high rates of infection by *B. sulcata* in cattle. Morphologically, *B. sulcata* is similar to *B. coli* of pig and man[15]. In the present study, the prevalence and intensity of *B. sulcata* was reported in cattle in relation to age and seasons. The prevalence of *B. sulcata* was 56.4% in adult heifer and 13.7%, 63.4%, and 60%, in calves 6 months old, one year old, and two years, respectively.

It is well known that neonatal calves receive maternal antibodies with colostrum during the first few days after birth. These antibodies may partially protect the calves from a variety of infections including *B. sulcata* infection. As the calf grows, the maternal antibodies gradually decrease. This explains that, as with anther study[17], our recorded infection rates were high among calves over one month old as compared with those under one month old.

We recorded the highest prevalence of 45% in the winter season, followed by 43% in autumn and 41% in spring; while the highest intensity of buxtonellosis was noted in summer and autumn. The incidence of diarrhea

in calves having *B. sulcata* cysts is higher compared with calves without cysts. A strong relationship between the intensity of infection with this parasite (number of cysts per gram of feces) and diarrhea was reported[5]. The resulting diarrhea in calves is due to changes in the parasite microenvironment in the gastrointestinal tract, especially pH changes. It was shown that intestinal pH of calves dropped to 6.6 after 2 hours of milk ingestion, predisposing neonatal calves to infection with *B. sulcata*[18]. Differences in prevalence could be related to different environmental situations, individual animal, farm management practices and stress factors. Seasonal fluctuations is related to changes in the diet opportunities for transmission. In addition, female pregnant cattle in poor health and low immunity are at greatest risk of infection with higher subsequent shedding of cysts of *B. sulcata, which* may result in an increase in prevalence of infection[9]. Factors contributing to favorable outcomes include adequate husbandry conditions, nutrition, care and immunoprophylaxis; and from the veterinary aspect, administration of prophylactic preventive therapy as a crucial part of cattle farming.

In conclusion, the results showed the seasonal and age dynamics of the prevalence and intensity of buxtonellosis in cattle, in Kaluga region in the Russian Federation. The highest prevalence rate was observed in winter with a slight decrease in spring, and the lowest was in summer with an increase towards autumn. The prevalence of *B. sulcata* was higher in adult heifer calves (one year old) and calves (two years old). Further studies would be beneficial to assess the impact of improved housing conditions, hygiene, and therapeutic agents in the control of *B. sulcata*.

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