INTRODUCTION

Bovine herpesvirus 1 (BoHV-1) is classified in the Varicellovirus genus in the subfamily Alphaherpesvirinae of the family Herpesviridae. There are three subtypes of BoHV-1. Subtypes 1 and 2a cause respiratory symptoms and abortions. Subtype 2b results in Infectious Pustular Vulvovaginitis/Infectious Balanopostitis (IPV-IPB) characterized by genital lesions (Yilmaz et al., 2016). The clinical onset of the infection changes with the subtypes of virus, virulence and the immune status of the host (Queiroz-Castro et al., 2019). The BoHV-1 virion is 150-200 nm in diameter and has an icosahedral capsid consisting of 162 capsomeres. It is enveloped. It has an infectious genome with a linear double strand of 136 kbp, containing at least 65 genes. The entry of the virus into the cell is governed by membrane glycoproteins (gB, gC, gD). Like other herpes viruses, BoHV-1 becomes latent in the trigeminal and sacral ganglia following primary infection, and reactivates later in stressful conditions like pregnancy, transplantation, corticosteroid administration etc. The recurrent infection period includes infective virus scattering with clinical findings (Kaddour et al., 2019).

BoHV-4 is an agent classified in the Gammaherpesvirinae subfamily of the Herpesviridae family and in the Rhadinovirus genus. The agent has an icosahedral nucleocapsid having a diameter of 150 nm and contains double stranded DNA. The antigenic and biological relation of BoHV-4 with other common bovine herpesviruses has not been determined (Roizman et al., 1992). Clinically, it can cause mastitis, peritonitis, vulvovaginitis, metritis, der-
matitis, respiratory problems and abortions (Wellenberg et al., 2001), and it also can be isolated from materials of healthy-looking cattle (Yang et al., 2019). Endometritis causes economic losses due to decreasing reproductive performance, increasing feed intake, decreasing milk yield. It also affects the animal welfare negatively.

The PCR technique used to detect BoHV-4 viral DNA is a specific and sensitive method. Glycoprotein B is an essential protein in viral infectivity and is the most important component of virion for BoHV-4 (Lomonte et al., 1997). This indicates that the gB gene is present in all BoHV-4 strains. Wellenberg et al. (2001) found that viral DNA can be detected by gB PCR when there is 2–10 BoHV-4 DNA copies in a clinical sample. The same researchers reported the sensitivity of the gB PCR and virus isolation methods as 93% and 61%, respectively.

Endometritis is an important problem in cattle in both the North-eastern Anatolia and Turkey. Especially, endometritis rate caused by viral agents is dramatically increasing in the recent years. This study investigated the presence of BoHV-1 and BoHV-4 nucleic acids in leukocyte samples obtained from small-scale family farms in the province of Kars, Turkey. PCR was used for the detection of gC and gB genes of BoHV-1 and BoHV-4, respectively. This study was performed to assess the etiological role of the virus in the cases of endometritis.

MATERIAL AND METHODS

ETHICS STATEMENT

This research was conducted after the approval of Kafkas University Animal Experiments Local Ethics Council (Approval Number: KAU- HADYEK-2015-070).

STUDY AREA AND SAMPLE COLLECTION

This study was conducted in Kars region in Northeast part of Turkey. The Kars region, located in Northeastern Turkey (43.05° E and 40.36° N), is the most important livestock production area in Turkey. It is a mountainous area and has a cold climate (Figure 1). Leukocyte samples were obtained from 100 cattle with clinically endometritis aged above 3 years between November in 2017 to March in 2018 from small scale family farms (less than twenty cattle) in Kars district in Turkey. The cattle included in the study were not vaccinated against BoHV-1 and BoHV-4. The diagnosis of endometritis was done by rectal and vaginoscopic examination. In these examinations, the appearance of the uterus, the character and quantity of uterine influx were considered. Blood samples were taken from the vena jugularis to EDTA tubes. The peripheral blood samples in EDTA tubes were centrifuged at 2000 x rpm for 20 min and leukocyte fractions were collected with Pasteur pipettes and resuspended in 2 ml PBS.

DNA EXTRACTION AND PCR TECHNIQUE

From leukocyte samples, viral DNA was extracted using a GeneJet Viral DNA and RNA Purification Kit (Thermo Scientific, Waltham, MA, USA), according to the manufacturer’s recommendation. The detection of BoHV-1 DNA was performed using the BoHV1-glycoprotein C (gC) PCR as described by Van Engelenburg et al. (1993). The primer pair (P1: 5’-CTGCTTGTCATAGCCCA-CAACG-3’), and (P2: 5’-TGTGACCTTTGCGATGCCATGTCGC-3’), produced a 173 bp fragment. The detection of BoHV-4 DNA was performed using the BoHV4-glycoprotein B (gB) PCR as described by Wellenberg et al. (2001) with some modifications. The primer pair (B1:5’-CCCTTCTTTACCACCATCCTACA-3’) and (B2:5’-TGCCATAGCACGAAAACATGA-3’) produced a 615 bp fragment. The reaction mix contained 2.5 U Taq polymerase, 3.5 mM dNTP mix, primers at 10 pmol concentrations, 1.5 mM MgCl2, 1X PCR buffer, 6% DMSO and DNase/RNase free water. Thermal cycling conditions were 6 min at 96°C followed by 40 cycles at 95°C for 1 min, 56°C for 45 sec, 72°C for 2 min and followed by a final 10 min extension at 72°C for both primer sets. Five microlitres of each PCR product were analyzed on 1% agarose gel containing ethidium bromide (Sigma, USA). The gels were read for specific size bands by UV transillumination. BoHV-4 DN-599 strain and BoHV-1 Cooper strain were used as control viruses for PCR. Reference virus strains were kindly obtained from the Ankara University Faculty of Veterinary Medicine Virology Department.

RESULTS AND DISCUSSION

A total of 100 leukocyte samples were analyzed by PCR. BoHV-4 DNA was detected in 42% (42/100) of leuko-
BoHV-1 infection is still widespread worldwide (Ferreira et al., 2018; Mendes et al., 2018), but eradication studies have been performed and being performed in many European countries. BoHV-1, is reported to have high seroprevalence in cattle in Turkey, ratios of up to 100% have been reported (Alkan et al., 1997; Yavru et al., 2001; Tan et al., 2006; Yildirim et al., 2009). Cabalar (1993) investigated the role of BoHV-1 infection in Turkey’s different regions where fertility problems exist in cows and found seropositivity rate of 68.1% despite not being able to isolate the virus. Özkul et al. (1995) reported that BVDV and BoHV-1 caused a combination infection in 45.9% of the cows with genital tract problems investigated in 19 dairy cattle farms. In a few European countries such as Denmark, Sweden and Finland, which take place in the European Union, vaccination is prohibited, and a program based on the removal of seropositive animals for BoHV-1 specific antibodies from the herds is carried out to eradicate the infection. In some countries such as Austria and the Netherlands, a national eradication program based on vaccinating with a marker vaccine. This allows distinguishing of naturally infected animals and animals vaccinated with marker vaccines. Naturally infected animals are removed from herds at an economically acceptable level (Kofer et al., 1999; Van Schaik et al., 2001).

BoHV-4 infection was detected in Africa, several European countries and the United States (Mohanty et al., 1971; Truman et al., 1986; Van Malderen et al., 1987; Graham et al., 2005; Monge et al., 2006). The presence of BoHV-4 infection in different clinical symptoms has been reported (Fittion et al., 1990; Wellenberg et al., 2000; Graham et al., 2005; Monge et al., 2006) but could not be associated with the role as etiological agent. In a comparative study in animals with and without genital duct problems, Biuk-Rudan et al. (1998) found that the seroprevalence of BoHV-1 was 80.8% in animals with genital canal problems and in 46.8% of patients without genital canal problems. Frazier et al. (2002) reported endometritis cases associated with BoHV-4 in the USA. Monge et al. (2006) found that BoHV-4 was an important factor in postpartum metritis cases in Spain. Deim et al. (2007) reported that the virus plays an active role in genital tract problems. Wellemans et al. (1986) reported that after experimental inoculation of BoHV-4, long-lasting metritis was observed in cattle and deaths with unknown etiology were detected in the study. Wellenberg et al. (2001) found that BoHV-4 was an important factor in mastitis cases. Izumi et al. (2006) reported BoHV-4 detection in teat lesions.

Bilge Dağalp et al. (2010) demonstrated the presence of BoHV-4 infection serologically and virologically in a farm with metritis problems in Turkey. Bilge Dağalp et al. (2012) investigated the presence of BoHV-1 and BoHV-4 nucleic acid in 13 different dairy cattle farms using gC PCR and gB PCR techniques in leukocyte samples, vaginal swabs and waste fetuses belonging to cattle with reproductive disorders. While BoHV-1 was not detectable, positivity for BoHV-4 gB gene was 26.1% and 33.6% in vaginal swab and leukocyte samples, respectively. Sevik and Avci (2015) tested organ samples (lungs, liver and spleen) in aborted small ruminant fetuses (43 sheep and 23 goats) with glycoprotein D (gD) gene-specific PCR technique and were not able to detect BoHV-1 presence.

In this study, PCR was used for the detection of gC and gB genes of BoHV-1 and BoHV-4, respectively. As a result of our study, BoHV-1 could not be detected in cattle with endometritis. In contrast, 42% (42/100) of the sam-
BoHV-4 has been shown to cause persistent infection and suppress the immune response (Klamminger et al., 2017). This effect of the virus affects the defense of animals against other pathogens during acute and latent BoHV-4 infection. In some cases, BoHV-4 causes persistent infection in leukocytes, splenic macrophages and endothelial cells (Tebaldi et al., 2016; Klamminger et al., 2017; Yang et al., 2017) and may be reactivated in tissues by administration of dexamethasone (Castrucci et al., 1987). Researchers (Wellemans et al., 1986; Monge et al., 2006) also reported that pregnancy may cause BoHV-4 reactivation and emphasized the importance of this in the onset of postpartum metritis.

Consequently, this study demonstrates that BoHV-4 plays an important etiological role in cases of endometritis. Small family farms with endometritis should be periodically checked for viral agents that cause endometritis. Furthermore, genomic identification of the BoHV-4 strains obtained from this study will play an important role in future studies on protection and control strategies to combat and prevent the spread of infection.

ACKNOWLEDGEMENT

This project was supported by the Commission for the Scientific Research Projects of Kafkas University (KAU BAP-2015-TS-81).

CONFLICT OF INTEREST

There is no conflict of interest.

AUTHORS CONTRIBUTION

All authors contributed equally.

REFERENCES

- Ackerman M, Wyler R (1984). The DNA of an IPV strain of Bovid Herpesvirus 1 in sacral ganglia latency after intravaginal infection. Vet. Microbiol. 3: 53-63. https://doi.org/10.1016/0378-1135(84)90078-6
- Alkan F, Özkul A, Karaoğlu MT, Bilge S, Akça Y, Burgu İ, Yeşişlağ K, Oguçoğlu TC (1997). Seroepidemiological studies on respiratory infections of cattle caused by viruses. AÜ Vet. Fak. Derg. 44: 1: 73–80.
- Aslan ME, Azkur AK, Gazyagci S (2015). Epidemiology and genetic characterization of BVDV, BHV-1, BHV-4, BHV-5 and Brucella spp. infections in cattle in Turkey. J. Vet. Med. Sci. 14: 0167. https://doi.org/10.1292/jvms.14-0167
- Bilge Dagalp S, Güngör E, Demir AB, Oguçoğlu C, Yılmaz V, Pınar D, Ataseven VS, Alkan F (2010). The investigation of the presence of bovine herpesvirus type 4 (BoHV-4) in cows with metritis in a dairy herd. AÜ Vet. Fak. Derg. 57: 2: 87-91. https://doi.org/10.1501/Vetfak_0000002316
- Bilge Dagalp S, Alkan F, Çalışkan E, Yüldirım Y, Oguçoğlu TC, Can Sahna K, Burgu İ (2012). The investigation of the herpesviruses (BoHV-1 and BoHV-4) on the occurrence of the reproductive disorders in dairy cattle herds, Turkey. Revue Med. Vet. 163: 4: 206-211.
- Biuk–Rudan N, Cvetnik S, Madic J, Rudan D (1998). Prevalence of antibodies of to IBR and BVD viruses in dairy cows with reproductive disorders. Theriogenology. 51:875-881. https://doi.org/10.1016/S0093-691X(99)00034-5
- Çabalar M (1993). The isolation and seroepidemiological studies of IBR/IPV virus on cows with fertility problems. AÜ Saglık Bilimleri Enstitüsü, Doktora tezi.
- Castrucci G, Frigeri F, Ferrari M, Pedini B, Aldrovandi V, Cilli V, Rampichini I, Gatti R (1987). Reactivation in calves of latent infection by bovine herpesvirus-4. Microbiologia. 10: 37-45.
- Deim Z, Szeredi L, Tompo V, Eugy L (2007). Detection of bovine herpesvirus 4 in aborted bovine placentas. Mic. Pathol. 41:144-148. https://doi.org/10.1016/j.micpath.2006.03.006
- Ferreira HCC, Campos MG, Vulgal PMP, Santos MR, De Carvalho OV, Bressan GC, Junor AS (2018). Latent bovine herpesvirus 1 and 5 in milk from naturally infected dairy cattle. J. Vet. Med. Sci. 80. 11: 1787-1790. https://doi.org/10.1292/jvms.17-0062
- Fitton J, Beenham J, Edwards S (1999). Bovine herpesvirus-4 antibody in cattle in Great Britain. Vet. Rec. 126-173.
- Frazier K, Baldwin CA, Pence M, West J, Bernard J, Liggett A, Miller D, Hines ME (2002). Seroprevalence and comparison of isolates of endometriotropic bovine herpesvirus-4. J. Vet. Diag. Invest. 14: 457-462. https://doi.org/10.1177/104063870201400602
- Graham DA, McNelll GJ, Calvert V, Mawhinney K, Curran W, Ball NW, Todd D, (2005). Virological and serological evidence of bovine herpesvirus type 4 in cattle in Northern Ireland. Vet. Rec. 29: 539-543. https://doi.org/10.1136/vr.157.18.539
- Izumi Y, Taduku S, Murakami K, Tsboi T, Konishi M, Harirani M, Kaniyoshi T, Kimura K, Sentmsi H (2006). Characterization of Bovine Herpesvirus Type 4 isolated from cattle with mastitis and subclinical infection by the virus amongst cattle. J. Vet. Med. Sci. 68 (2): 189-193. https://doi.org/10.1292/jvms.68.189
- Kadzorz A, Bouyoucef A, Fernandez G, Prieto A., Geda F, Moula N (2019). Bovine herpesvirus 1 in the northeast of Algiers, Algeria: Seroprevalence and associated risk factors in dairy herd. J. Adv. Vet. Anim. Res. 6 (1): 60-65. https://doi.org/10.5455/javar.2019.012
- Klamminger S, Prunner I, Giuliodori M, Drillisch M (2017). Uterine infection with bovine herpesvirus type 4 in dairy cows.
Lomonte P, Filee P, Lyaku JR, Bublot M, Pastoret PP, Thiry
Mendes VR, Costa EP, Queiroz VL, Silva Júnior A, Alves SV,
Mohanty SB, Hammond RC, Lillie MG (1971). A new bovine
Monge A, Elvira L, Gonzalez JV, Astiz S, Wellenberg GJ
Ozkul A, Çabalar M, Bilge S, Akça Y, Burgu I (1995). The role
Sevik M, Avci, O (2015). Molecular detection of Bovine
Tan MT, Yıldırım Y, Erol N, Güngör B (2006). The
Timurkan, M. Ö., Aydın, H. (2019). Increased genetic diversity
Truman D, Ludwig H, Storz J. (1986). Bovine herpesvirus type
Dohanik VT, Santos MR, Silva-Júnior A (2019). Detection of
Van Engelenburg FAC, Maes RK, Van Oirschot JT, Rijssijkew FAM (1993). Development of a rapid and sensitive polymerase chain reaction assay for detection of bovine herpesvirus type 1 in bovine semen. J. Clin. Microbiol. 31: 3129-3135. https://doi.org/10.1128/JCM.31.12.3129-3135.1993
Van Malderen G, VanOpdenbosch E, Wellemans G (1987). Bovine herpesvirus 1 and 4: A seroepidemiological survey of the Belgian cattle population. VI. Diergeneesk. Tijdschr. 56, 364-371.
Van Schaik G, Schukken YM, Nielen M, Dijkhuizen AA, Benedictus G (2001). Risk factors for introduction of BHV1 into BHV1-free Dutch dairy farms: a case-control study. Vet. Quart. 23: 71-76. https://doi.org/10.1080/01652176.2001.9695085
Wellenberg GJ, Van Der Poel WHM, Van Der Vorst TJK, Van Valkengoed PHR, Schukken YH, Wagenaar F, Van Oirschot JT (2000). BHV-4 in bovine clinical mastitis. Vet. Rec. 147: 222-225. https://doi.org/10.1126/vz.147.8.222
Wellenberg GJ, Verstraten E, Belak S, Verschuren FAM, Rijssijkew R, Peshev R, Van Oirschot JT (2001). Detection of bovine herpes virus 4 glycoprotein B and thymidine kinase DNA by PCR assays in bovine milk. J. Virol. Methods. 97: 101-112. https://doi.org/10.1016/S0166-0934(01)00341-X
Wellemans G, Van Opdenbosch E, Mammernicks M (1986). Experimental inoculation of Bovine Herpes Virus 4 (Strain LVR 140) in pregnant and nonpregnant cows. Ann. Rech. Vet. 17 (1): 89-94.
Yang B, Li Y, Bogado Pascottini O, Xie J, Wei R, Opsomer G, Nauwynck H (2017). Primary replication and invasion of the bovine gammaherpesvirus BoHV-4 in the genital mucosa. Vet. Res. 48, 1, 83. https://doi.org/10.1186/s13567-017-0489-3
Yang B, Pascottini, OB, Xie J, Desmarets L, Cu, T, Opsomer G, Nauwynck, HJ (2019). Presence of gammaherpesvirus BoHV-4 in endometrial cytology samples is not associated with subclinical endometritis diagnosed at artificial insemination in dairy cows. Vet. Microbiol. 229: 130-137. https://doi.org/10.1016/j.vetmic.2018.12.025
Yavru S, Öztürk F, Simşek A, Yapıkçı O, Yıldız C (2001). Isolation of bovine herpes virus type-1 from bovine semen. Revue Med. Vet. 152, 8-9: 633-636.
Yıldırım Y, Yilmaz V, Desmarets L, Cu, T, Opsomer G, Nauwynck, HJ (2019). Presence of gammaherpesvirus BoHV-4 in endometrial cytology samples is not associated with subclinical endometritis diagnosed at artificial insemination in dairy cows. Vet. Microbiol. 229: 130-137. https://doi.org/10.1016/j.vetmic.2018.12.025
Yavru S, Öztürk F, Simşek A, Yapıkçı O, Yıldız C (2001). Isolation of bovine herpes virus type-1 from bovine semen. Revue Med. Vet. 152, 8-9: 633-636.
Yıldırım Y, Yilmaz V, Faraji Majarashin AR (2009). Seroprevalence of Viral Respiratory System Infections in Cattle in the Border Provinces of North-East Turkey. Kafkas Univ. Vet. Fak. Derg. 15 (4): 601-606. https://doi.org/10.9775/kvfd.2009.078-A
Yilmaz V, Coskun N, Sahin M (2016). Molecular detection of Bovine Herpes Virus-1 (BoHV-1), Bovine Herpes Virus-4 (BoHV-4) and Bovine Viral Diarrhoea Virus (BVDV) in aborted ruminant fetuses from Kars province in Northeast Turkey. Indian J. Anim. Res. 50 (4): 551-556. https://doi.org/10.18805/ijar.9372

May 2020 | Volume 8 | Issue 5 | Page 535