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Diagnostic evaluation of foot and mouth disease in cattle

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Abstract
The study was carried out on 08 cattle affected with FMD, showing clinical signs like fever, vesicular lesions on the tongue, dental pad, gums, interdigital space, ropy salivation and smacking of lips. Age of the animals affected was 5-6 years, significant increase in rectal temperature and respiratory rate was recorded. Hematologically significant decrease in RBC and haemoglobin was seen. Biochemically significant increase in ALT, AST, creatinine and glucose, significant decrease in TP and albumin was evident. Electrocardiography revealed normal sinus rhythm in 87.5 % and second-degree AV-block in 12.5 % animals. The concentration of *cTn-I* did not vary significantly indicating absence of myocardial injury.

Keywords: FMD, *cTn-I*, electrocardiography, haematology and AV-block

Introduction
Foot and mouth disease (FMD) is a highly contagious vesicular disease affecting a number of domestic and wild cloven-hoofed mammals (Samuel and Knowles, 2001) [13]. The disease is caused by foot-and-mouth disease virus (FMDV), which is a member of the genus Aphthus virus under Picornaviridae family, FMDV is a small, non-enveloped, virus with an icosahedral capsid composed of 60 copies each of four structural proteins (VP1, VP2, VP3 and VP4), which surround a single stranded positive sense RNA genome of approximately 8500 nucleotides (Grubman and Baxt, 2004) [5]. The virus is classified into seven immunologically distinct serotypes i.e., A, C, O, Asia 1, SAT 1, SAT2, and SAT3 (Sobhy *et al.*, 2018) [14]. The disease is charactezised by Pyrexia, vesicles/ulcers or erosions with shreds of epithelium on the dorsum and lateral margins of the tongue, hard palate, dental pad, lips, gums, muzzle, coronary band, interdigital space in hooves, on teats, lip smacking, anorexia, frothy/ropy salivation, bilateral mucopurulent nasal discharge covering the muzzle (Hemalatha *et al.*,2020) [7] The disease is notorious having high morbidity and low mortality, except in suckling animals, the mortality rate is about 5 % in adult ruminants but the rate can be boosted up to 50 % by myocardial damage in young animals (Barker *et al.*, 1993) [2]. The diagnosis of FMD is can be arrived by modalities like hematobiochemical changes, electrocardiography, estimation of specific cardiac biomarkers like cardiac troponin-I, virus isolation and identification (Aktas *et al.*, 2015; Priyanka *et al.*, 2019) [1, 10].

Materials and Methods
The present study was conducted on 08 animals presented to department of veterinary clinical complex veterinary college Bidar- KVAFSU, age ranging from 5 to 6 years and 6 apparently healthy cattle were selected for determining the reference values, animals showing clinical signs like fever, vesicular lesions on the tongue, dental pad, gums, interdigital space, ropy salivation and smacking of lips were selected for detailed clinical examination and parameters like temperature, heart rate, respiratory rate and capillary refill time were recorded. 2ml of blood was collected in EDTA vial and complete blood count was carried out using fully automated haematology analyser (ERMA PCE 210® by AGD biomedicals private limited, Chennai-India) and 4ml of blood was collected in clot activated vial and serum parameters like ALT, AST, ALP, TP, albumin, calcium, glucose and creatinine was estimated using commercially available kits (ERBA Manheim®) in semi-automated biochemical analyser (MICROLAB-300®, Eli Tech Group). Electrocardiography was carried out using base apex lead system in lead I were the positive electrode of lead I (left arm) was attached to the skin of

the fifth intercostal space just caudal to olecranon and the negative electrode (right arm) on the jugular furrow about 1/3rd of the left side of the neck (Rezakhani et al., 2004) and lead II were the positive electrode (Left Leg) was placed on the skin over the left fifth intercostal space at the level of the elbow; the negative electrode (right arm was placed on the skin over the right jugular furrow roughly 30 cm from the thoracic inlet and the ground electrode (left arm) was attached to the neck or withers (Peak and McGuirk, 2008) using BPL™ (CARDIART 6108T® Machine). Cardiac troponin-I (cTn-I) was estimated by ELISA using commercially available kits (Bovine Cardiac Troponin I®, cTn-I GENLISA ELISA™, Krishgen Biosystems). All the data obtained were statistically analysed as described by Snedecor and Cochran (1994). the data were analysed by student t-test using SPSS software 20.0 (SPSS Inc. Chicago, IL, USA). Difference at $p \leq 0.05$ was considered statistically significant.

Results

The clinical signs in animals affected with FMD were fever, vesicular lesions on the tongue, dental pad, gums, interdigital space, ropy salivation and smacking of lips (Fig.1 and 2).

Significant increase in the rectal temperature and respiratory rate whereas, heart rate and capillary refill time was within the normal limits (table 1).

Electrocardiographic study revealed second degree AV block in 12.5 % animals and normal sinus rhythm in 87.5 % animals (Fig. 3,4 and 5).

Hematologically significant reduction in the RBC count and haemoglobin concentration were recorded and the other parameters were within the normal limits (table 2).

Biochemically significant increase in the concentration of ALT, AST, glucose and creatinine, and significant decrease in the concentration of TP and albumin were recorded (table 3).

The concentration of cardiac troponin-I was within the normal physiological range (table 3).

Table 1: Mean ± SE values of vital parameters in healthy and FMD affected cattle

Parameter	Healthy cattle	FMD affected cattle
Temperature (^{0}F)	100.28 ± 0.14^a	101.22 ± 0.49^b
Heart rate (bpm)	75.33 ± 2.81^a	75.25 ± 6.48^a
Respiratory rate (breaths/min)	15.0 ± 0.85^a	19.50 ± 1.11^b
Capillary refill time (sec's)	2.33 ± 0.42^a	2.62 ± 0.26^a

Table 2: Mean ± SE values of haematological parameters in healthy and FMD affected cattle

Parameters	Healthy control	FMD affected
TLC (10^3/µL)	9.06 ± 0.84^a	9.03± 1.35^a
RBC (million/µL)	7.31 ± 0.87^a	6.62 ± 0.31^b
Hb (g/dL)	9.03 ± 0.18^a	7.67 ± 0.10^b
PCV (%)	36.70 ± 4.65^a	35.07 ± 1.09^a
PLT (x10^3/µL)	136.50 ± 30.45^a	194.25 ± 39.36^a
Neutrophil's (%)	39.33 ± 1.80^a	45.25 ± 1.97^a
Lymphocyte's (%)	60.00 ± 1.73^a	54.12 ± 2.11^a
Monocyte's (%)	0.66 ± 0.33^a	0.37 ± 0.26^a
Eosinophil's (%)	0.00 ± 0.00^a	0.25 ± 0.16^a

Table 3: Mean ± SE values of biochemical parameters in healthy and FMD affected cattle

Parameters	Healthy control	FMD affected
ALT (U/L)	30.58 ± 1.52^a	38.75 ± 2.42^b
AST (U/L)	46.35 ± 4.46^a	66.65 ± 6.94^b
ALP (U/L)	47.83 ± 12.70^a	113.31 ± 26.25^a
TP (g/dL)	9.36 ± 0.81^a	5.61 ± 0.32^b
Albumin (g/dL)	3.85 ± 0.40^a	2.78 ± 0. 23^b
Calcium (mg/dL)	10.10 ± 0.67^a	9.20 ± 0.87^a
Glucose (mg/dL)	64.90 ± 1.61^a	76.95 ± 10.76^b
Creatinine (mg/dL)	0.93 ± 0.05^a	2.08 ± 0.26^b
cTn-I (ng/mL)	0.29 ± 0.08^a	0.44 ± 0.09^a

Note: Mean ± SE values bearing different superscript differ significantly at ($p \leq 0.05$).

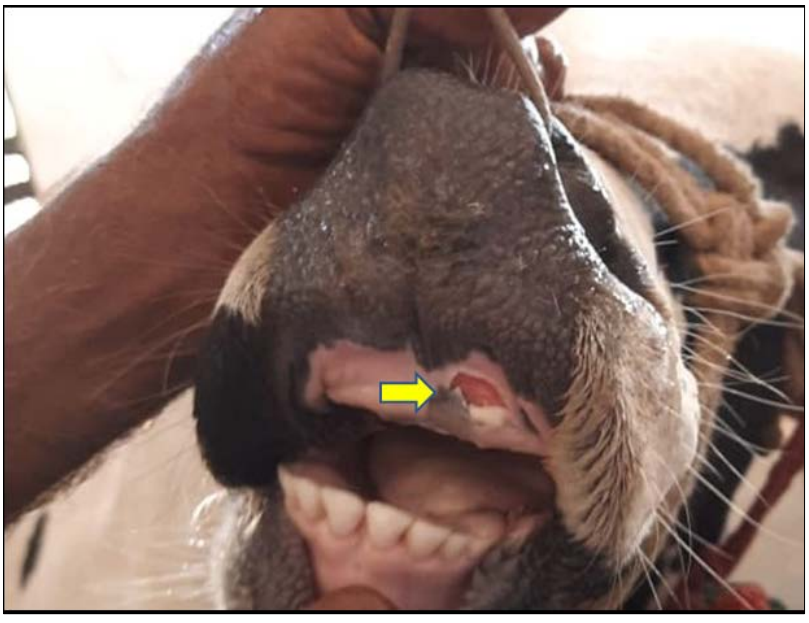

Fig 1: Oral vesicular lesions in a cow affected with FMD

Fig 2: Vesicular lesions on foot in a cow affected with FMD

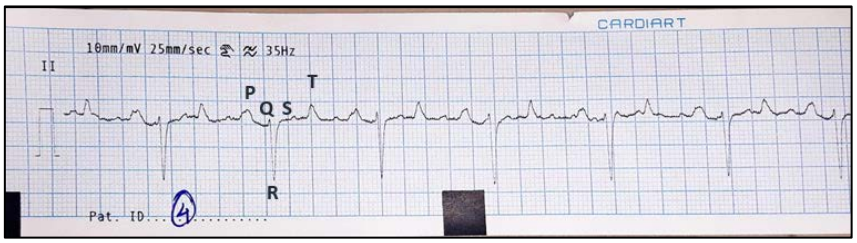

Fig 3: ECG of healthy cow (Lead II)

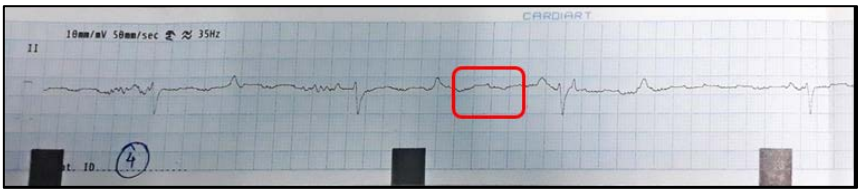

Fig 4: ECG showing second degree AV block in a cow affected with FMD

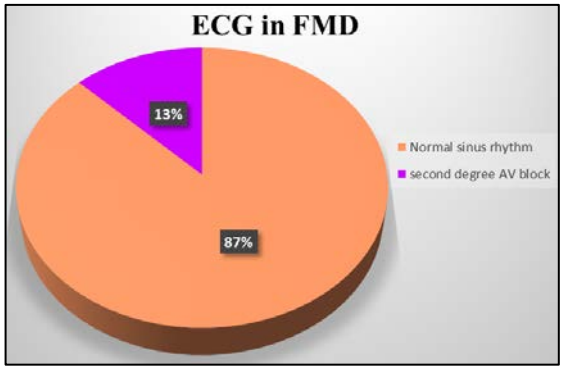

Fig 5: Electrocardiographic interpretation in FMD affected cattle

Discussion

FMD is a disease of economic importance causing the loses in terms of decreased production and performance and increased cost of treatment of the affected animals (Salim *et al.*, 2019) [12]. The clinical signs in animals affected with FMD were depression, fever, smacking of lips, froathy salivation, vesicular lesions on the epithelium of oral cavity, tongue, gums and vesicular lesions at interdigital space causing lameness similar clinical findings were recorded by Bozukluhan *et al.* (2013) [3], Sobhy *et al.* (2018) [14] and Nikvand *et al.* (2019) [9].

Significant increase in the rectal temperature and respiratory rate in the affected group, the findings were in accordance with Mousa and Galal (2013) [8], the increased core body temperature might be due to presence of endogenous pyrogens such as interleukins and tumour necrosis factor-α released in response to antigens.

Hematologically significant reduction in the RBC count and the haemoglobin concentration was recorded similar results were obtained by Ghanem and Abdel-Hamid (2010) [4] and Mousa and Galal (2013) [8], this could be due to increased inflammatory cytokines or endocrinopathy occurring secondary to FMD virus infection.

Biochemically significant increase in the levels of ALT and AST was recorded the similar findings were obtained by Ghanem and Abdel-Hamid (2010) [4] and Salim *et al.* (2019) [12], this might be due to impaired hepatic function as a consequence of hepatic damage by accumulated toxins. significant decrease in the levels of total protein and albumin were recorded in the present study the results were in concurrent with Ghanem and Abdel-Hamid (2010) [4] and Mousa and Galal (2013) [8], the hypo-proteinemia may be due

to severe anorexia and off food. Significant increase in the levels of glucose were recorded in affected cattle compared to healthy control these findings were in accordance with Ghanem and Abdel-Hamid (2010) [4] and Mousa and Galal (2013) [8], The hyperglycaemia might be due to destruction of β-cells of pancreas by FMD virus. Significant increase in the concentration of the creatinine was recorded the findings were in correlation with Hashem *et al.* (2018) [6], Higher creatinine concentration might be due to reduced renal blood flow, reduction in the glomerular filtration and increased catabolic rate of protein causing renal impairment.

Electrocardiographic study revealed second degree block in 12.5 % animals this could be attributed to myocarditis or electrolyte imbalances (Radostits *et al.*, 2007: Varshney, 2020) [11, 12]. The concentration of cardiac troponin-I did not vary significantly in affected group compared to healthy control this might be due to the animals in the present study were adults and the myocardial form of the FMD occurs at the age of less than six months (Aktas *et al.*, 2015) [1] indicting no damage to the myocardium or absence of myocarditis.

Conclusion

Myocardial form of foot and mouth disease may be seen in young animals *i.e.*, less than 6 months.

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