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Research Article

Seroprevalence of Maedi-Visna Infection in Sheep in the Central Black Sea Region of Türkiye

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ABSTRACT

Maedi-Visna is a slowly progressive infection of sheep that affects the respiratory and nervous systems and causes significant yield losses worldwide. This study was conducted to assess the seroprevalence of Maedi-Visna infection in sheep across several provinces in the Central Black Sea region of Türkiye, namely Samsun, Sinop, Ordu, Giresun, Amasya and Tokat. A total of 476 sheep serum samples were collected for further analysis. The presence of antibodies in the sera was determined by Ab ELISA. As a result of the study, 263 (55.25%) blood serum samples were positive for the presence of MVV antibodies. Seropositivity rates by province were as follows: Samsun 45%, Sinop 80%, Ordu 58.75%, Giresun 35%, Amasya 38.75%, Tokat 75%. Notably, our findings suggest a significantly high seroprevalence of Maedi-Visna infection in this region compared to other studies conducted in different parts of Türkiye This information is pivotal for understanding the extent of the infection in the sheep population of the Central Black Sea region and can contribute to the development of strategies for disease management and control.

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INTRODUCTION

Maedi-Visna (MV) is a lifelong and incurable viral infection with an extended incubation period in sheep. Also referred to as progressive pneumonia of sheep, this disease poses a significant challenge to sheep farming globally (Boer et al., 1979).

MV is a lifelong and incurable viral infection with an extended incubation period in sheep. Also referred to sometimes as progressive pneumonia of sheep and this disease represents a significant challenge to sheep farming globally (Boer et al., 1979). The causative agent is classified within the *Lentivirus* genus of the *Orthoretrovirinae* subfamily, belonging to the *Retroviridae* family (ICTV, 2023). Owing to its genetic similarity with Caprine arthritis encephalitis virus, found in the same family, these two viruses are collectively referred to as lentivirus infections of small ruminates (Blacklaws,2012). According to phylogenetic analysis, small ruminant lentiviruses are categorized into five genotypes. Maedi-Visna virus (MVV) is classified under genotype A (Glaria et al., 2012). The virus primarily targets the immune system by infecting monocytes and macrophages. Due to the generally slow viral replication, the disease exhibits a slowly progressive course, and clinical symptoms are nonspecific in the early stages. The primary mode of transmission is horizontal, occurring through colostrum and aerosol from the infected mother (Dawson,1980). Additionally, there is ongoing evaluation regarding the potential transplacental transmission of the virus, although this mechanism has not been fully elucidated. (Broughton-Neiswanger et al., 2010). The organs predominantly affected by MVV include the lungs, mammary glands, nervous system tissues and joints. The Maedi form of the disease is linked to respiratory symptoms, while the Visna form is associated with central nervous system manifestations (Minguijón et al., 2015; Gomez-Lucia et al., 2018). The maedi form exhibits the most prevalent clinical manifestations of the infection. Initial symptoms include a decline in body condition, with affected animals trailing behind the herd. In the advanced stage, dyspnea is characterized by an elevated respiratory rate and the presence of lymphocytic interstitial pneumonia becomes evident (Christodoulopoulos,2006; Lopez and Martinson,2017). MVV can induce indurative, non-suppurative interstitial mastitis in the mammary gland. The virus replication in macrophages and mammary gland epithelial cells leads to a substantial reduction in milk production (Minguijón et al., 2015). The Visna form of the disease is less common than the maedi form. Clinical signs observed in Visna include weight loss, impaired coordination, weakness in the hind limbs and eventual paralysis (Christodoulopoulos,2006). The diagnosis of infection relies on either directly detecting the presence of the virus or identifying antibodies specific to the agent (Kaba et al., 2013). At present, there is no effective treatment option against MVV infection. Despite numerous vaccine studies, including live attenuated, recombinant, and DNA vaccines, no success has been achieved in preventing the disease (Cheevers et al., 1994; Pétursson et al., 2005; González et al., 2005; Torsteinsdóttir et al., 2007).

The objective of this study was to assess the prevalence of Maedi-Visna infection in sheep across the provinces of Samsun, Sinop, Ordu, Giresun, Amasya, and Tokat in the Central Black Sea Region, aiming to determine the current status of the infection in the region.

MATERIAL AND METHOD

Sampling

Our study utilized 476 sheep serum samples that came from Samsun, Sinop, Ordu, Giresun, Amasya, and Tokat provinces located in the Central Black Sea Region of Türkiye (Figure.1). Blood Samples were collected from various areas in a consistent manner between January 2018 and December 2020 from clinically healthy sheep flocks aged between 1-2 years. General clinical findings were examined to ensure the health status of the animals, and the appropriate number of animals for the study were determined randomly. Serum samples were heat-inactivated at 56° C for 30 minutes and stored at -20 °C until testing by Enzyme-Linked Immuno Sorbent Assay (ELISA) method.

Figure 1. *Map showing the study area where serum samples were collected.*

ELISA Assay

For the detection of MVV specific antibodies, a commercially available indirect ELISA test kit, "ID.vet ID Screen MVV/ CAEV Indirect Screening test (Grabels-France)" was used. After performing the test according to the manufacturer's instructions, the plates were read at 450 nm and OD values were calculated. The specificity of the kit is 99.6% in sheep and 99.2% in goats, while its sensitivity is 98.9% in sheep and 98.6% in goats (Nowicka et al., 2014).

According to the kits manual, samples were evaluated as follows:

S/P%= $\frac{ODsample-ODnc}{ODpc-ODnc} x100$ (S/P%: sample/positive percentage, ODsample: optic density of the sample, ODnc: optic density of negative control, ODpc: optic density of positive control).

- Samples presenting an S/P ratio equal to or below 50% were considered negative.
- Samples presenting an S/P ratio between 50% and 60% were considered doubtful.
- Samples presenting an S/P ratio equal to or above 60% were considered positive.
- The results were considered valid when the OD of the positive control was greater than 0.350, and the mean value of the positive and negative controls was more than 3.

RESULTS

From 476 serum samples that were tested, 263 serum samples were evaluated as positive for MVV antibody. Whereas the overall seropositivity rate was 55.25%, the seropositivity rates per province were as follows: Samsun 36/80 (45%), Sinop 64/80 (80%), Ordu 47/80 (58.75%), Giresun 28/80 (35%), Amasya 31/80 (38.75%), Tokat 57/76 (75%) (Table.1).

Table 1. *Seropositivity distribution by provinces*

Province	Serum sample	Positive serum	Seropositivity(%)
Samsun	80	36	%45
Sinop	80	64	%80
Ordu	80	47	%58.75
Giresun	80	28	%35
Amasya	80	31	%38.75
Tokat	76	57	%75
Total	476	263	%55.25

DISCUSSION

MVV infection represents a persistent lentivirus infection in sheep (Peterhans et al., 2004). Initially perceived as distinct diseases, it was later recognized that Maedi and Visna represent different clinical courses of the same underlying disease (Sigurdsson et al., 1952; Dawson,1980). The disease initially was reported in Iceland in 1939, and various research efforts have been ongoing since the 1940s (Schaller et al., 2000; Straub, 2004; Reina et al., 2009; Zhang et al., 2013). Presently, Maedi-Visna infection is widespread worldwide, with the exception of Australia and New Zealand. Recognizing its substantial economic impact on livestock, the disease is listed among the notifiable terrestrial and aquatic animal diseases by the World Organization for Animal Health (WOAH, 2018).

MVV infection is prevalent in Turkey and worldwide, prompting numerous studies on its seroprevalence in recent years. The first investigation into the virus's presence in Turkey was conducted by Alibaşoğlu et al. (1975), focusing on pathological findings for virus detection. Subsequently, many studies have been undertaken to detect the virus using serological and virological methods (Girgin et al., 1987; Karaoğlu et al., 2003; Çimtay et al., 2004; Arslan et al., 2012; Gürçay et al., 2013).

The virus was first isolated by Tan and Alkan (2002), and molecular characterization was subsequently conducted by Muz et al. (2013). Numerous epidemiological studies have been conducted in between them and after, revealing diverse seropositivity rates in different regions of Turkey. A study conducted on 198 sheep sera from Erzurum province, 1.5% seropositivity was detected (Schreuder et al., 1988). Burgu et al. (1990), found a higher seropositivity rate of 23.9% among 1099 blood serum samples collected from sheep farms across all of Turkey. Similarly, study conducted on 465 sheep serum samples in Van province, reported just a 6.45% seropositivity rate (Akkan et al., 2009). In Istanbul province, a study conducted with 542 serum samples revealed a seroprevalence rate of 15.3% (Prezıuso et al., 2010), while Azkur et al. (2011) reported a seroprevalence of 19.4% in Kırıkkale. Yavru et al. (2012) detected a seropositivity rate of 2.90% in 1343 serum samples from enterprises in the Konya province. Albayrak et al. (2012) conducted a study in the Black Sea region, revealing a serosensitivity rate of 23.5% in 583 serum samples. Another similar study conducted in Afyonkarahisar reported a lower seroprevalence of around 5.7% (17/294) (Arık et al., 2015). Ün et al. (2018) determined a seroprevalence of 5.29% among 1096 sheep sera from different farms in Şanlıurfa province. Finally, in a study conducted most recently in Kars province in 2021, a 16% (32/200) seropositivity rate was revealed (Gezer et al., 2021).

This study investigated the seroepidemiology of MVV infection across six provinces in the Central Black Sea Region: Samsun, Sinop, Ordu, Giresun, Amasya, and Tokat. Our study showed 55.25% overall seroprevalence for MMV infection in this region, with Sinop exhibiting the highest seroprevalence at 80% and Giresun the lowest at 35%. Our findings indicate a notably higher seroprevalence of MVV infection in the Black Sea Region compared to previous studies conducted in Turkey. Moreover, this rate emphasizes a significant increase compared to the previous study by Albayrak et al. (2012) within the same region. This increase could be attributed to changes in animal populations over time and the introduction of new animals into the herds, especially from abroad.

MVV infection follows a persistent course and lacks an effective treatment, posing significant challenges for disease control. The virus establishes a permanent infection by integrating into the host genome, akin to other lentiviruses, and can mutate to evade neutralizing antibodies, making the efforts to control the disease more complicated. With no effective vaccine currently available, the emphasis lies on implementing robust control programmes to prevent the spread of the disease. In this context, we advocate for prioritizing prevention strategies to thwart disease introduction into herds. This necessitates sourcing animals from MVV-free herds as a primary measure to mitigate disease transmission.

Early diagnosis plays a pivotal role in controlling persistent infections, underscoring the importance of regular screening tests in large-scale enterprises and small family-run operations. So, prior to introducing new animals into the herd, rigorous testing for infection and subsequent quarantine until test results are obtained are imperative measures. Upon detection of infection, fast identification and elimination of the source should be the primary objective. In this regard, it is recommended to identify and segregate seropositive animals from the herd, and separate offspring born from infected mothers, raising them alone with the possibility of providing heat-treated colostrum feeding, because it is considered as the most

important transmission route of infection (Blacklaws et al., 2004). Moreover, selecting a breeding system appropriate for herd size is crucial, particularly in densely populated herds; also, for the control of horizontal transmission, semi-intensive or extensive feeding according to herd density instead of intensive feeding is an essential control measurement.

Based on the evidence that MVV can be transmitted via infected ram semen (Preziuso et al.,2003; Kalogianni et al.,2020), careful selection of breeding rams from infection-free herds is paramount to prevent transmission. Recent studies have shed light on resistant and susceptible genes associated with small ruminant lentiviruses, suggesting the possibility of the presence of some genes that may be resistant to this disease (Yaman et al., 2019; Riggio et al.,2023; Heaton et al.,2013; White and Knowles,2013). By leveraging the findings of these studies that highlighted the potential for genetic resistance against the disease, it may be feasible to to breed genetically resistant breeds, offering enhanced protection against MVV infection.

CONCLUSIONS

In conclusion, our study revealed the current status of MVV infection, which causes significant yield losses in small ruminants in the Black Sea Region. The data we obtained showed that the seroprevalence of the infection has increased and effective control methods should be taken to prevent the disease.

AUTHOR CONTRIBUTION

All authors contributed equally.

ETHICAL STATEMENT

Scientific rules, ethics and citation rules were followed during the writing process of the study titled " **Seroprevalence of Maedi-Visna Infection in Sheep in the Central Black Sea Region of Türkiye**"; There was no tampering with the data collected and this study was not sent to any other academic publication environment for evaluation. No ethical approval was required, as no animals were culled or treated during this study. Therefore, the study was not subject to ethics committee permission according to Article 2 (2) b, "Non-experimental clinical veterinary practices," of the Regulation on Working Procedures and Principles of Animal Experiments Ethics Committees by the Republic of Turkey Ministry of Agriculture and Forestry.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

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