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Research Article
Clinico-Epidemiological Features of Lumpy Skin Disease Affecting Cattle in Bangladesh

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Abstract

Background and Objective: Lumpy skin disease (LSD) is a contagious viral, eruptive and one of the most economically important cattle diseases which are characterized by the appearance of nodules on the skin and other parts of the body. The present study was conducted to evaluate the clinical features along with unveiling a haematological picture and the risk factors associated with LSD affecting cattle in Bangladesh. **Materials and Methods:** Spatial data on cattle affected by LSD were collected from October through December, 2019. Clinico-epidemiological data from selected an Upazila (a sub-district, lower administrative unit in Bangladesh) of the same district. Blood samples were directly collected from randomly selected animals suffering from LSD and examined for different haematological parameters. **Results:** Of 72 clinical cases, 32 cattle were found to be affected by LSD. The prevalence of the disease was higher in cattle on smallholdings compared with on organized farms. Among the risk factors, male and indigenous cattle are comparatively less susceptible compared with female and exotic breeds or cross-breed cattle. Fever, skin lumps, lymph node enlargement, salivation and anorexia were more common clinical signs of LSD. Among several complications identified cutaneous oedema (18.7%) was recorded with the highest frequency. Haematological examination revealed that the diseased animals were anaemic and the erythrocyte count (TEC), Hematocrit Value (HCT), Haemoglobin Level (Hb) and RBC Distribution Width (RDW) parameters were below their corresponding normal reference ranges in these animals. **Conclusion:** The cross-bred cattle were more susceptible to LSD compared with the indigenous cattle and anaemia could be a common finding in bovine animals affected naturally with LSD.

Key words: Lumpy skin disease, spatial data, clinical signs, complications, prevalence, haematology, risk factors

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Lumpy skin disease (LSD) is a notifiable transboundary animal disease, caused by the Lumpy Skin Disease Virus (LSDV), a DNA virus of the genus *Capripoxvirus* of the *Chordopoxvirinae* subfamily under the family *Poxviridae* with a prototype strain of Neethling virus. This virus has a strong similarity to sheep pox and goat poxviruses as they are serologically and antigenically indistinguishable but genetically dissimilar[1,2]. The LSD is characterized by fever, circumscribed skin nodules (lumps) of 1-5 cm in diameter[3], lacrimation, enlargement of lymph nodes, oedema in legs and brisket, conjunctivitis, anorexia, salivation, depression and nasal discharge[4-6].

Animals that recovered from the disease may suffer from mastitis, pneumonia, formation of necrotic skin plugs leaving deep holes, reduction in milk production, abortion and temporary or permanent sterility[3]. The incubation period of the disease ranges between 1-4 weeks in natural outbreaks while after experimental conditions, skin lesions reportedly developed within 1-3 weeks post-infection[7]. The disease spreads rapidly with high morbidity ranging from 1-90%, but low mortality of less than 10%[2,8]. The most potential route of transmission of LSDV is mechanical, through biting insects. The virus was detected in stable flies (*Stomoxys* sp.), mosquitoes of the genera *Aedes* and *Culex* and hard tick species namely, *Rhipicephalus appendiculatus* and *Amblyomma hebraeum* during some field outbreaks[3,9]. Besides, semen of the infected bull and milk of the infected lactating cow, saliva and nasal discharge are also believed to be possible transmission sources[10].

The LSD was first reported in 1929 in Northern Rhodesia (currently Zambia)[11] from where it spreads to the south to the Southern part of Africa in a series of epizootics[8]. The first outbreak of LSD in Bangladesh was reported in July, 2019 and all cases were reported from three adjacent Upazilas (Anowara, Karofully and Patia) in the Chattogram District of Chattogram Division[12,13]. An investigation from the Department of Livestock Services (DLS), Bangladesh revealed 66 clinical cases of LSD in 360 susceptible animals. However, none of the affected animals died. Central Disease Investigation Laboratory (CDIL) of DLS, Bangladesh collected the samples and a real-time polymerase chain reaction was used to confirm the LSD virus[14].

Although there is no specific etiological treatment for LSD, the clinical treatment of LSD is based on the application of antibiotics to stop secondary bacterial complications and the use of anti-inflammatory drugs[15]. Among the approaches, mentioned vaccination should be the prime choice in any resource-limited setting such as Bangladesh. Until a mass vaccination is adopted/started across the country the first and foremost approach should be suggesting an ideal supporting treatment regimen for the animals affected naturally with the disease. To do that adequate clinical picture as well as epidemiological factors associated with the disease need to be known which is very scanty to the date. This study was performed to determine clinical signs, epidemiological characteristics and haematological findings of LSD affected cattle in the southeastern part of Bangladesh where the disease was reported for the first time in the history of the country.

MATERIALS AND METHODS

Ethical approval: No institutional ethical approval was taken due to the passive sampling technique (Veterinary hospital patients). Oral consent from the farm owners was taken during epidemiological data collection.

Study area and population: The study was conducted in Boalkhali Upazila (administrative sub-district) Veterinary Hospital (UVH), Chattogram, Bangladesh from October through December, 2019. All the cattle registered to the Boalkhali Upazila Veterinary Hospital for treatment from different smallholdings as well as from organized farms were included in this study.

Spatial data collection: Data of LSD affected cattle (e.g., the population at risk, case number, coordinates of the reported union) in different Upazilas and metropolitan areas of Chattogram District (October-December, 2019) were collected from the monthly report the of District Livestock Office, Chattogram, Bangladesh.

Clinico-epidemiological data collection: Clinico-epidemiological information of each of the cases was collected by administrating a proto-type questionnaire. The questionnaire was designed to collect data on animal demography, history of vaccination, de-worming, previous disease occurrence, duration of illness, defecation, micturition and vomiting along with the owner's demographic information.

Clinical examination: All the cattle were undergone thorough clinical examinations and a diagnosis of an LSD case was performed considering the general and specific signs of LSD including pyrexia, circumscribed skin nodules, anorexia, superficial lymph node enlargement and oedema.

Sample collection: Blood samples were collected from the jugular vein of some randomly chosen cattle affected with LSD and taken into sterile tubes containing EDTA and transported to the laboratory for further haematological investigations.

Investigation for haematological parameters: Haematological parameters include Total Erythrocyte Count (TEC), Hematocrit value (HCT), Haemoglobin Concentration (Hb), Mean Corpuscular Volume (MCV) and total White Blood Cells (WBC), RBC Distribution Width (RDW) were determined by the Nihon Kohdens haematology analyzer (Celltac Alpha VET MEK-6550). Differential leukocyte counts and Erythrocyte Sedimentation Rate (ESR) were also estimated.

Data analysis: The data generated were entered into Microsoft Excel 2013 spreadsheet and exported to STATA-13 (StataCorp, 4905, Lakeway Drive, College Station, Texas 77845, USA) for conducting descriptive and univariable statistical analysis. The spatial data were used for computing the prevalence of LSD in each Upazila of the Chattogram District and the distribution of LSD reported union was generated by QGIS 2.13.1 software[16]. Afterwards, statistical analysis was carried out on the data by Fisher's exact test to assess the association between the disease and a selected factor (source, age, sex, breed and rearing system). An association having a $p \leq 0.05$ was considered statistically significant.

RESULTS

Prevalence of LSD: An overview of the total cattle populations at risk of LSD and the numbers of animals affected with the disease in different Upazilas of the Chattogram District was shown in Table 1. The prevalence of LSD was estimated to be 1.3% (95% CI:1.27-1.32%). Among the Upazilas of Chattogram, the prevalence was significantly higher in Karnafully (11.7%), Shatkania (10.9%) and Sitakundu (8.9%) and the lowest in Mirsarai (0.01%) and Boalkhali (0.02%). The spatial distribution of unions in which LSD was reported was presented in Fig. 1. With variable prevalence estimates the disease was reported from almost all of the unions of the Upazilas enrolled in the study.

Risk factors: The results of the univariable analysis revealed that the prevalence of LSD was significantly higher ($p<0.05$) in cattle reared on smallholdings 64.7% (95% CI: 47.9-78.6%), in female animals 56.8% (95% CI:40.9-71.3%), in cross-bred animals 47.4% (95% CI:32.5-62.7%) and in adult cattle 72.2% (95% CI: 48.8-87.8%) (Table 2).

Table 1: Overview of the cattle populations at risk and animals affected with LSD in different Upazila/Thanas of Chattogram District

Upazila/Thana	Total population at risk	No. of affected with LSD	Prevalence (%)	95% CI
Metropolitan area	36762	34	0.33	0.28-0.39
Anwara	43106	1753	4.07	3.88-4.26
Bashkhali	167519	1280	0.76	0.72-0.81
Boalkhali	83477	15	0.02	0.01-0.03
Chandanaish	10393	20	0.19	0.11-0.30
Fatikchhari	97416	3919	4.01	3.90-4.15
Shatkania	36871	4011	10.88	10.56-11.20
Rangunia	119704	222	0.19	0.16-0.21
Hathazari	163063	717	0.44	0.41-0.47
Karnafully	4683	546	11.66	10.75-12.61
Raozan	109450	195	0.18	0.15-0.20
Lohagara	105235	623	0.59	0.55-0.64
Mirsarai	26200	5	0.01	0.006-0.04
Sandwip	18300	44	0.24	0.17-0.32
Sitakundu	36084	323	8.95	8.01-9.98
Total	1062363	13808	1.30	1.27-1.32

Table 2: Univariable analysis on risk factors associated with LSD in cattle in the study population (N = 72)

Variable	Co-variable	No. of cattle	No. of LSD positive	Percentage (95% CI)	p-value
Source	Family livestock	34	22	64.71 (47.85-78.58)	0.001
	Farm animal	38	10	26.32 (14.81-42.17)	
Sex	Female	37	21	56.76 (40.9-71.34)	0.031
	Male	35	11	31.43 (18.45-48.08)	
Age	1-18 months	36	12	33.33 (20.14-49.74)	0.022
	18-36 months	18	7	38.89 (20.23-61.64)	
	>36 month	18	13	72.22 (48.8-87.83)	
Breed	Cross	38	18	47.37 (32.48-62.74)	0.007
	Local	34	14	41.18 (26.34-57.8)	
Rearing system	Semi-intensive	41	21	51.22 (36.48-65.75)	0.183
	intensive	31	11	35.48 (21.05-53.12)	

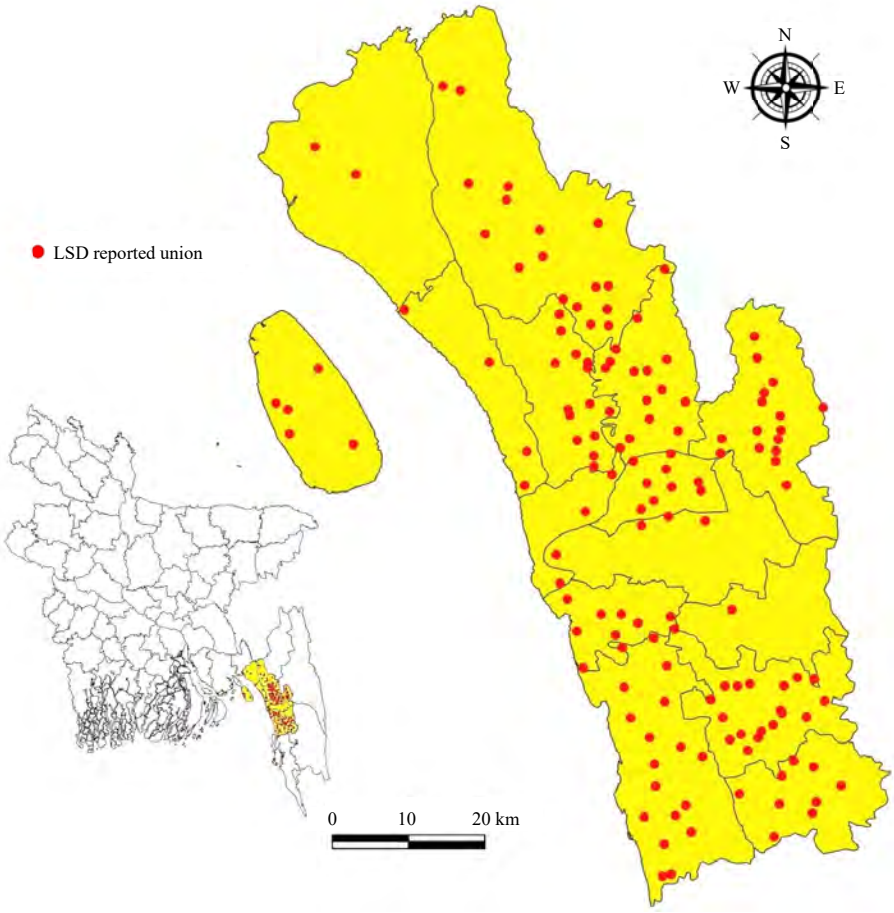

Fig. 1: Spatial distribution of unions in which LSD was reported from cattle populations
Closure view of the Chattogram District is shown on the right-hand side displaying the unions as red dots wherefrom the occurrences of LSD were reported

Table 3: Frequency distribution of clinical signs observed in cattle (N = 32) suffering from LSD

Variable	Co-variable	Frequency	Percentage (95%CI)
Duration of illness	<5 days	14	43.7 (28.15-60.69)
	5-10 days	15	46.8 (29.09-65.26)
	>10 days	3	9.3 (1.98-25.02)
Temperature (°F)	98-100	2	6.2 (0.77-20.80)
	101-103	9	28.1 (13.74-46.75)
	103-105	18	56.2 (37.66-73.63)
	>105	3	9.3 (1.98-25.02)
Dehydration	Normal	5	15.6 (5.27-32.79)
	Mild	25	78.1 (60.02-90.72)
	Moderate	2	6.2 (0.77-20.80)
Salivation	Yes	13	40.6 (23.70-59.35)
	No	19	59.3 (40.64-76.30)
Feeding habit	Normal	2	6.2 (0.77-20.80)
	Anorexia	26	81.25 (63.56-92.79)
	Off-fed	4	12.5 (3.51-28.99)
Complications/lesions	Skin nodules/lumps	31	96.8 (83.78-99.92)
	Lymphadenitis	27	84.3 (67.21-94.72)
	Cutaneous edema	6	18.7 (7.20-36.44)
	Sloughing off lumps	4	12.5 (3.51-28.99)
	Cellulitis	5	15.6 (5.27-32.79)
	Recumbency	1	3.1 (0.07-16.21)
	Pneumonia	2	6.2 (0.77-20.80)
	Diarrhoea	1	3.1 (0.07-16.21)
	Lactation decreased in lactating cows (n = 14)	12	85.7(57.19-98.22)

Fig. 2(a-f): Clinical symptoms of LSD affected cattle, (a) A lumpy skin diseased cattle showing skin nodules covering the entire body, (b) Enlargement of superficial lymph node of LSD affected cattle, (c) LSD-affected calf suffering from edematous swelling in the brisket region, (d) Sloughing off lumps due to LSD, (e) Animals suffered from LSD showing lumps all over the skin before the treatment begun and (f) Animals showing regressed lumps at the recovery stage

Clinical manifestations: Most of the animals affected with LSD were brought to the hospital around 5-10 days after the onset of the illness. Fever, coughing, mild dehydration, salivation, skin nodules, anorexia and enlargement of lymph nodes were the most common clinical manifestations as observed during the clinical examinations (Fig. 2a-f). The predominant complications, as identified, associated with LSD were cutaneous oedema in different sites, sloughing off the lumps, cellulitis, pneumonia, recumbency and diarrhoea (Table 3).

Table 4: Haematological parameters of cattle (N = 10) suffering from LSD

Parameter	Mean±SD	Reference value*
Haemoglobin (G dL^{-1})	7.76±0.789	8-15
TEC (*10^6 μL^{-1})	3.50±1.49	5-10
ESR (Wintrobe tube method) (mm in 1st hr)	0.05±0.158	0-1
Haematocrit (HCT) (%)	13.40±7.80	24-48
MCV (fL)	42.60±2.90	40-60
RDW (%)	9.11±7.14	15.5-19.7
WBC (*10^3 μL^{-1})	9.13±3.40	4-12
Neutrophils (%)	14.00±2.98	15-33
Lymphocytes (%)	79.33±3.05	45-75
Eosinophils (%)	3.33±1.52	0-20
Monocytes (%)	3.00±1.73	0-8
Basophils (%)	0.33±0.58	0-2

*Adapted from: George *et al.*[25], TEC: Total erythrocyte count, RDW: RBC distribution width, MCV: Mean corpuscular volume and WBC: Total white blood cells

Haematological parameters: Haematological analysis was performed from blood samples collected from 10 LSD affected cattle. The results revealed that RBC, haematocrit, Red Blood Cell Distribution Width (RDW) and haemoglobin levels were found to be significantly lower in cattle suffering from LSD compared with their corresponding reference values as seen in healthy cattle. Other blood parameters including total leukocyte count (WBC), Erythrocyte Sedimentation Rate (ESR) and Differential Leukocyte Count (DLC) remained within their normal reference ranges (Table 4).

DISCUSSION

The LSD, reported first time in Bangladesh in mid-July, 2019 is a devastating, acute or apparent pox viral disease of cattle with major socioeconomic impact by production losses, adding treatment costs, chronic debilitation and death of the animals. This study summarized the clinical outbreaks of LSD in the backyard and commercial cattle population in the Chattogram District unrevealing the disease burden and associated risk factors.

From the spatial data analysis, the prevalence of clinically expressed LSD was found to be around 10% in Bangladesh, corroborated with Hasib *et al.*[13], which also reported a prevalence of 10% of the disease in the same geographical location. The presence of high densities of biting insects, poor drainage system, improper management conditions, the difference in husbandry practices and less awareness of the farmers could be some probable reasons for seeing such a high prevalence of the disease in Bangladesh[13,17].

The LSD was significantly higher in cattle that were reared on smallholdings compared with cattle reared in organized farms. The reason for this was that farmers kept their cattle in open grazing areas which potentially allowed biting flies to easily transmit the virus while the zero-grazing management system of farms kept them away from arthropod vectors. This finding was also supported by previous studies[13,18]. Female animals had a significantly increased risk of LSD due to physiological conditions (lactation, pregnancy etc.). This result was corroborated by a similar observation of previous studies[13,18]. Analysis of the association of the factor age with LSD revealed that adult animals had a significantly higher prevalence of LSD and this could be related to weaning of maternally derived immunity level and more duration of exposure to the virus. Contrarily, younger cattle didn't show higher susceptibility to LSD due to the existence of passive maternal immunity, lower frequency of exposure and restricted rearing in a better-protected environment, away from the access of flies and other vectors. This finding was similar to findings of many other studies[18,19], however, disagrees with some others[20,21]. Local or native breeds were found to be at significantly lower risk for LSD than cross-breeds because of their genetic differences, stronger immune response and well adaptability to the environment which was in agreement with many previous studies[2,8,13,18,19,21].

The frequent clinical features of LSD, as seen, were characteristic skin nodules, fever, enlargement of lymph nodes, anorexia and salivation, in agreement with many previous studies[2,3,9,11,22]. The first noticeable sign of LSD was a fever that could take 4-14 days and a more prolonged fever, suggesting the involvement of secondary bacterial reaction[10]. The complications of LSD involving cutaneous oedema, sloughing off lumps, cellulitis, pneumonia, recumbency and diarrhoea observed in this study were also reported previously[21]. These complications resulted from a persistent fever, immunosuppression and damage to the skin or mucous membrane could be aggravated by secondary bacterial invasions, suggesting the need for treating the secondary bacterial infections[2]. Recumbency resulted from severe debilitation and cachexia needs a longer time to recover. The presence of LSD nodules in intestinal mucosa invaded later by bacteria could result in diarrhoea and bacterial invasion on eroded areas in bronchial and tracheal mucosa could result in pneumonia[8].

Haematological assessment of blood samples obtained from LSD affected cattle revealed that total leukocyte count (WBC), differential leukocyte count and Mean Corpuscular Volume (MCV) remained in normal reference ranges. But such findings were in disagreement with a Abutarbush[23] where leukocytosis in some animals and leukopenia in others were reported. Similarly, the count of lymphocytes was found to be higher which indicated viral infection. The levels of Total Erythrocyte Count (TEC), haemoglobin (Hb), Haematocrit Value (HCT) and Red Blood Cell Distribution Width (RDW) were found to be decreased in the present study, supported by a previous study[10]. This pan reduction in key erythrocyte parameters could be an indication of anaemia plus inflammation resulting from the release of inflammatory cytokines such as TNF, IL-1α, IL1β and IF-γ or lower bone marrow responsiveness to erythropoietin, anorexia and reduction in serum iron[10,24].

As a viral disease, LSD has no specific treatment and only symptomatic therapy is applicable by using a combination of antimicrobials and anti-inflammatory drugs. The most common antibiotics that were used to treat animals in the present study were found to be amoxicillin, oxytetracycline, strepto-penicillin and penicillin. When secondary infections were suspected due to clinical presentations, as already discussed, the use of systemic antibiotics seemed to be logical and required for speeder clinical recovery[8]. The outcome of treatment was comparatively better when amoxicillin and oxytetracycline were administered, according to the follow-up feedback received from the owners of the affected animals.

CONCLUSION

The prevalence of clinically expressed LSD in cattle in Bangladesh was found to be around 10%. Cross-bred cattle are more susceptible to the disease compared with the indigenous bovine animals. With classical clinical presentations, such as the presence of nodules or lumps covering the major parts of the body and lymphadenitis, signs of aggravation such as sloughing off the lumps, cellulitis and oedema, pneumonia and diarrhoea could also be seen due to secondary bacterial infection(s). Moreover, the animals affected could be anaemic. All of these findings suggested the need for use of antibiotics plus an effective anti-inflammatory drug to treat the animals suffering from LSD to hasten clinical recovery avoiding other complications.

SIGNIFICANCE STATEMENT

As a viral disease, mass vaccination across the country is an ultimate remedy. However, until adopting a suitable vaccine, the first and foremost approach should be suggesting an ideal supporting treatment regimen for the animals affected with LSD. Among 10% of clinically expressed LSD cattle, crossbred cattle are more susceptible to the disease compared with the indigenous bovine animals. With classical clinical presentations, such as the presence of nodules or lumps covering the major parts of the body and lymphadenitis, signs of aggravation such as sloughing off the lumps, cellulitis and oedema, pneumonia and diarrhoea could also be seen due to secondary bacterial infection(s). All these findings suggested the need for use of antibiotics as well as an effective anti-inflammatory drug to treat the animals suffering from LSD to hasten clinical recovery avoiding other complications.

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