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Seroprevalence of Bovine Viral Diarrhoea Virus, Bovine Herpesvirus Type 1 and Bovine Herpesvirus Type 4 infections in cattle in Ağrı Province, Eastern Anatolia Region, Turkey

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Abstract: This research was carried out to determine the seroprevalence of Bovine Viral Diarrhoea Virus (BVDV), Bovine Herpes Virus 1 (BoHV-1), and Bovine Herpes Virus 4 (BoHV-4) in cattle (n = 188) in Ağrı province of Eastern Anatolia Region, Turkey. The presence of BVDV, BoHV-1, and BoHV-4 antibodies in sera samples were determined by an ELISA test kit. It was determined that the highest seropositivity for BoHV-1 in Tutak disrict (9.9%), in ≤ 3 years age groups (3.39%), and in Simmental cattle (14.28%); for BoHV-4 in Doğubeyazıt disrict (4.16%), %), in ≤ 3 years age groups (1.70%), and in Simmental cross breed cattle (4.54%); for BVDV in Diyadin disrict (8.33%), in ≤ 3 years age groups (3.39%), and in Eastern Anatolian Red cattle (11.11%); for BoHV-1 + BoHV-4 in Hamur disrict (14.28%), in ≤ 3 years age groups (10.17%), and in Simmental cattle (14.28%); for BoHV-1 + BVDV in Tutak disrict (30.30%), in 6 > years age groups (18.46%), and in Holstein cross-breed cattle (25%); for BoHV-4 + BVDV in Patnos disrict (12.5%), in ≤ 3 years age groups (5.08%), and in Holstein cross-breed cattle (25%); for BoHV-1 + BoHV-4 + BVDV in Ağrı center (83.87%), in >3-6≤ years age groups (71.78%), and in Anatolian Black cross-breed cattle (100%) were found in the studied population. Rhinotracheitis and conjunctivitis were determined as the most common clinical signs in seropositive animals. In conclusion, the data obtained in this study showed that exposure to BoHV-1, BVDV and BoHV-4 agents were common among cattle in Ağrı province in the Eastern Anatolia Region of Turkey. Additionally, the highest positivity was determined in BoHV-1 + BoHV-4 + BVDV.

Key words: Bovine, Seroprevalence, BVDV, BoHV-1, BoHV-4, Ağrı

1. Introductıon

Bovine viral diarrhea (BVD), which is discovered by Cornell University researchers in 1946, is today one of the most important infectious diseases of cattle worldwide due to its animal health and economic importance [1, 2]. The agent is bovine viral diarrhea virus (BVDV) from the *Flaviviridae* family. There are 2 strains, cytopathogenic and non-cytopathogenic. Besides, BVDV-1 and BVDV-2 types exist as genotypes and subtypes. Non-cytopathogenic strains constitute 90% of the infections formed in field conditions. The virus is spread by the secretion, extract, and abortion material of cattle. Persistent infected calves are the main source of BVDV. Transmission occurs through respiratory, digestive, and genital routes [3]. The disease progresses in clinical and subclinical forms in cattle. The disease causes respiratory, digestive, and genital organ lesions, diarrhea, mucosal disease (MD), abortion, and also congenital defects, malformations, immunosuppression, and neonatal mortality in newborns [4].

Bovine Herpesvirus type-1 (BoHV-1) is a member of the Herpesviridae family *Alfaherpesvirinae* subfamily, and the *Varicellovirus* genus. It is one of the major pathogens of cattle worldwide and causes significant economic losses [5]. The clinical course of BoHV-1 infection varies depending on various factors, the main of them are virus strain and dose, route of transmission, immune status, and environmental factors [6]. Infection with BoHV-1 causes various clinical diseases, including infectious bovine rhinotracheitis (IBR) (BoHV-1 subtypes 1 and 2a), infectious pustular vulvovaginitis, infectious pustular balanoposthitis (BoHV-1 subtype 2b), and encephalitis (BoHV-1 subtype 3). IBR, which is among these diseases, can cause various clinical consequences including severe respiratory diseases, venereal diseases that reduce reproductive performance, and abortion [7]. Besides, like other herpes viruses, BoHV-1 can also cause long-term latent infections. All animals affected by BoHV-1 infection develop a latent infection following primary infection. This situation poses a constant danger to healthy herds. The virus can spread among cattle via aerosol, infected sperm, and embryos [8].

Bovine herpes virus type 4 (BoHV-4) is a member of the *Herpesviridae* family, *Gammaherpesviridae* subfamily,

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and *Rhadinovirus* genus. BoHV-4 does not have a close biological and virological relationship with other known herpes viruses of the *Bovidae* family [9]. Although cattle are the main host of BoHV-4, it is stated that various other ruminant species are also susceptible [10]. The virus has been isolated from clinically healthy infected cattle showing respiratory and ocular symptoms. Other distinct clinical findings are pneumonia, diarrhea, mastitis, abort, metritis, vulvovaginitis, encephalitis, skin lesions, and tumor in the bladder and the rumen [11, 12].

In the studies conducted in different countries around the world on BVDV, BoHV-1, and BoHV-4 seropositivity in cattle, while 1.2%–89.49% [13–22] seropositivity for BVDV, 14.88%–64.5% [23–26] for BoHV-1, and 1.8%–66% [27–29] for BoHV-4 was determined, these rates are 0.6%–96.8% [30–42] for BVDV, 4.05%–51.63% for BoHV-1 [43–46], and between 44% and 69% [47–50] for BoHV-4 in studies conducted in various cities in Turkey. Ağrı province, which is located in the Eastern Anatolia Region of Turkey is one of Turkey's most important livestock centers, whose economy is also based on the production and sale of agriculture and animal products [51]. There was no study found on seropositivity of related diseases in the Ağrı province of Turkey. Therefore, in the present study, it was aimed to determine the seropositivity of BVDV, BoHV-1, and BoHV-4 and to evaluate risk factors such as age, breed, presence of abortion, and the clinical findings related to the diseases or diseases experienced by the seropositive animals during their lifetime in cattle in Ağrı province of Eastern Anatolia Region, Turkey.

2. Materials and methods

2.1. Study area and animal

The study was carried out in 2017. In the study, 188 cows of different breeds and ages, living in the center and districts of Ağrı province, who were not vaccinated against BVDV and BoHV-4 (Ethics Committee Decision Number: 2016/83) were used. The animals included in the study were divided into 3 groups as ≤3, >3-6≤, and 6> according to their age. Besides, the information about whether their animals had symptoms of rhinotracheitis/conjunctivitis, abortus, metritis, arthritis, and enteritis recently, and whether the animals gave birth with an anomaly or not were gathered from the owners of the animals included in the study.

2.2. Sample collection

Blood samples were taken from the *vena jugularis* of the animals in 10 mL gel tubes (BD Vacutainer System, Plymouth, UK). After clotting at room temperature for 30 min and centrifugation (at 3000 rpm for 10 min) sera were carefully harvested and stored at –80° C until analysis.

2.3. Serological investigations

A commercial indirect ELISA test kit (BIO K 072 Abortion ELISA kit, Bio-X Diagnostics, Belgium) was used to determine the presence of antibodies against BVDV, BoHV-1, and BoHV-4 in sera samples obtained from animals. The analyzes were made in line with the manufacturer's recommendations.

2.4. Statistical analysis

Chi-square independence test was used to determine statistical significance between age groups, breeds, and clinical findings related to diseases or diseases that seropositive animals experience during their lifetime in BVDV, BoHV-1, and BoHV-4 seropositive cattle. The significant level was determined as $p < 0.05$. SPSS 20.0 package program was used in the analysis [52].

3. Results

The number of animals that were only BoHV-1 positive was determined as 5 (2.66%), the number of animals that were only BoHV-4 positive was 2 (1.06%), the number of animals that were only BVDV positive was 4 (2.12%), BoHV-1 + BoHV-4 positive animals were 14 (7.44%), BoHV-1 + BVDV positive animals were 27 (14.36%), BoHV-4 + BVDV positive animals were 6 (3.19%), the number of animals positive for BoHV-1 + BoHV-4 + BVDV was 128 (68.08%). The seropositivity rates according to the districts were given in Table 1.

When seropositivity was evaluated according to age, the highest BoHV-1, BoHV-4, BVDV, BoHV-1 + BoHV-4, BoHV-4 + BVDV positivity was found to be in the ≤3 age group, the highest BoHV-1 + BVDV positivity was found to be in the 6> age group, the highest BoHV-1 + BoHV-4 + BVDV positivity was found to be in the >3-6≤ age group. It was determined that there was no statistically significant difference between age-dependent groups ($p > 0.05$). The distribution of seropositivity rate by age was given in Table 2.

When the animals included in the study were examined in terms of seropositivity according to their breeds, only BoHV-1 positivity was the highest in Simental cattle (14.28%), only BoHV-4 positivity was the highest in Simental crossbred cattle (4.54%), only BVDV positivity was the highest in Eastern Anatolian Red cattle (11.11%), BoHV-1 + BoHV-4 positivity was the highest in Simental cattle (14.28%), BoHV-1 + BVDV and BoHV-4 + BVDV positivity was the highest in Holstein crossbred cattle (25%), BoHV-1 + BoHV- 4 + BVDV positivity was found to be the highest (100%) in Yerlikara cross-breed cattle. It was determined that there was no statistically significant difference between breed groups ($p > 0.05$). The seropositivity rates according to the breeds were given in Table 3.

In the animals included in the study, when the clinical findings related to the diseases or diseases experienced by the seropositive animals during their lifetime were evaluated according to the anamnesis information

Table 1. The seropositivity rates according to the districts.

Disrict	Negative (%)	BoHV-1 (%)	BoHV-4 (%)	BVDV (%)	BoHV-1 + BoHV-4 (%)	BoHV-1 + BVDV (%)	BoHV-4 + BVDV (%)	BoHV-1 + BoHV-4 + BVDV (%)
Ağrı Center (n = 31)	-	-	-	1 (3.22)	-	4 (12.90)	-	26 (83.87)
Tutak (n = 33)	-	3 (9.09)	1 (3.03)	-	3 (9.09)	10 (30.30)	-	16 (48.48)
Taşlıçay (n = 24)	-	-	-	1 (4.16)	1 (4.16)	3 (12.5)	1 (4.16)	18 (74)
Hamur (n = 28)	1 (3.5)	2 (7.14)	-	-	4 (14.28)	1 (3.5)	-	20 (71.42)
Patnos (n = 24)	1 (4.17)	-	-	-	3 (12.5)	2 (8.33)	3 (12.5)	15 (62.5)
D.beyazıt (n = 24)	-	-	1 (4.16)	-	3 (12.5)	2 (8.33)	2 (8.33)	16 (66.66)
Diyadin (n = 24)	-	-	-	2 (8.33)	-	5 (20.83)	-	17 (70.83)

BoHV-1: Bovine Herpes Virus-1, BoHV-4: Bovine Herpes Virus-4, BVDV: Bovine Viral Diarrhoea Virus, D.beyazıt: Doğubeyazıt.

Table 2. The seropositivity rates according to the age.

Age (Year)	Negative (%)	BoHV-1 (%)	BoHV-4 (%)	BVDV (%)	BoHV-1 + BoHV-4 (%)	BoHV-1 + BVDV (%)	BoHV-4 + BVDV (%)	BoHV-1 + BoHV-4 + BVDV (%)
≤3 (n = 59)	2 (3.39)	2 (3.39)	1 (1.70)	2 (3.39)	6 (10.17)	8 (13.55)	3 (5.08)	35 (59.32)
>3-6≤ (n = 64)	-	2 (3.12)	1 (1.56)	-	5 (7.81)	8 (12.5)	2 (3.12)	46 (71.88)
6> (n = 65)	-	1 (1.54)	-	2 (3.07)	3 (4.61)	12 (18.46)	1 (1.54)	46 (70.77)
Chi-Square value = 12.250				P>0.05				

BoHV-1: Bovine Herpes Virus-1, BoHV-4: Bovine Herpes Virus-4, BVDV: Bovine Viral Diarrhoea Virus.

obtained from the animal owners, it was determined that rhinotracheitis/conjunctivitis and enteritis were the most common in BoHV-1 and BoHV-4 positive animals; rhinotracheit / conjunctivitis was the most common in BVDV, BoHV-1 + BoHV-4 and BoHV-1 + BVDV positive animals; enteritis was the most common in BoHV-4 + BVDV positive animals; rhinotracheit / conjunctivitis was most common in BoHV-1 + BoHV-4 + BVDV positive animals. It was determined that there was no statistically significant difference between the groups depending on the clinical symptoms ($p > 0.05$). Besides, it was learned that none of the animals were vaccinated against the related diseases, and animals entered all of the herds/barns where the animals included in the study live from time to time. Clinical findings of the diseases or diseases experienced by the seropositive animals during their lifetime were given in Table 4.

4. Discussion

The production and performance of animals are mainly based on their health status. Viral diseases, yield loss, treatment costs, threaten animal health, and cause serious economic loss due to persistent infected animals. BVDV, BoHV-1, and BoHV-4 are the main viral agents. Therefore, conducting herd, province and country-based prevalence studies in combating these diseases are

Table 3. The seropositivity rates according to the breeds.

Breeds	Negative (%)	BoHV-1 (%)	BoHV-4 (%)	BVDV (%)	BoHV-1 + BoHV-4 (%)	BoHV-1 + BVDV (%)	BoHV-4 + BVDV (%)	BoHV-1+ BoHV-4 + BVDV (%)
Simmental cross-breed (n = 44)	-	2 (4.54)	2 (4.54)	1 (2.27)	5 (11.36)	6 (13.63)	-	28 (63.63)
Simmental (n = 7)	-	1 (14.28)	-	-	1 (14.28)	-	-	5 (71.42)
Eastern Anatolian Red (n = 18)	-	-	-	2 (11.11)	1 (5.55)	2 (11.11)	2 (11.11)	11 (61.11)
Eastern Anatolian Red cross-breed (n = 15)	-	-	-	-	1 (6.66)	2 (13.3)	-	12 (80)
Brown Swiss cross-breed (n = 82)	1 (1.23)	2 (2.47)	-	1 (1.23)	4 (4.88)	16 (19.51)	2 (2.47)	56 (68.29)
Anatolian Black (16)	1 (6.25)	-	-	-	1 (6.25)	-	1 (6.25)	13 (81.25)
Anatolian Black cross-breed (2)	-	-	-	-	-	-	-	2 (100)
Holstein cross-breed (n = 4)	-	-	-	-	-	1 (25)	1 (25)	2 (50)
Chi-Square value = 47.376				P>0.05				

BoHV-1: Bovine Herpes Virus-1, BoHV-4: Bovine Herpes Virus-4, BVDV: Bovine Viral Diarrhoea Virus.

Table 4. Clinical findings related to diseases or diseases that seropositive animals experience during their lifetime.

Clinical Finding	Negative	BoHV-1	BoHV-4	BVDV	BoHV-1 + BoHV-4	BoHV-1 + BVDV	BoHV-4 + BVDV	BoHV-1 + BoHV-4 + BVDV
Rhinotracheitis Conjunctivitis	-	4	2	3	5	16	3	116
Abortus	-	-	-	-	-	-	-	-
Metritis	-	-	-	-	-	2	-	17
Arthritis	-	1	-	2	1	5	1	17
Enteritis	1	4	2	2	3	12	4	87
Birth Anomaly	-	-	-	-	-	-		1
No Symptoms	1			2	4	5	2	20
Chi-Square value = 26.075				P>0.05				

BoHV-1: Bovine Herpes Virus-1, BoHV-4: Bovine Herpes Virus-4, BVDV: Bovine Viral Diarrhoea Virus.

important in revealing the real conditions of the related diseases and in establishing/determining eradication and control programs. There is no study made on the subject in Turkey's Ağrı province. Therefore, in the presented study, it was aimed to determine the seroprevalence of BVDV, BoHV-1, and BoHV-4 in cattle in the Ağrı region.

In studies on BVDV on the seropositivity in different countries around the world, seropositivity was determined as 36.22% in Equator, 100% in Bangladesh, 14.18%–89.49% in China, 1.2% in America, 68.33% in Iran, 12.4% in Hungary, 33.2% in Malaysia, 3.3%–10% in Nepal, 53.3% in Botswana, 23.7% in Korea [13–22]. In studies conducted in various provinces of Turkey, the seropositivity was determined as 79.2%–96.8% in Eastern and Southeastern Anatolia, and in another study conducted across 26 dairy herds in different regions of Turkey, the seropositivity

was determined as 0.6%–70%, 89.8% in Konya, 1.27% in Bursa, 75.22% in Isparta, 5.5% in Erzurum, 38.09% in Bingöl, 77.75% in Malatya, 89.85% in Kars,14.6% in Gökçeada, 53.19% in Samsun and its surroundings, 41.4% in the Marmara Region, in another study covering Kars, Iğdır and Ardahan provinces, the seropositivity was determined as 58.86%, and in a study covering 9 provinces in the Southeastern Anatolia region (Adıyaman, Batman, Diyarbakır, Gaziantep, Mardin, Kilis, Siirt, Şanlıurfa, and Şırnak), the seropositivity was determined as 48.05% [30–42]. In the study presented, only BVDV, BoHV-1 + BVDV, BoHV-4 + BVDV, and BVDV + BoHV-1 + BoHV-4 seropositivity were determined as 2.12%, 14.36%, 3.19%, and 68.08% respectively. Besides, the findings obtained from the study showed that the majority of BVDV seropositive animals were also seropositive in terms of other infections. It is thought that this situation may be caused by the immunosuppressive feature of BVDV as reported by the researchers [41]. Çabalar and Karaoğlu [30] indicate that BVD disease remains endemic in cattle in Turkey, and they indicate that the majority of animals are seropositive. The above literature data and the data obtained from the presented study support this information.

Although different results were obtained in the assessment made according to age in studies investigating BVDV seropositivity in cattle, it was stated that the evidence emerged in most of these studies was that the seropositivity increased with the increase of age, and the possible reason for this was the increase in the risk with the increase of age [17, 19, 34]. Contrary to these reports, Elhassan et al. [53] and Wilson et al. [16] reported that there was no significant difference between ages in seropositive animals. In the presented study, only the age groups of BVDV positive animals were ≤3 and 6>, and the seropositivity rate in these groups was determined as 3.39% and 3.07%, respectively, and, as Elhassan et al. [53] and Wilson et al. [16] stated, there has been no significant difference between age groups in positive animals determined.

When the seropositivity against BVDV is evaluated according to the breeds, studies are indicating that there is a statistically significant difference between the breeds [34, 54]. Besides, it has been reported that pure breeds produce serum neutralized antibodies against the agent, patients recover in a short time and the disease progresses subclinically [55]. In their study on cattle, Daves et al. [19] found that culture breeds were more susceptible to disease than indigenous breeds. In the presented study, although it was not statistically significant, it was determined that seropositivity against only BVDV was higher in pure breeds.

When the diseases or disease symptoms shown by animals that are seropositive against BVDV in their past are evaluated, Yıldırım et al. [50] found BVDV positivity as 52.9% in their study on cattle with a history of abortus. Gürses [56] found that BVDV positivity was 96.11% in his study in cattle with a history of respiratory system disease symptoms. Şimşek et al. [57] found BVDV seropositivity as 71.56% in a study they conducted on 109 cattle showing symptoms of respiratory and digestive system diseases. Consistent with this report, it was determined in this study that BVDV seropositive animals showed the most symptoms of respiratory and digestive system diseases, but there was no significant difference between clinical symptoms.

BoHV-1 is the causative agent of an acute, febrile, and infectious disease that causes serious economic losses up to 100% morbidity, and 20-30% mortality in dairy farms [58]. Studies have been conducted on the seroprevalence of BoHV-1 in cattle in different countries of the world, and, in these studies, the seropositivity was determined as 14.88% in India, 27.68% in Iran, 59% in Brazil, 64.5% in Mexico [23–26]. It was determined as 19.5% in Aydın, 51.63% in Kayseri, 9.25 % in Burdur, 4.05% in Denizli, 61.4% in Kars; in another study covering the provinces of Kars, Iğdır, and Ardahan, it was determined as 61.50%, and, in another study covering 9 provinces in the Southeastern Anatolia Region (Adıyaman, Batman, Diyarbakır, Gaziantep, Mardin, Kilis, Siirt, Şanlıurfa and Şırnak), it was determined as %40.11 [41–46, 50]. In this study, the seropositivity rate only BoHV-1, BoHV-1 + BoHV-4, and BoHV-1 + BoHV-4 + BVDV were determined as 2.66%, 7.44%, and 68.08% respectively.

Different results have emerged in studies evaluating seropositivity against BoHV-1 according to age. Ezzi et al. [59] determined that as age increases, positivity against BoHV-1 also increases. Similar results have been obtained in other studies on the subject [26, 60, 61]. Samrath [60] stated that higher seropositivity in elderly animals may be caused by the virus being latent after primary infection and reactivation and decreased immune status under stress or old age. In the present study, in contrast to the above reports, only the animals with positive against BoHV-1 were found to be 3.39% in the ≤3 age group, 3.12% in the >3-6≤age group, and 1.54% in the 6> age group, and it was determined that these differences were found to be statistically not significant.

In studies where seropositivity against BoHV-1 was evaluated according to breeds; Elhassan et al. [53] explained that there was no significant relationship between breed and seropositivity, and the reason for this was that animals living in the same conditions had an equal risk of getting the infection. Contrary to this report, Samrath [60] reported that the rate is low in indigenous and undefined

breeds, which may be due to their relatively high resistance to diseases and their better adaptation to environmental conditions. In the study presented in accordance with the report of Samrath [60], it was determined that positivity was higher in pure breeds, although it was not statistically significant.

When the diseases or disease symptoms of animals that are seropositive against BoHV-1 were evaluated, different clinical symptoms were obtained. Namely, Samrath [60] stated that 44.58% of the seropositive animals did not have any clinical symptoms, but 24.46% of the positive animals had various clinical symptoms, and the highest clinical symptoms were conjunctivitis and rhinitis; he found that infertility, rhinitis, abortus, anoestrus, conjunctivitis, and retentio secundinarum follow these clinical symptoms. On the other hand, Queiroz-Castro et al. [62] determined that the biggest clinical problem in the history of seropositive animals is reproductive problems. It is stated that the high level of seropositivity in animals that do not show any signs of the disease may have been formed due to latent infection in the form of a persistent virus [63]. In this study, it was determined that animals that were only seropositive to BoHV-1 had clinical findings related to the respiratory and digestive systems mostly, although they were not statistically significant in their history. Similarly, Şimşek et al. [64] found BoHV-1 seropositivity as 47.71% in a study they conducted on 109 cattle showing symptoms of respiratory and digestive system diseases. One of the most important risk factors for BoHV-1 is direct and long-term contact with animals in the herd with animals that are purchased and included in the herd and whose history is unknown [64]. In accordance with these statements, it was learned that all animals included in the study presented were purchased and included in the herd in the barn/herds over time.

In studies conducted worldwide on the seroprevalence of BoHV-4 in cattle, the seropositivity was determined as 1.8%–66% in Brazil, 21% in Serbia, and 22.3% in America [27–29]. On a few studies conducted on bovine seropositivity of BoHV-4 in Turkey, positivity was determined at varying rates between 44% and 69% [47–50]. In the presented study, only BoHV-4, BoHV-1 + BoHV-4, BoHV-4 + BVDV, and BoHV-1 + BoHV-4 + BVDV seropositivity were determined as 1.06%, 7.44%, 3.19%, and 68.08% respectively.

When the relationship between positivity and age in animals that are seropositive to BoHV-4 is evaluated, Dağalp et al. [47] found that seropositivity increases with age and that seropositivity is higher in the elderly compared to the young animals. Guo et al [65] and Elhassan et al. [53] also obtained similar results in their studies. Kale et al. [49] found in their study that there was no significant difference between BoHV-4 and age. In this study, only BoHV-4 seropositivity was determined in the ≤3 and >3-6≤ age groups, and the rates were found to be similar. Besides, it was determined that there was no statistically significant difference.

There are scarcely any studies conducted to reveal the relationship between BoHV-4 seropositivity and breed. Elhassan et al. [53] found that there was no significant difference on the subject. In this study, although it was not statistically significant, it was determined that seropositivity against BoHV-4 was higher in pure breed animals.

There are a few studies evaluating the diseases or disease symptoms of animals that are seropositive against BoHV-4. It has been reported that seropositivity is observed equally in healthy animals and animals with the reproductive disease, and the probable reason for this may be due to the high level of subclinical course of BoHV-4 [47]. Yıldırım et al. [50] found antibody positivity against BoHV-4 as 29.3% in their study on cattle with a history of abortion. In this study, it was determined that animals that were only seropositive to BoHV-4 had clinical findings related to respiratory and digestive systems mostly in their history, although they were not statistically significant.

As a result, the data obtained in this study showed that exposure to BoHV-1, BVDV, and BoHV-4 infection is common in cattle in Ağrı province located in eastern part of Turkey, the percentage in seropositivity is too high where a combination of all three factors exist together, there was no breed and age predisposition in single or combined appearance. Therefore, it was concluded that immunization and biosecurity measures should be determined and implemented for the eradication and control of the infections caused by the relevant factors.

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