STUDY ON PREVALENCE AND EFFICACY OF ANTIBIOTICS AGAINST SECONDARY BACTERIAL INFECTION OF FOOT AND MOUTH DISEASE IN CATTLE IN KURIGRAM DISTRICT

A THESIS

BY

MD. MIZANUR RAHMAN
Registration No. 1505046
Session: 2015-16
Semester: January-June, 2016

MASTER OF SCIENCE (M.S.)

IN

MEDICINE

DEPARTMENT OF MEDICINE, SURGERY AND OBSTETRICS

HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR-5200

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Submitted to the Department of Medicine, Surgery and Obstetrics
Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh
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JUNE, 2017

Dedicated

to

My Beloved

Parents

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The Author

ABSTRACT

The study was carried out to investigate the prevalence and efficacy of commercial antibiotics against FMD virus in cattle in the chars of Kurigram district over a period of six months from October, 2014 to March, 2015. A total of 472 animals were monitored randomly on the basis of age, sex, breed and season. More or less similar affected rate was recorded both in male 12.68% and female 12.73% cattle. There was no statistically significant difference in affected rate of FMD in indigenous cattle by age and sex. The affected rate in animal of different age groups ranged from 16.67% in cattle up to 12 months age, 13.33 % in 13 to 26 months, 12.83% in 27 to 45 months, 12.22% in 46 to 60 months age groups in cattle. The affected rate of FMD increased gradually from 7.69 % in October to 9.72% in November to 16% in December with a peak of 18.88 % in January and then gradually decreased to 15.00% in February to 7.78% in March. The affected rate on the basis of breed indigenous animals were 12.30% and the cross breed animals were 13%. Some commercial antibacterial drugs were used to evaluate their efficacy against secondary bacterial infection in the Foot-and-mouth disease affected cattle. Efficacy of commercial antibiotic treatment was observed in four groups of animals. The Amoxicillin for group A, combined Penicillin + Streptomycin for group B, Oxytetracycline for group C, and soda, potassium permanganate, sohaga and honey for group D. Efficacy results of these antibacterial drugs were compared among the treatment groups on the basis of complete recovery from clinical sings and healing of foot lesions in days required. It was observed the efficacy of antibiotic above the mentioned treated group treated with the antibiotic Amoxicillin in group A showed statistically significant result to recover the Foot and Mouth Disease than the other group B, C and D.

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ABBREVIATION AND SYMBOLS

FMD	:	Foot and Mouth Disease
FMDV	:	Foot and Mouth Disease Virus
DLS	:	Department of Livestock Service
SAT	:	South African Teritori
MW	:	Molecular Weight
RNA	:	Ribonucleic Acid
NA	:	Nucleic Acid
^{0}F	:	Degree Fahrenheit
BHK	:	Baby Hamster Kidney
ELISA	:	Enzyme-Linked Immunosorbent Assay
CFT	:	Complement Fixation Test
VNT	:	Virus Neutralization Test
ICP	:	Incubation Period
Ag	:	Antigen
%	:	Percentage
et al.	:	And his associates
Etc.	:	Etcetera
U.S	:	United State
UK	:	United Kingdom
pH	:	Potential of hydrogen
OIE	:	Office International des Epizooties

CHAPTER I

INTRODUCTION

CHAPTER I

INTRODUCTION

Bangladesh is one of the most densely populated countries in the South Asia of the world. Livestock is an important sub-sector in this country, considered to the backbone of agriculture. According to the Department of Livestock, Bangladesh loses as much as US$125 million annually due to FMD. In Bangladesh, 20 million households keep 23 million of cattle heads under traditional farming system. Cattle among other livestock species available are the most versatile component in relation to existing integrated agricultural farming system in Bangladesh. Agro-based Tropical, Bangladesh has 53.21 million livestock of which 23.34 million are cattle (BER, 2014).The density of livestock population per acre of cultivable land is 7.37. Foot-and-mouth disease (FMD) is endemic in Bangladesh and is predominantly due to FMDV serotype O. In 2012, FMD outbreaks were identified in five different districts of Bangladesh (Nandi *et al*., 2015). Foot and Mouth Disease (FMD) is an important viral disease of various animals. FMD is an extremely contagious, acute viral disease primarily of all cloven hoof animals like cattle, buffalo, pig, sheep and goat, characterized by fever and vesicular eruption in the mouth, muzzle, foot, teats and other hairless soft areas of the body (Chowdhury *et al*., 1994). Foot and Mouth Disease (FMD) is a highly contagious viral disease with major economic consequences. In Israel, FMD epidemics recur almost every year and mostly affect cattle. The highest number of outbreaks occurs among beef cattle farms, followed by feedlot farms and dairy farms (Elnekave *et al*. 2016). Foot and Mouth Disease (FMD) has constituted a major threat to the health of livestock for at least 450 years worldwide (Brooks by, 1958). Although the disease has been eradicated from several of the more highly developed countries like USA, Canada, Scandinavian countries, Albania, Ireland, luxembourg but it still remains as enzootic in Asia, Africa and south America. Australia and New Zealand have never experienced the disease. However, the disease continues to spread virtually unchecked and uncontrolled throughout large areas Asia, Africa and even in some regions of South America (Hyslop, 1970). The economic losses due to FMD occurs in many ways, mainly loss of production, the expense of control, the interference with movement of animal and animal products (milk, meat) at international levels (Ham-m-van *et al.,* 1994) although the disease is not a killing one (the mortality rate in adults 2% and in young stock 20%) but production (meat and milk) and draught

power are seriously impaired in acute cases (Rahman *et al*.,1985) ; Blood and Radostits, 1989). Foot-and-mouth disease virus is a highly contagious and genetically variable virus. Sporadic introductions of this virus into FMD-free countries may cause outbreaks with devastating consequences. In 2010 and 2011, incursions of the FMDV O/SEA/Mya-98 strain, normally restricted to countries in mainland Southeast Asia, caused extensive outbreaks across East Asia (Valdazo-González *et al*. 2013). It is a highly infectious febrile disease of cloven hoofed animals, and it is endemic in Indo-Bangladesh sub-continent widespread outbreaks occur throughout the sub-continent in different seasons (Kamaruddin and Pandit, 1988; Sarma and Hazarika, 1996). Although the outbreaks from the disease has been reported in cattle, buffaloes, sheep, goats, pigs, elephants and other wild and semi-wild animals from India (Barman *et al*., 1990 ; Ahuja and Prasad, 1996) but it has only been reported in cattle from Bangladesh (Kamaruddin and Pandit, 1988). Besides clinically sick animals, carrier state of animals (McLean, 1938; Sutmoller and Gaggero, 1965) play a significant role in the spread of virus. A number of factors like migratory animals, fodder, wild animals, newly purchased animals, strong wind and rain, flooding necessitating movements of large number of animals and personnel have been recognized to the possible sources of FMD infection (Ray *et al*., 1989 a, b; Ekue *et al*., 1990). The role played in spread of the disease by animal fairs and markets, common grazing areas and carrier animals have been reported to cause outbreak of the disease (Prasad *et al*., 1981). The clinical disease in cattle is characterized by fever and vesicular eruption in the mouth (tongue and buccal mucosa) and on the feet (interdigital spaces). It has different epidemiological characteristics in the different animals' species and even within some species of animals. The exotic and cross-bred cattle have shown to be more susceptible than indigenous breed and lactating and recently calved cows than heifers, dry cow's males (Singh *et al*., 1981). FMD is prevalent in Bangladesh with virus types A, O, C, Asia-1 and sub-types A_5 and A_{22} (Chowdhury *et al*., 1994; 1996). Epidemiological surveillance and mass vaccination are the important aspects to control FMD in endemic countries. A rapid assessment of the type and advice on the suitability of available vaccines is essential for disease containment and control. Unfortunately this has not yet been achieved in Bangladesh due to lack of sufficient epidemiological information on the disease. Moreover, the uncontrolled movements of animals, lack of awareness in reporting the disease as well as lack of systematic procedures for mass vaccination of animals complicate the epidemiology of FMD in Bangladesh. The FMD vaccines are used under the Government aided programmes and some individual farmers

purchase vaccine to protect high yielding cattle. The Milk-vita has undertaken some vaccination programme to control FMD in Milk-shed areas in Bangladesh which are mainly based on demand by the farmers during outbreak of the disease. Some outbreaks of FMD were noticed in a number of villages in the Tangail Milk- shed areas during 1995. This study justifies the economic impact of FMD including how it varies in different settings and how knowledge of this should be used to guide control policy. This included a synthesis of current literature on the subject. To help appreciate the scale of global FMD impact estimates were made of the direct costs of disease and vaccination in endemic countries as well as outbreak costs in free countries. The findings of this study also emphasis the formulation of more effective disease management and control strategies, including appropriate vaccination policies in Bangladesh. A detailed clinico-epidemiological investigation was undertaken with a view to study the following objectives-

Objectives:

1. To determine the prevalence rate of Foot and Mouth Disease in cattle on the basis of sex, age, month and breed.
2. To evaluate the effectiveness of antibacterial drugs to control secondary bacterial infections in clinical cases of Foot and Mouth Disease.

CHAPTER II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

2.1 Foot and Mouth Disease

Foot and Mouth Disease (FMD) is a highly contagious and economically devastating viral disease of cloven-hoofed animals. It is characterized by fever, loss of appetite, salivation and vesicular eruptions on the feet, mouth and teats (Thomson, 1994). The disease is a threat to the livestock population throughout the world due to its high contagiousness, rapid multiplicity of the types and subtypes, wide species of animals susceptibility, short lived immunity and the existence of persistent or carrier state (Sevilla and Domingo, 1996).

2.2 History

FMD has a long past history. It is the first animal viral disease of the world. The first written description of this disease was done by an Italian monk Girolamo Fracastoro (Hieronymi Fracastorii Veronensis) in 1546, in Verona, (Olascoaga, 1999). Almost 400 years later, in 1897, Loeffler and Frosch demonstrated that a filterable agent smaller than bacteria caused it. This was the first demonstration that a disease of animals was caused by a filterable agent and ushered in the era of virology. In 1922, Vallée and Carré first showed the existence of two immunological types of FMDV by cross-immunity tests in cattle. They were designated by their areas of origin, O (Oise, a department in northern France) and A (Allemagne -Germany) and a few years later type C was added (Waldmann and Trautwein, 1926). Recognition and typing of endemic African strains, the so called SAT types only commenced in 1948 (Brooksby, 1958). The seventh serotype, designated as Asia 1, was first recognized in the early 1950's and viruses were isolated from India in 1951 and 1952 (Dhanda *et al.*, 1957) and Pakistan in 1954 (Brooksby and Rogers, 1957). FMD vaccine was first developed at the end of the 19th century and commercially available at large scale from 1950 onwards (Lombard *et al.*, 2007).

2.3 Etiology of Foot and Mouth Disease virus

2.3.1. Taxonomy

FMD virus was defined in 1963 by the International Committee on Taxonomy of Viruses (ICTV) as belonging to the genus *Aphthovirus*, family *Picornaviridae*. The name, *Picornaviridae* is derived from the Latin word '*Pico*' meaning small and '*rna*' meaning RNA, which refers to the size and genome type, of the virus while the genus name '*Aphthovirus*' refers to the vesicular lesions produced in cloven-hoofed animals (OIE, 2004). This genus also includes the equine rhinitis A virus, formerly named equine rhinovirus 1, whose genomic structure is more closely related to FMDV than to other picornaviruses (Li *et al.*, 1996).

2.3.2 Serotypes and sub types

The virus exists as seven immunologically distinct serotypes that is O, A, C, Asia 1, Southern African Territories (SAT) 1, SAT 2 and SAT 3 with multiple subtypes within each serotype (Pereira, 1977). New subtypes occasionally arise spontaneously. Serotypes O, A, C are widely distributed, whereas serotypes SAT1, SAT2, SAT3 are normally restricted to Africa and serotype Asia1 to Asia (Knowles and Samuel, 2003), although rare incursions into other regions have been recorded. This includes the introduction of SAT 2 for the first time into Saudi-Arabia and Kuwait in 2000. Similarly Asia 1 has been recorded for the first time in Greece in 2000 (http://www.oie.int). Among seven serotypes, serotype C occurs infrequently, with most outbreaks being due to serotype O (Kitching, 1998). There is considerable heterogeneity within serotypes and there is little cross-immunity between serotypes (Robson *et al.*, 1977). Previous infection or vaccination with one serotype will not protect against subsequent infection with another, and within a serotype divergent strains of the virus may reduce the efficacy of existing vaccines (Kitching, 1998).

2.3.3 Genome of Foot and Mouth Disease virus

The FMDV genome has a basic organization similar to those of other members of the *Picornaviridae* (Rueckert and Wimmer, 1984). FMDV consists of a single-stranded, plussense RNA genome of approximately 8,500 nucleotides (nt) surrounded by a protein capsid (Rueckert, 1996). The virus capsid is non-enveloped and has icosahedral symmetry with a diameter of approximately 300 Å, consisting of 60 copies of each of the

structural proteins (VP1 [1D], VP2 [1B], VP3 [1C], and VP4 [1A]) (Wild *et al.*, 1969). Amongst them, VP1, VP2 and VP3 (MW≈24 kDa) are surface-oriented, whereas VP4 (MW≈8.5 kDa) is internal and has a N-terminal myristic acid (also called tetradecanoic acid) (Chow *et al.*, 1987). VP1, 2 and 3 proteins have a similar eight-stranded beta-barrel topology, although there is no sequence homology between the genes, whereas VP4 has a distinct extended conformation (Acharya *et al.*, 1989). The virion is a 140S particle (Grubman and Baxt, 2004). The viral RNA contains a single lengthy open reading frame (ORF) encoding the viral polyprotein which is subsequently cleaved into multiple mature proteins by virally encoded proteinases (Ryan *et al.*, 1989). The antigenicity of FMDV particles is associated with amino acid residues that are well exposed on the surface of the capsid (Mateu, 1995). A major continuous antigenic site is located in the G-H loop of VP1, as deduced from the immunogenicity of peptides spanning VP1 residues around positions 140–160 (Pfaff *et al.*, 1982). In addition, a large proportion of monoclonal antibody (mAb)-resistant mutants obtained with mAbs raised against entire viral particles include amino acid substitutions within this site (Usherwood and Nash, 1995).

2.3.4 Survivability of FMDV in the environment

FMDV is moderately stable but can readily be inactivated by appropriate disinfectants and heat. In general, most strains are stable within the pH range 7.0–8.5, especially at lower temperatures, but increasingly labile at pH values outside that range (Bachrach, 1968). The capsid of FMDV consists of polypeptides, which are devoid of lipo-protein, and hence is stable to lipid solvents like ether and chloroform (Cooper *et al.*, 1978). Two percent solutions of NaOH or KOH and 4% Na_2CO_3 are effective disinfectants for FMD contaminated objects, but the virus is resistant to alcohol, phenolic and quaternary ammonium disinfectants (Sahle, 2004). The acidity produced in carcass meat during rigor mortis in cattle will inactivate the virus (Alexandersen *et al.*, 2003a). The pH in bone marrow, lymph nodes and certain organs and offal does not decline during rigor mortis; virus can therefore be found in such material (especially if refrigerated or frozen) for an extended period of time (Mckercher and Callis, 1983), and may cause new outbreaks if fed to livestock as unheated waste food (Donaldson, 1987). However, in milk and milk products, the virion is protected, and can survive at 70o C for 15 seconds and pH 4.6. Sunlight has little or no direct effect on infectivity; any loss is indirect and occurs mainly through the effects of drying and temperature (Donaldson and Alexandersen, 2003). Seasons also play a direct role on the survival of FMDV in the

field. The disease outbreak is high in winter (December- February) and in monsoon (July-September) of a year. Survival rate of the viral particles in the nature during winter is high compared to the season of hot weather. In the monsoon most of the herbivores are allowed to grazing which facilitates the transmission of the disease from sick to healthy animals (Chakrabarty *et al.,* 1979).

2.3.5 Antigenic variations

The antigenic variation within FMDV makes control extremely difficult, since even the best vaccine may induce immunologic pressure within the population that results in the emergence of a new variant (Grubman and Baxt, 2004). In order to increase protective level of immunity in the vaccinated animals there must be homogeneity between the vaccine strain and the field viruses (Beck and Strohmaier, 1987). The rise of new variants is inevitably caused by continued circulation of the virus in the field and the quasispecies nature of the RNA genome (Domingo *et. al.,* 2003). The quasi species nature of the FMDV genome was described over 20 years ago (Sobrino *et. al.,* 1983). RNA viruses in general, and FMDV in particular, have very high mutation rates, in range of 10-3 to 10-5 per nucleotide site per genome replication, due to the lack of error correction mechanisms during RNA replication (Drake and Holland, 1999). This high error rate leads to differences of FMDV replicated genomes from the original parental genome of 0.1 to 10 base positions (Haydon *et al.,* 2001a) and the quasi species concept was developed to explain the effects of errors in replication on the evolution of replicating RNA molecules. In addition to variation caused by mutation, FMDV has been shown to undergo RNA recombination in tissue culture (Wilson *et. al.,* 1988). Interestingly, these studies indicated that recombination was more likely to occur within the regions of the genome coding for the NS proteins; however, another study has suggested that RNA recombination within the capsid-coding P1 region of the genome may contribute to genetic diversity in FMDVs isolated from the field (Tosh *et al.,* 2002).

Antigenic sites on the surface of the FMD virion have been identified for five of the seven serotypes of the virus (SAT 1 and 3 being the only exceptions) (Haydon *et al.,* 1998). At least four antigenic sites have been identified, involving one or more of the capsid proteins, VP1, VP2, and VP3; however each serotype may not contain all four sites. While this site is clearly the major antigenic site, FMDV antigenic variation is associated with mutations leading to amino acid replacements within all of the known

antigenic sites (Feigel stock *et al.,* 1992). Antigenic variation in the field increases with time and most probably results from immunologic pressure placed on the virus by either the infected or vaccinated host species (Haydon *et al.,* 2001b). In addition, antigenic variation in FMDV has also been observed in tissue culture in the absence of immunologic pressure (Fares *et. al.,* 2001) indicating that antigenic sites on the virion may also be involved in other virus functions. Regardless of the mechanism, analysis of both genome sequence and antigenic variation has been invaluable in epidemiological studies of outbreaks and analysis of virus within countries where the disease is enzootic, and, in the case of a possible deliberate introduction of virus, it will also have forensic value in tracking the source (Knowles and Samuel, 2003).

2.4 Epidemiology of FMD

2.4.1 Geographical distribution of FMD

FMD is a global disease that through the years has affected most of the countries (Sutmoller *et al.,* 2003). After World War II, the disease was widely distributed throughout the world. Some regions have eradicated FMD, often following mass annual prophylactic vaccination campaigns and through the stringent application of zoo sanitary measures following outbreaks. Continental Europe falls mostly into this category. Some countries, such as the United Kingdom, have eradicated FMD without resort to vaccination. However, FMD is epizootic in several areas of the world and endemic in much of the developing world, including Africa, Asia, part of South America, and the Middle and Far East. This situation exists despite continued efforts to control the disease and the extensive use of FMD vaccine throughout the affected areas of the world (Asseged, 2005). Western Europe has had recent outbreaks, which have all been successfully controlled. This includes the 2001 outbreak in the UK, which spread to Ireland, France, and the Netherlands, and separate outbreaks in Italy and Greece. Japan has also recently eradicated outbreaks (Leforban and Gerbier, 2002).

2.4.2 Host range

With some minor exceptions, FMD affects members of the order *Arteriodactyla,* that is, all cloven-hoofed animals including domestic and wild ruminants and pigs (Thomson, 1994). Of the domesticated species, cattle, pigs, sheep, goats and water buffalo are most susceptible to FMD (FAO, 1984). FMDV can also infect more than 70 wildlife species

(Coetzer *et al.,* 1994). Mice, guinea-pigs, rabbits and even cats, dogs, mink, monkeys, snakes, birds, chickens and embryonated eggs have been infected under experimental conditions (Sahu and Dardiri, 1979).

2.4.3 The role of carrier in the epidemiology of FMD

The existence of a carrier state in cattle was first demonstrated by (Van Bekum *et al.,* 1959). Carrier, in FMD, is defined as an animal from which FMDV can be isolated from the oesophageal pharyngeal (OP) area, more than 28 days after infection (Sutmoller *et al.,* 1968). Although it is well established that FMD virus persists in buffalo (up to 5 years), cattle (up to 3 years), Sheep (up to 9 months), and goats (between 3-6 month), the mechanisms underlying persistence and the immunological pathway that eventually leads to viral clearance are not well understood (Bastos *et al.,* 2000). Host variation is however likely to play a role as different breeds of sheep and goats displays differential ability to act as the carriers of the FMDV (Anderson *et al.,* 1976). Of the livestock infected by FMD only pigs are believed to be incapable of establishing a persistent infection although one isolated report has indicated that persistence in swine is possible (Merzencio *et al.,* 1999). In addition, the long persistence and replication of the virus in the host animals can lead to genetic variation in the field, possibly being responsible for the generation of new viral variants (Toja *et al.,* 1999).

2.4.4 Transmissions

The most common and efficient mechanism of spread of FMD is by direct contact which may be initiated by the deposition of droplets or droplet nuclei (aerosols) in the respiratory tract or by mechanical transfer of virus from infected to susceptible animals and subsequent virus entry through cuts or abrasions in the skin or mucosae (Alexandersen and Mowat, 2005). Contact transmission is considered to be the principal route of infection in pigs, which are quite resistant to aerosol inhalation (Alexandersen *et al.,* 2002). Transmission of virus may also occur indirectly, via any contaminated surface or product, i.e. contaminated personnel, vehicles and all fomites (Alexandersen and Mowat, 2005). Virus is excreted into the milk of dairy cattle (Ray *et al.,* 1989) as well as in semen, urine, and feces (Kitching, 1992) and calves can become infected by inhaling milk droplets. The animals recovered from FMD remained as carrier and could play a vital role in the transmission of the causal agent of the disease to the susceptible animals (Tenzin *et al.,* 2008). Another mechanism of spread, which is uncontrollable, is the

carriage of virus by the wind. This form of spread is not uncommon over short distances but only rarely occurs over long distances. When long distance spread occurs the consequences can be dramatic (Donaldson *et al.*, 1984).

2.4.5 Molecular epidemiology

Phylogenetic analysis of the virus protein 1 (VP1) region of FMD virus has been used extensively to investigate the molecular epidemiology of the disease worldwide. These techniques have assisted in studies of the genetic relationships between different FMD virus isolates, geographical distribution of lineages, and genotypes. It is also used for the establishment of genetically and geographically linked topotypes and tracing the source of virus during outbreaks (Sangare *et al.,* 2003). Sequence differences of 30 to 55% of the VP1 gene were obtained between seven serotypes of FMD while different subgroups (genotypes to phenotypes) were defined by differences of 15 to 20% (Knowles and Samuel, 2003). Since1987, the analysis of the genetic distance and phylogenetic resolution of the sequence of VP1 encoding gene have provided crucial epidemiological information covering different degree of genetic relationships between field isolates (Samuel *et al*., 1999). The evolutionary changes of virus are determined by comparing genomic material from more than one virus with each other. At present, DNA sequencing and phylogenetic trees are widely used to illustrate the genetic relationship between viruses (Sahle, 2004).

2.5 Incubation period

The incubation period for FMD is highly variable, and depends on the strain and dose of virus, the route of transmission, the animal species and the husbandry conditions (Alexandersen *et al.*, 2003a, b). The incubation period for farm-to-farm airborne spread ranges from 4 to 14 days (Sellers and Forman, 1973) and this is also the normal range for farm-to-farm spread by indirect contact. The incubation period for farm-to-farm spread resulting from direct contact may range from 2 to 14 days (Garland and Donaldson, 1990). When spread is occurring within a herd or flock, the typical incubation period is 2–6 days, although under certain conditions it may be as short as 1 day or as long as 14 days. These ranges in incubation period are supported by both field and experimental observations (Alexandersen *et al.*, 2003 b). Under experimental conditions the mean incubation period was 3.5 days for continuous, direct cattle-to-cattle contact and 2 days for intensive sheep-to-sheep contact (Alexandersen *et al.,* 2002c, 2003b). Pigs were

readily infected by direct pig-to-pig contact exposure, with a mean incubation period of 1–3 days depending on the intensity of contact (Alexandersen *et al.*, 2003a). These differences confirm the strong relation between dose and length of incubation, i.e., the higher the dose or the intensity of contact the shorter is the incubation period (Alexandersen *et al.*, 2003b).

2.6 Pathogenesis

While FMD affects a wide variety of cloven-hoofed animals, pathogenesis has been studied mainly in cattle and pigs (Grubman and Baxt, 2004). Infection of cattle generally occurs via the respiratory route by aerosolized virus (Donaldson, 1987). Initial viral replication occurs in the pre pharyngeal area and the lungs followed by viremic spread to other tissues and organs before the onset of clinical disease. FMDV is then distributed throughout the body, to reach best sites of multiplication such as the epithelium of oro-phrynx, oral cavity, feet, the udder and heart. Virus probably replicate in the mammary gland of susceptible cow and in the pituitary gland. Viral excretion commences about 24 hours prior to the onset of clinical disease and continues for several days. The acute phase of the disease lasts about one week and viremia usually declines gradually coinciding with the appearance of strong humeral responses (Murphy *et al.*, 1999). Recovered cattle produce neutralizing antibodies and can resist re-infection by the same subtype of virus for up to one year. It was suggested that heat intolerance was a sequel to FMD and was caused by damage to the endocrine system (Radostits *et al.*, 1994).

2.7 Clinical signs

Animals affected by FMDV develop various degrees of clinical signs from inapparent to typical generalized lesions (Frederick, 1999). Alteration of virulence in virus or the species susceptibility of virus may explain the various degrees of clinical signs (Frederick *et al.*, 1998). For example, the O Taiwan 1997 strain caused severe lesions in pigs, but no cases were seen in ruminants (Dunn and Donaldson, 1997). The marker for the severe virulence of the O Taiwan 1997 strain for pigs and the absence of virulence for cattle is associated with changes in the 3A gene of the virus (Knowles *et al.*, 2001). Some species of buffalo present natural resistance to FMDV infection, despite the animals having seroconverted to positive (Hedger and Condy, 1985). When FMDV is in a carrier state, it is characterized by an inapparent persistent infection (Salt, 1993).

The clinical signs can range from a mild or inapparent in sheep and goats to a severe disease occurring in cattle and pigs (OIE, 2004). In cattle, the initial signs are fever of 103-105˚F (39.4-40.6˚C), dullness, anorexia followed by excessive salivation, smacking of the lips, grinding of the teeth, drooling, serous nasal discharge, shaking, kicking of the feet or lameness; and vesicle (blister) formation. The predilection sites for vesicles are areas where there is friction such as on the tongue, dental pad, gums, soft palate, nostrils, muzzle, interdigital space, coronary band, and teats (Sahle, 2004). Clinical disease is usually severe in pigs characterized by severe vesicular lesions affecting the coronary band, the bulb of the heel and the interdigital space but sometimes also including the dorsal and rostral surface of the snout, accessory digits and pressure points on knees, hocks and elsewhere (Kitching and Alexandersen, 2002). In sheep and goats the signs are usually rather mild and tend to be characterised by superficial lesions that heal rapidly (Donaldson and Sellers, 2000). Serological field surveys and experimental investigations have shown that FMD in small ruminants may be clinically unapparent in a significant proportion of animals (Donaldson and Sellers, 2000). Pregnant animals may abort (Blood *et al.,* 1994). The course of an FMD infection is 2 to 3 weeks although infection may delay recovery of mouth, feet and teat lesions, resulting in hoof deformation, mastitis, low milk production, failure to gain weight, and breeding problems. A lactating animal may not recover to preinfection production because of damage to the secretory tissue. A chronic panting syndrome characterized by dyspnea, anemia, and hair overgrowth and heat intolerance has been reported as a sequel in cattle recovered from FMD associated with pituitary gland damage (Burrow *et al.,* 1981).

2.8 Pathological Features

The first histopathological changes in the cornified, stratified squamous epithelium are ballooning degeneration and increased cytoplasmic eosinophilic staining of the cells in the stratum spinosum, and the onset of intercellular oedema within the dermis. These early lesions are detectable only by microscopical examination (Gailiunas, 1968; Yilma, 1980) and as indicated earlier, apparently normal skin may contain significant amounts of virus (Alexandersen *et al.,* 2001). This early stage may be followed by necrosis and subsequent mononuclear cell and granulocyte infiltration; the lesions, now macroscopically visible, develop into vesicles by separation of the epithelium from the underlying tissue and filling of the cavity with vesicular fluid. In some cases vesicular fluid production may be high and the vesicles are large; in other cases the amount of

fluid may be limited and the epithelium undergoes necrosis or is torn off by physical trauma without the formation of a conspicuous vesicle. It should also be noted that ruptured lesions are sometimes seen on the pillars of the rumen (Alexandersen and Mowat, 2005**)**. Loss of epithelium is most common on the dorsal surface of the anterior two-thirds of the bovine tongue, which is separated by a transverse notch from a dorsal eminence occupying the posterior third of the tongue. The entire epithelium over the anterior area may be lost, leaving a raw, red surface that oozes blood (Jones *et al.*, 1994). Mortality in adult animals is generally low, but it may be high in young animals, including calves and especially lambs and piglets, due to acute myocarditis. Myocarditis is considered as a fatal form of FMD that occurs without vesiculation in young animals (Barker *et al.*, 1993; Alexandersen *et al.*, 2003b). Macroscopical examination of the heart in these cases often reveals a soft, not well-contracted, heart with white greyish spots or stripes (so called tiger heart) mainly in the left ventricle and interventricular septum (Alexandersen *et al.*, 2003b**)**. However, a lympho-histiocytic myocarditis with hyaline degeneration, necrosis of myocytes and infiltration with mononuclear cells can be observed by histopathological examination (Donaldson *et al.*, 1984). Skeletal muscle lesions occur but are rare (Woodbury, 1995).

2.9 Symptomatic treatment and immunization

The post vaccination effects in cattle immunized against FMD. They recorded tissue reactions mild to severe in intensity at the inoculation sites which lasted for 2 to 3 weeks. A few animal had hypersensitive reactions, characterized by large, heavy oedematious swelling of the inoculation sites (Rahman *et al*., 1983)**.** The antiviral activity of levamisole and zinc salt against FMD virus type Asia-1 infection in baby mice and guineapigs. In baby mice, levamisole gave 13.33 to 18.75% protection when administered 12 to 24 hour before challenge infection, while 24 hour pre-treatment with levamisole led to 100% protection among guineapigs from generalized infection. In simultaneous treatment and challenge studies, it protected 92.86% of guineapigs. Antiviral activity of zinc salt was reported to be very poor against experimental FMD virus infection in baby mice but it delayed deaths due to the disease, whereas in guineapigs, 24 hour pre-treatment with zinc salt led to 93.3% protection against infection. In case of simultaneous treatment and challenge studies, 70% of guineapigs showed resistance to generalized infection. The results obtained by both levamisole and zinc salt call for further investigation and the efficacy of such compounds in the

treatment and prophylaxis against FMD in domesticated animals (Gangopadhyay *et al*.,1990). The FMD control system in france. The previous system relied on an annual vaccination of all cattle and of some sheep and goats. Since 1991, vaccination has been prohibited and surveillance programme reinforced, including an information campaign for the farmers, and instruction and testing equipment for the veterinarians. A fund was set up to reimburse farmers with animals slaughtered during outbreaks. The cost of the two scheme before and after the cessation of vaccination have been estimated in the equivalent of 1992 French Francs. The results show that the new scheme is considerably cheaper. The estimation of the cost with vaccination is over 237.7 million Francs, but the cost of the new scheme is only a little more than 18.8 MF, i.e. 13 times less (Dufour and Moutou, 1994).

Caustic soda used to treat the clinical cases of FMD in cattle. The animals had been fed with grain treated with caustic soda. The FMD was only ruled out after epithelial samples were tested for the virus and found to be negative in treated animals. The importance of caustic soda treated forage being correctly prepared and handled was emphasized (Kilner, 1994).The frequent generation of antigenic viral variants in the field might be one of the major obstacles to the design of effective antiviral vaccines. The types of variants that will become dominant during disease outbreaks is often unpredictable. The genetic and antigenic characterization of emerging FMD virus variants with antigenically critical amino acid substitutions predicted by model studies using reference viruses and monoclonal antibodies is reported (Feigelstock *et al*., 1996)). Five outbreaks of FMD in the North Eastern states (Assam, Arunachal Pradesh, Meghalaya, Tripura and West Bengal), India in 1994. They found that all the outbreaks involved cattle vaccinated against FMD except the Meghalaya outbreak, with the prevalence rate varying from 45 to 100%. They suggested that the occurrence of the disease three months after vaccination, indicated the short duration of immunity produced by the vaccine (Sharma and Hazarika, 1996). An apparent failure of prophylactic vaccination and emergency revaccination to control and outbreak of FMD in West Bengal. A large scale vaccination progrmme using the prevalent serotypes O, A, C and Asia-1 and involving 2500 animal was carried out in February and March 1994 but an epidemic that involved over 500 animals occurred in the vaccinated population in August of that year. Although they recorded severe morbidity but the mortality rate was 2%. Necropsy examination of dead cattle revealed atypical lesions in the nasopharynx,

oesophagus and larynx of two animals. They identified Asia-1 type FMD virus as the cause of the epidemic. They also recognized the differences between the vaccine and field strains of virus, insufficient control measures (including restriction of movement of affected animals), concurrent parasitism, malnutrition and diseases and improper cold storage of the vaccine during transportation as the possible reason for the vaccination failure (Jana and Mailty, 1997). An outbreak of Foot and Mouth Disease (FMD) affecting 95 (57.2%) out of 166 cattle occurred in a medium-scale dairy farm in Kikuyu district, Kenya. Ethnoveterinary remedies of natural Soda ash solution (97% sodium bicarbonate), honey and finger millet flour were used to manage the FMD lesions. The lesions were washed with soda ash solution to remove the necrotic tissue after which raw honey and finger millet flour were applied to the cleaned lesions. The lesions were examined daily and those with necrotic material washed again with the Soda ash solution. Honey and finger millet flour were applied daily for three days. There was rapid healing of the lesions with the animals resuming feeding after three days. The fast healing of the lesions vindicates the use of these cheap, locally available and easy to apply products in the management of FMD lesions (DW Gakuya *et al*. 2012).

2.10 Public Health Significance

FMD is not considered to have public health significance. Given the concern arising in the public mind following the outbreaks of FMD, it is pertinent to mention that FMD generally not believed to be a zoonosis in man. However the virus has been isolated in at least 40 human infections (Bauer, 1997). Clinical signs vary from asymptomatic to severe, with blisters in the mouth and on the hands & feet. However, healing is rapid. The virus type most frequently isolated from humans are type O, followed by the type C and rarely type A. Although humans are not readily infected with FMDV, it should be stressed that they can play a role as intermediaries in disease transmission, as demonstrated by the case of the noninfected individuals the retained virus in his nasal passage for more than 24 hour before transferring the disease to susceptible cattle (Sellers *et al.,* 1971).

2.10.1 Foot and Mouth Disease in Bangladesh:

Foot and Mouth Disease is considered endemic in Bangladesh. However, no data is available on countrywide prevalence of FMD. (Howlader *et al*., 2004) investigated FMD outbreaks in 1999 at Baghabari milk-shed area of Sirajganj district. They observed 63%,

51% and 48% incidence of FMD in a population of 4,845 cattle, 938 sheep/goats and 329 buffaloes, respectively. Among the affected cattle 1,287 were calves, of which 125 (9.71%) died (Loth *et al.*, 2011).

2.11 Economic importance

FMD is one of the most economically important viral diseases of domestic animals (Pereira, 1981). FMD is associated with high morbidity 100% and variable rate of mortality 1-100% depending on the age distribution of animal. In case of the young animal, mortality rate could reach up to 100%. Although FMD does not result in high mortality in adult animals, the disease has an economic significance, which is responsible for large economic losses in terms of morbidity through permanent loss of milk, meat and draught ability. It is estimated that 25% productivity of individual recovered animals are lost due to FMD (Russel and Endington, 1985). Infection with FMDV is a significant constraint to international trade in animals and animal products (milk, meat, hide and butter) (Kitching *et al.,* 2005). FMD, therefore, threatens the livelihoods of simple farmers, large sophisticated farming practices and the national and the international economies of the countries (Asseged, 2005). The control of outbreak (slaughter of infected and in contact, disposal of carcass in disease free zones) and the loss due to the ban on livestock exports costs several million US dollars for a single outbreak (Sellers and Daggupaty, 1990). On the other hand, the economic consequences of FMD incursion into disease-free regions may be severe. For instance, in the first 3 months of the 1997 outbreak in Taiwan, >6,000 farms were affected, 4 million pigs were destroyed or died from the disease, and >21 million doses of vaccine were used (Yang *et al.,* 1999). The cost of controlling the disease was estimated at US $378.6 million. An additional $1.6 billion was lost in export trade, and >65,000 jobs in pig farming and associated industries were lost (Yang *et al.,* 1999). Therefore, the highly contagious nature of FMDV and the associated productivity losses make it a primary animal health concern worldwide. Analysis of economic impacts of FMD in Bangladesh is rather limited. A hypothetical prediction of economic impact of FMD revealed that annual direct loss stands at Tk. 819 million (US$ 10.92 million). Indirect loss from the diseases and overhead cost of the state veterinary services were not considered for this analysis (Islam, 2011).

CHAPTER III

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

3.1 Study areas

The study was conducted in the Fander char, Messerer char and char Krishnopur of Ballaver ghas union of Nageshwari upazila in Kurigram district. These chars were under a project named Chars Livelihoods Programme (CLP). These chars are situated on the riverside of Gangadhar. It is 40 kilometers away from sadar Kurigram.

3.2 Study period and animals

The study was conducted at different chars of Kurigram district during October, 2014 to March, 2015. The animals were examined at household to study the prevalence on the basis of chars, age, sex, month and breed and to study the efficacy of antibiotics against secondary bacterial infection due to FMD in cattle during the study period. A total of 472 cattle population were examined in three chars named Funder char(170), Messerer char(120) and char Krishnopur(182) respectively. Among which, 60 animals were affected with FMD.

3.3 Epidemiological study

As a livestock officer of Chars and Livelihoods Programme responsibilities was regular monitoring and motivation of beneficiaries and also be advised of the beneficiaries and given solution of problems arising from animals. So epidemiological data was collected from that observation and from the beneficiaries by study of the case histories and clinical examination. The data about the age, sex, month of occurrence etc. were recorded as per methods described by (Prasad *et al*., 1981, and Singh *et al*., 1981)

3.4 General examination

Body Condition Score (BCS), behavior, posture, gait, ulcer in mouth and tongue, salivation, anorexia, red lesion hooves and interdigital space, locomotive disturbance were observed by distant visual examination of the patient.

3.5 Physical examination

Examination of different physical parts of the body of each of the animal clinically attend at char were done by using various close observation techniques.

3.6 Clinical examination

The general clinical examination was performed to determine the posture, behavior, gait and physical condition of each of the FMD affected animal. The inspection and palpation were used to examine on the mouth and foot. The tongue was checked for injury, ulceration, vesicles, abnormal mobility and consistency. The foot of each animal was examined on inspection and palpation to detect any lesion on the interdigital spaces and to find the unwillingness to take weight on the limbs.

3.7 Prevalence

Prevalence was calculated as number of cases of disease divided by population at risk and multiple by 100.

$$\text{Prevalence rate (\%)} = \frac{\text{Number of cases of disease}}{\text{Population at risk}} \times 100$$

3.8 Grouping of animals for Antibiotic therapy

Group A: Consisting of 15 FMD affected animals and each animal was treated with Amoxicillin @8-10mg/kg body wt. i/m ly.

Group B: Consisting of 15 FMD affected animals and each animal was treated with penicillin + streptomycin combined @40,000 iu/kg body wt. + 15mg/kg body wt. i/m ly.

Group C: Consisting of 15 FMD affected animals and each animal was treated Oxytetracycline @ 5-8 mg /kg body wt. i/m ly.

Group D: Control group consisting of 15 animals and each animal treated by $KMnO_4$, Soda, Sohaga and Honey etc. no antibiotics were applied.

The therapeutic evaluation was assessed on the basis of days required for complete healing of month and foot lesions as described by (Rahman *et al*., 1985).

3.9 Monitoring the antibiotic treated results

Chars and Livelihoods Programme selected a Livestock Service Provider (LSP) to assist in every respective char to treat the animals. Sometimes they were provided training about the treatment and the management of animals from the project. Whenever any problem or symptom were observed by beneficiaries they communicated LSP and medicine would be given. Especially the efficacy of different antibiotics against FMD was recorded.

3.10 Statistical analysis

The data obtained for different characters were statistically analyzed following the analysis of variance techniques by using MSTAT-C computer package programme. The significant differences among the treatment means were compared by Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS

CHAPTER IV

RESULTS

4.1 Epidemiological investigation

The major outbreak of Foot-and-mouth (FMD) was recorded in the month of November-December, 2014 at the Fander char and Messerer char and in the month of January, 2015 at the char krishnopur.

Table 1: Sex wise prevalence of Foot-and-mouth disease in cattle in Nageshwari upazila in Kurigram.

Name of char	Male animals			Female animals			Total		
	No. of animal examined	Affected		No. of animal examined	Affected		No. of animal examined	Affected	
		No.	(%)		No.	(%)		No.	(%)
Funder	75	10	(13.33)	95	13	(13.68)	170	23	(13.54)
Messerer	50	6	(12.00)	70	8	(11.43)	120	14	(11.66)
Krishnopur	80	10	(12.50)	102	13	(12.74)	182	23	(12.63)
Total	205	26	(12.68)	267	34	(12.73)	472	60	(12.71)
Level of significance						NS			

The affected rate of FMD on the basis of sex and age are presented in Tables 1 and Figure 1 respectively. It is evident from Figure 1 that all age groups of indigenous cattle are susceptible to FMD. More or less similar affected rate was recorded both in male 12.68% and female 12.73% cattle (Table 1). The prevalence rate in animal of different age groups ranged from 14.29% in cattle up to 12 months age, 13.33% in 13 to 36 months, 12.57% in 37 to 55 months, 11.87% in 56 to 72 months age groups in cattle (Fig.1)

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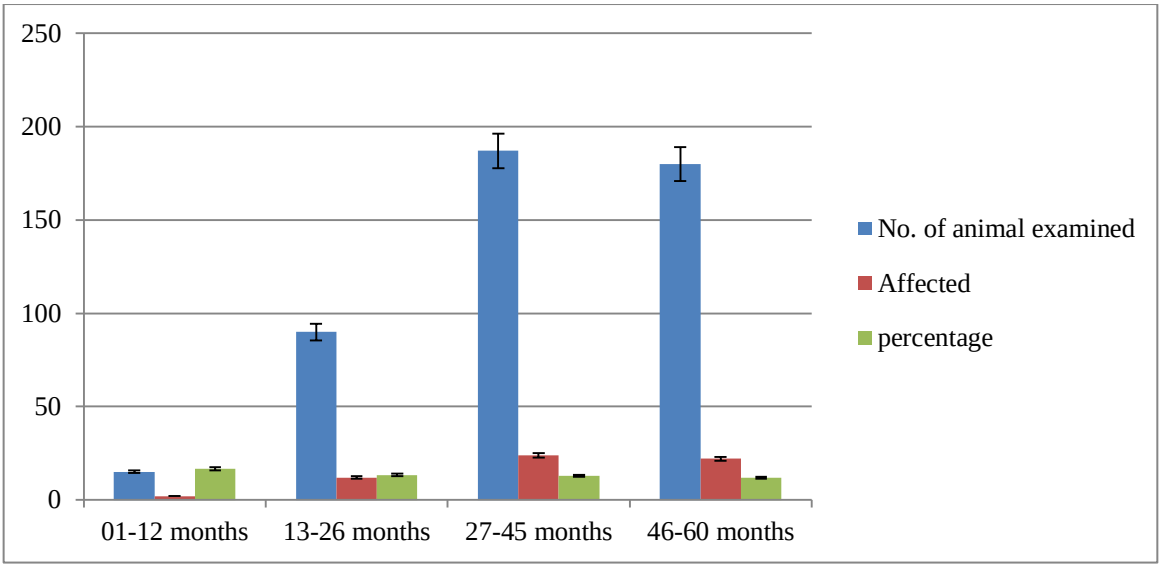

Fig. 1: Age-wise prevalence of FMD in the chars of Nageshwari upazila, Kurigram.

There was no statistically significant difference in prevalence rate of FMD in indigenous cattle by age and sex.

This study was conducted six months period only due to availability of clinical cases under these areas and the month-wise occurrence of FMD in indigenous cattle is presented in Table 2.

Table 2: Month-wise prevalence of Foot-and-mouth disease in cattle in the chars of Nageshwari upazila, Kurigram during winter season.

Month	No. of animals	Animals affected	
		No.	percentage
October	65	5	7.69%
November	72	7	9.7%
December	75	12	16.00%
January	90	17	18.88% (**)
February	80	12	15.00%
March	90	7	7.78%
Total	472	60	12.71%
Chi square Test (P-value)			0.000**

** Significant at p<0.01

It appears from Table 2 that the affected rate of FMD increased gradually from 7.69% in October to 9.72% in November to 16% in December with a peak of 18.88% in January and then gradually decreased to 15% in February to 7.78% in March.

Table 3: Breed wise prevalence of FMD in Nageshwari upazila, Kurigram.

Breed Name	Number of cattles	Affected	(%)
Indigenous animals examined	325	40	(12.30)
Cross breed animals examined	147	20	(13.00)
Total	472	60	(12.71)

4.2 Clinico-pathological investigation

Most of the cattle affected with Foot-and-mouth disease showed high rectal temperature (103 to 105^0 F) accompanied by severe salivation and anorexia, followed by painful stomatitis. The affected animals showed abundant salivation and saliva hanging in long, ropey strings (photo 1). Vesicles appeared on the buccal mucosa on the tongue and gum which ruptured to form ulcer (photo2). Concurrently with the oral lesions, lesions appeared on the feet particularly on the clefts and the coronet/interdigital space (photo 3).

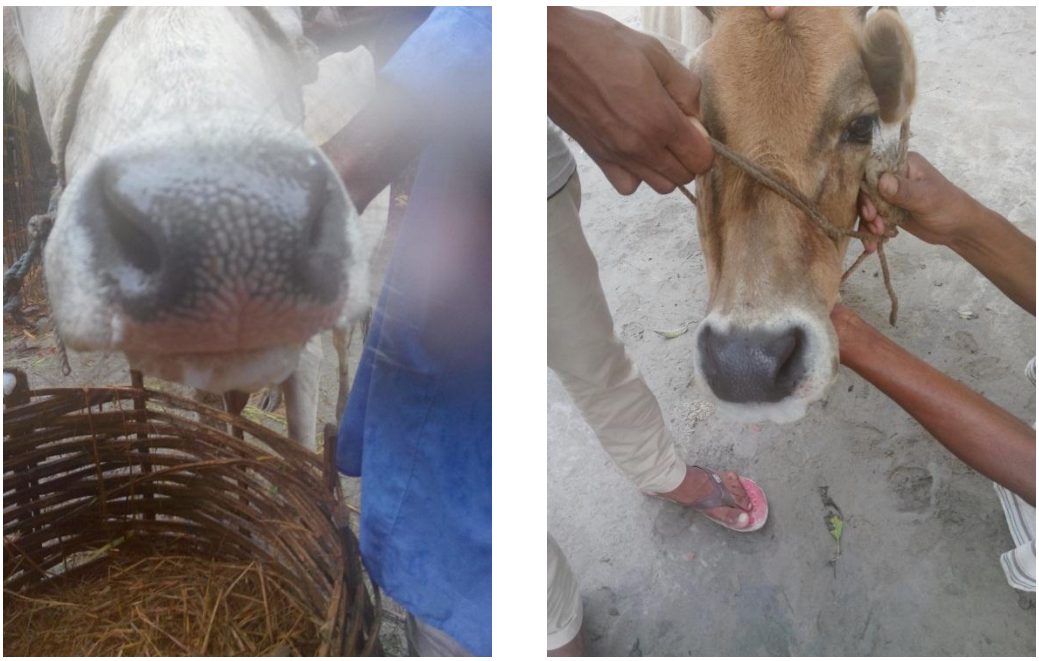

Photo 1: Salivation and saliva hanging

Photo 2: Buccal mucosa, tongue and gum which ruptured to form ulcer

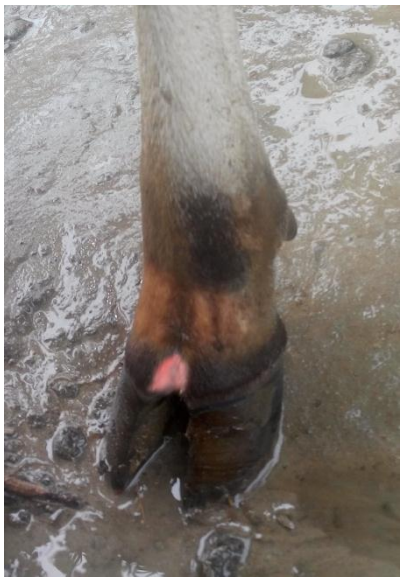

Photo 3: Lesions appeared on the feet (cleft)

The clinical sings of FMD were found more severe in young calves than adults.

4.3 Monitoring the Therapy Result

Some commercial antibacterial drugs available in the Kurigram were used to evaluate their efficacy against secondary bacterial infection in the Foot-and-mouth disease affected cattle that is shown in the table no. 4.

Table 4: Grouping of affected animals for therapeutic evaluation of antibacterial drugs against secondary bacterial infection due to Foot-and-mouth disease in cattle.

Name of group	No. of animals treated	Name of antibiotic	Dose and route of administration	Range of days (Mean± SE) for recovery
Group-A	15	Amoxicillin	@8-10mg/kg body wt. i/m ly.	5.2 ± 0.14^{a}
Group-B	15	Penicillin + Streptomycin	@40,000iu/kg body wt. + @15mg/kg body wt. i/m ly.	7.1 ± 0.23^{b}
Group-C	15	Oxytetracycline	@5-8 mg /kg body wt. i/m ly.	7.5 ± 0.19^{b}
Group-D	15	Supportive agents	Soda, sohaga, potassium permanganate and honey	10 ± 0.25^{c}
LSD				1.01
Level of Significance				*

* Significant $P < 0.05$

The Amoxicillin as company instruction was given for group A, the combined drug like penicillin+ streptomycin as company instruction was given for group B, Oxytetracycline as company instruction was given for group C, and soda, potassium permanganate, sohaga and honey for group D. Efficacy results of these antibacterial drugs were compared among the treatment groups on the basis of complete recovery from clinical sings and healing of foot lesions in days required. It was observed the efficacy of antibiotic above the mentioned treated group that the clinical sings and foot lesions treated with Amoxicillin, Penicillin+ Streptomycin, Oxytetracycline and supportive treatment recovered with in different days. The treating antibiotic Amoxicillin in group A showed statistically significant result to recover the Foot and Mouth Disease than the other group B, C and D.

CHAPTER V

DISCUSSION

CHAPTER V

DISCUSSION

Foot and Mouth Disease (FMD) is endemic in Bangladesh and its neighbouring countries like India, Pakistan and widespread outbreaks in epidemic pattern occur throughout the Indo-Bangladesh sub-continent. This disease has been reported from almost all the districts in Bangladesh (Kamaruddin and Pandit, 1988) and the economic losses caused by FMD has been estimated in draught cattle Bangladesh (Rahman *et al*., 1985). The A, O and Asia-1 types of FMD virus of cattle were recorded during 1975 to 1982 in Bangladesh (Kamaruddin and Pandit, 1988). Recently, of the seven types of FMD virus, four types A, O, C and Asia-1 have been identified in Bangladesh (Rahman *et al.,* 1989; 1991). More recently in addition to four types, two sub-types (A_5 and A_{22}) have been identified in cattle of Bangladesh (Chowdhury *et al.,* 1994 a, b; 1996).

The occurrence of similar types and sub-types of FMD virus have been reported from India in association with outbreaks of the disease in cattle during 1975 to 1990 (Ray *et al.,* 1989 a, b; Barman *et al.,* 1990). The free movement of cattle across the borders and unrestricted importation of mostly discarded cattle from India to Bangladesh might spread the new sub-types of FMD virus from India to Bangladesh.

5.1 Epidemiological investigation

The major outbreaks of FMD were recorded in higher in cattle in the chars of Nageshwari upazila in the month of January, 2015 than any other month of the year. Epidemiological investigation of 472 randomly selected cattle in the outbreak areas revealed that only 60 (12.71 %) animals were clinically affected with FMD of which 2 (3.33 %) severely affected calves died. The morbidity, mortality and case fatality were (12.71%, .42% and 3.33%) respectively. Although the occurrence of FMD outbreaks have been reported to be high in cattle in the district of Tangail (average 8 outbreaks/year) but the information of morbidity, morality and case fatality rates are lacking in inland literature (Kamaruddin and Pandit, 1988). However, comparative higher morbidity (48 & 59.5%), mortality (7.2% & 1.8%) and case fatality (12.09%) rates have been reported in Indian cattle due to FMD (Patnaik, 1986; ray *et al*., 1989). These variations of morbidity, mortality and case fatality rates might be due to difference of breed, age, types of virus involved and annual vaccination programme against FMD.

Singh *et al*. (1981) reported higher morbidity rate due to FMD in exotic and cross-bred cattle than in indigenous breeds. Blood and Radostits (1989a, b) described only 2% mortality rate in adult cattle due to FMD and 20% in young stock. It is revealed from the review of literature that types A, O, C and asia-1 and sub-types A_5 and A_{22} have been identified in India in association with outbreaks (Srinivasan *et al*., 1922; Jana *et al.*, 1996).

Although the O, A, C and Asia-1 types of fmd virus have been identified from Bangladesh (Kamaruddin and Pandit, 1988; Rahman *et al.*, 1991) but recently sub-types A and A have been identified in association with outbreaks (Chowdhury *et al*., 1994a, b). Yhese sub-types of FMD virus might spread from India to Bangladesh through migratory cattle. It may be mentioned here that cattle are not usually allowed to slaughter for meat purpose in India due to mainly religious cause. As a result, a large number of slaughterable cattle are being exported from India to the neighboring countries like Bangladesh. This export and import business of cattle from India to Bangladesh is mainly made by private sector without considering health and disease of animals. As a result, different diseases and infections are being introduced in Bangladesh through diseased cattle. Islam investigated (1994) 336 imported Indian cattle and found most the imported cattle had clinical and subclinical infection, of which 44.34% had clinical infection with FMD. This indicates that the affected rate of FMD is higher in imported Indian cattle 44.34% than the local cattle 12.71% in the Nageshwari chars. Therefore, the importation of Indian cattle should be restricted with a necessary quarantine and health examination measures.

The prevalence rate in animal of different age groups ranged from 16.67 % in cattle between 1 to 12 months in age, 13.33% in cattle between 13 to 36 months in age, 12.83% in cattle between 27 to 45 months in age and 12.22% in cattle between 46 to 60 months in age groups. It indicates that all age groups of cattle are affected by FMD. However, severity of infection with mortality was recorded in young stock as had been reported by (Blood and Radostits, 1989) who reported 2% mortality in adult and 20% in young calves due to FMD. There was no difference of prevalence rate of FMD in male 12.68% and female 12.73% animals. However, insignificantly higher prevalence rate of FMD has been reported in female than male pigs (Shankar, 1992).

This study was only conducted during 6 months from October, 2014 to March, 2015 and it appears from the results that the clinical causes of FMD appeared in all the investigated months. However, the affected rate of FMD gradually increased from October 7.69 % to January 18.88% and gradually decreased from February 15% to March 7.78 %. These results support the earlier reports of (Chakraborty *et al.*, 1979) and (Prasad et al., 1981) who reported higher occurrence of outbreaks during winter (December to February) and Monsoon (June to September). Monsoon epidemics might be attributed to heavy rain and flooding necessitating movement of livestock and personnel to high ground which resulted close herding. This disease could also be easily spread by cattle fairs and markets, common grazing areas, movement of affected animals and through man carrier animals (Gorkirpal and Sandha, 1996; Cleland *et al.*, 1997). However, (Kamaruddin and pandit, 1988) reported that the occurrence of FMD varied from month to month and season to season, with higher frequency due to movement of infected animals for different purposes.

Although the occurrence of FMD has been reported in different species of domestic and wild animals elsewhere (Barman *et al*., 1990; Hafez *et al.*, 1993) but similar reports have not been documented from Bangladesh. Therefore, the epidemiological role of different animal species on the spread of the infection should be explored in this country.

5.2 Clinico-pathological investigation

During study period the clinical signs were examined carefully in the affected animal and the symptoms were recorded. The first clinical symptoms in FMD affected cattle were salivation, vesicles and ulcers in the mouth, tongue, gums and also in the interdigital space of the hoof, lameness, pyrexia and anorexia. In uncomplicated cases, the oral vesicles and ulcers usually healed within 8 to 10 days either by gradual replacement of the epithelium or after scab formation. In complicated cases, the courses of the disease ranged from 12 to 15 days and most of the cases are complicated with secondary bacterial infection. The clinical pictures resembled very closely to those described by (Sard, 1978; Blood and Radostits, 1989). However, skin lesions (Sen, 1990), eye and udder lesions with mastitis (Singh et al., 1981) and atypical lesions and allergic reactions (Jana and Mailty, 1997) reported in literatures have not been observed in this study.Necropsy examination of dead calves revealed atypical lesions of myocardial degeneration, necrosis and non-suppurative myocarditis, which though not pathognomic

are believed to be causes of death (Jones and Hunt, 1983). In addition, there were associated lesions of acute abomastitis, enteritis and pneumonia.

5.3 The effect of antibacterial drugs against secondary bacterial infection due to FMD

Some commercial antibacterial drugs available in the Kurigram were used to evaluate their efficacy against secondary bacterial infection in the Foot-and-mouth disease affected cattle. Efficacy results of antibacterial drugs were compared among the treatment groups on the basis of complete recovery from clinical sings and healing of foot lesions in days required. It was observed the efficacy of antibiotic treated group that the clinical sings and foot lesions treated with Amoxicillin, Penicillin+ Streptomycin, Oxytetracycline and supportive treatment recovered with in different days. The treating antibiotic Amoxicillin in group A showed statistically significant result to recover the Foot and Mouth Disease than the other group B, C and D. Amoxicillin is a penecillin derivatives and it works better in the skin and epithelial layer than other antibiotics and supportive treatment. The healing of untreated control cases generally required 10 to 15 days with an average 12 days and in some cases it became more complicated. These results could not be compared due to lack of similar reports in the available literature. The results indicates that the administration of drug would be required for rapid healing of FMD lesions and to prevent spread of the disease to other susceptible animals and neighboring villages. However,(Kilner, 1994) reported that cattle fed with grain treated with caustic soda and (Gangopadhya *et al*.,1990) reported levamisole and zinc salt has some antiviral activity against FMD virus.

CHAPTER VI

SUMMARY AND CONCLUSION

CHAPTER VI

SUMMARY AND CONCLUSION

Totally, 472 cattle of either sex, different age groups, month and breed based were investigated carefully and outbreaks of FMD of those chars area revealed that 60 (12.71%) animals were clinically affected with FMD and the 412 animals were found apparently normal or healthy. The prevalence rate also was recorded sex wise but there was no significant difference of prevalence rate between male 12.68% and female 12.73% animals. The affected rate was recorded month wise and affected rate was 7.69% in October, 9.72% in November, 16% in December, 18.88% in January, 15% in February, and 7.78% in March respectively. In Bangladesh November to February is winter season and peak cold weather in December-January and animals are moved in high ground and close herding, so affected rate is high. The affected rate in Indigenous animals and Cross breed animals was respectively 12.30% and 13% which were non-significant. It was observed the efficacy of antibiotic among the treated four group with Amoxicillin, Penicillin+ Streptomycin, Oxytetracycline and supportive treatment recovered with in different days. The treating antibiotic Amoxicillin in group A showed statistically significant result to recover the Foot and Mouth Disease than the other group B, C and D. So, this study is recommended that Amoxicillin is the best than the combine effect of Penicillin and Streptomycin, single effect of Oxytetracycline and supportive treatment for the Foot and Mouth Disease. But further researches are needed for better recommendation.

CHAPTER VII

REFERENCES

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