Research Article

Fecal Microbiota Transplantation Against Respiratoy Disease in Goats at Field Conditions

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Abstract

In our study, it was aimed to determine the effect of fecal microbiota transplantation on the severity of pneumonia with cumulative clinical scoring in a goat herd encountered respiratory system problems. Respiratory system findings of 38 goats were confirmed with anamnesis that was reported to be seasonally recurrent and no response to antibiotic applications and that clinical examination along with necropsy findings performed by the veterinary surgeon. After performing physical examination and clinical examinations of goats with pneumonia, fecal microbiota with feces obtained from healthy goats was transplanted to goats with pneumonia for once. Scoring was realized by clinical remission of pre-post treatment. Decreasing the severity of pneumonia and clinical remission were diminished on third day of treatment.

Keywords: Fecal microbiota, Goat, Transplantation

Introduction

In goats, especially in yearlings, pneumonia frequently develops due to etiological agents such as *Mannheimia haemolytica, Pasteurella multocida, Mycoplasma ovipneumoniae* and *Mycoplasma arginini* and manifests itself as proliferative exudative pneumonia, proliferative interstitial pneumonia, atypical pneumonia and chronic non-progressive pneumonia. Mistakes made in care management conditions and deficiencies in colostrum management are generally reported as predisposing factors that play a role in the development of the disease (Fleming, 2009). It reveals that the regulations in the intestinal microbiota affect the functions of alveolar macrophages and play an important role in preventing pneumonia (Fleming, 2009; Wu and Wu, 2012). This study aimed to determine the effect of fecal microbiota transplantation on clinical recovery in goats with pneumonia.

Material and Method

The study was carried out in Denizli, Acıpayam District. In the enterprise containing a total of 278 head of goats (Figure 1a), 38 goats aged between 4 months and 6 years were included in the study. It was understood by the field physician, both with anamnesis and necropsy (Figure 1b and c), that the cases had not responded to different antibiotic trials for the last 2 weeks and that deaths continued despite antibacterial applications. After isolating all patients by providing medical records, our study team performed clinical examination, respiratory frequency, body temperature measurement, lung auscultation findings, and laryngotracheal palpation. Cumulative clinical scores (Table 1) were performed in each case within the modified clinical scoring system, similar to that used for calves (Poulsen and McGuirk, 2009) and sheep (4. Christodoulopoulos et al., 2002), based on the application of Kaçar et al (2018). Fresh fecal samples obtained from other healthy goats were mixed in a pool for all sick cases, and an isotonic suspension was obtained by mixing an equal amount of isotonic with the total amount of feces. After the subsequent solid particles were removed, a minimum of 150 ml of fecal microbiota transplantation (fmt) was applied to all sick goats as the liquid part rectal enema (Figure 2). Starting from the 4th day (after the main part of the study was completed), the cases were also recommended orally 8 mg/kg tiamulin (Vetmulin oral solution granule, 450 mg thaimulin hydrogen fumarate (Norm Animal Health, Konya) for 5 days by our study team.

Figure 1. Demographic view of the herd in Denizli Acıpayam district, its conditions and autopsy findings of the field physician

Figure 2. Fecal microbiota transplantation under field conditions; a) mixing of different stool samples, taking into account age-related biodiversity, b) preparation, c) and d) practical application of the suspension obtained instantaneously in two different cases in the form of rectal enema under field conditions.

Results

The distribution of respiratory system-related findings in the 38 patient goats included in the study is shown in Table 1. It was determined that respiratory symptoms were dominant and showed a seasonal increase.

As shown in Table 2, the change before and after treatment in terms of severity of pneumonia and mean values of cumulative clinical scoring (Figures 3 and 4) was statistically significant (*p = 0.00*).

Table 1. Clinical findings and incidence.

Clinical findings	N=	%
Increase in respiratory frequency	38	100
Pathological sounds on lung auscultation	38	97.4
Nasal discharge	27	69.2
Cough	31	79.4
Increase in body temperature	20	51.2
Conjunctival hyperemia	11	28.2

Table 2. Severity of pneumonia, mean values of cumulative clinical scoring and change before and after treatment.

Severity of pneumonia	Total Clinical Score	Before Treatment (day 0, n, %)	After treatment (3rd day, n, %)
	0	-	19 (%50)
	1	-	5 (%13,2)
	2	-	9 (%23,7)
	3	-	2 (%5,3)
	4	-	-
	5	3 (%7,9)	-
	6	2 (%5,3)	-
	7	3 (%7,9)	-
	8	16 (%42,1)	3 (%7,9)
	9	4 (%10,5)	-
	10	10 (%26,3)	-
Cumulative clinical score average		8,2	1,4
***P* value**		0,00	

Figure 3. Frequency distribution of patients' cumulative clinical scores before and after treatment

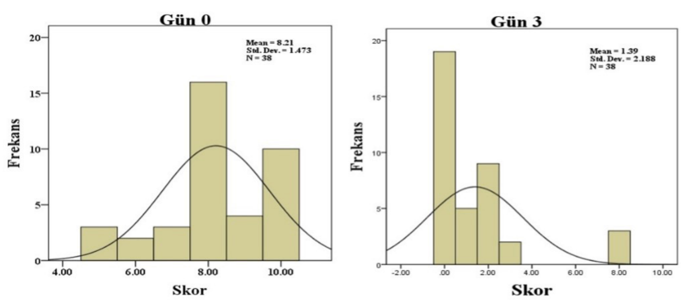
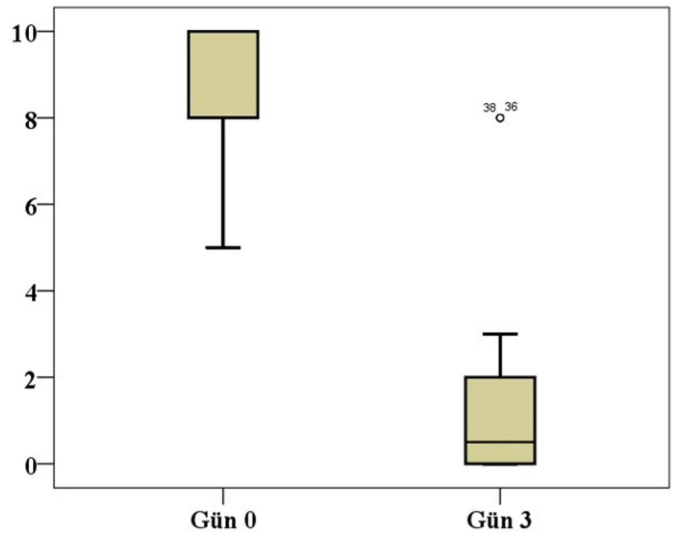


Figure 4. Box-plot distributions of pre-treatment and post-treatment scores



Discussion

Pneumonia in goats generally develops more frequently in young offspring and is caused by *M. haemolytica, P. multocida and Mycoplasmsa spp.* It is associated with species (Fleming, 2009; Jarikre et al., 2018). In this study, with the information received from our field physician, *M. hemolytica* and *Mycoplasma spp.* were detected in the same herd in previous years. Considering the information that the species were isolated, fmt was applied without waiting for isolation and identification, considering the field conditions, the ongoing deaths in the herd before this study, and saving time (taking into account the risk/benefit balance).

As reported in previous studies (Sadeghian et al., 2011), clinical findings such as predominant hardened lung sounds, nasal discharge, increased body temperature, similar to *P. multocida*-infected goats, were observed at varying rates in goats. The statistically significant change in cumulative clinical scores before and after treatment can be associated with the effectiveness of fmt. Not using any other active ingredient that would affect the treatment and overshadow the effectiveness of fmt can be interpreted as the successful use of fmt and the elimination of the disease.

The intestinal microbiota, as the largest and most complex element in the mammalian ecosystem, is not only responsible for the regulation and homeostasis of health, but also acts as a bridge between the host and the diet (Wu and Wu, 2012). The related interorgan connection is the gut-lung axis, which is less studied than the gut-brain axis (Dang and Marsland, 2019; Enaud et al., 2020). Microbiota studies have generally focused on bacterial elements within the microbial kingdom. Based on *in vivo* and *in vitro* studies (Lof et al., 2017; Soret et al., 2020), the cross-talk between these kingdoms may include physical interaction, the method of communication between some microorganisms through signaling molecules called 'quorum sensing', the production of antimicrobial agents, modulation of the immune response and changing nutritional sources (Peleg et al., 2010). In this study the efficacy of fmt was dedicated to successfull management of gut-lung axis.

Reasons such as the close relationship between the gut and lung microbiota throughout postnatal life and the host-based communication network (Grier et al., 2018), the fact that diet affects the composition of the lung microbiome and the fact that fmt in mice changes the lung microbiota (Liu et al., 2017) can all explain this two-way relationship. The health status of the host is also responsible for the gut-lung interaction. Both the intestinal and lung microbiota change in different respiratory diseases, and a similar correlation is observed in the cluster richness of high levels of bacteria (Dickson et al., 2016; Liu et al., 2017). On the other hand, lung microbiota can also change the composition of the intestinal microbiota (Dickson et al., 2016). In our study, in addition to the positive elements such as the change in cumulative scores and clinical improvement achieved only by fmt, we were inable to conduct etiological-based research (the risk/ benefit equation was taken into account when there were serial deaths in the herd, and also due to the new type of coronavirus epidemic, the transfer of laboratory analysis, investigation and ensuring biosafety were not carried out). Although it cannot directly name the disease (for reasons of concern) and provide evidence-based information, it can lead to the formation of an important treatment module for respiratory system problems under field conditions.

Conclusion

The gut-lung axis is better understood today, and although cumulative data is increasing, especially in our field of veterinary internal medicine, there is a need to better understand the field effectiveness of fmt within the scope of evidence-based data. In this respect, our study will be evidence of the field effectiveness of fmt. Fmt may be an important treatment module, especially in respiratory system disorders that do not respond to antibacterial or immunosuppressive drug applications under field conditions. Our subsequent studies, if budgetary resources can be provided, will be able to provide further support for these findings obtained in practice, through etio-pathological based research and microbiota analyses.

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