Prevalence and Management Strategies for Lumpy Skin Disease (LSD) in Cattle: Emphasizing a Region-Based Scenario in Bangladesh


ABSTRACT

The emergence of lumpy skin disease (LSD) in Bangladesh since 2019 is indeed concerning, and addressing its prevalence and control strategies is crucial for ensuring the health and well-being of cattle and preventing economic losses in farming and livestock. The objective of this study was to evaluate the present situation of LSD and its clinical managemental steps among various farms in Rajshahi district, located in the northwest region of Bangladesh. We collected data from Tanore, Paba, Bagha, Bagmara, Puthia, and Godagari upazilas in Rajshahi district between September 1, 2022 and December 30, 2022. We used a structured questionnaire and observed a total of 39 small farms and 99 cattle. We diagnosed LSD based on the clinical signs outlined in the OIE manual and analyzed the data using Microsoft Office Excel and SPSS statistical software. The study found that LSD had the highest morbidity rate (71.42%), mortality rate (7.14%), and case fatality rate (10%) in Tanore and Puthia upazilas in Rajshahi. Newly mature female animals (2–4 years) showed a higher susceptibility (36.23%) to LSD infection, followed by young bull cattle (2–4 years) at 33.33%. Bull and heifer calves were also susceptible to experiencing fatalities due to the infection of LSD. One of the significant clinical manifestations, Limb swelling, was most prevalent (18.18%) with LSD-positive young, mature cattle (2–4 years). We identified farm hygiene practices as crucial for LSDV distribution, with a higher proportion of LSD-affected cattle (42.43%) on poorly managed farms compared to those with good (1.01%) and medium (25.26%) hygiene practices. Despite the potential benefits of mosquito nets for controlling insects, most animal owners (89.74%) did not use them at night in cattle houses. The economic impact of LSD on the cattle industry underscores the importance of extensive epidemiological studies and the isolation, identification, and genome sequencing of LSDV from samples nationwide.

Keywords: Disease incidence, Hygienic management, LSD, Mosquitoes.

1. Introduction

In recent years, the increasing occurrence and resurgence of significant transboundary and emerging animal diseases have prompted notable financial and public health apprehensions on a global scale. These illnesses have a direct impact on food safety, leading to reduced access to and feasibility of premium animal products [1]. Among these, lumpy skin disease (LSD) has emerged as a particularly devastating threat to large domesticated animals like cattle, water buffalo, and wild bovine species [2], [3]. LSD is considered one of the most parsimoniously significant and reportable transboundary viral animal diseases identified by OIE (World Organization for Animal Health). It is also known as Neethling pseudo-urticaria, Pox virus disease, Exanthema nodularis bovis, and Knopvelsiekte [4]. The lumpy skin disease virus (LSDV), which belongs to the genus Capripoxvirus within the Poxviridae family, poses LSD. While LSDV shares close antigenic relations with sheep and goat poxviruses, it shows distinct phylogenetic differences [5], [6].
In 1929, LSD was first documented in Zambia and was initially believed to be limited to various regions within Africa, with periodic outbreaks recorded until 1986 [7]. Between 1986 and 1988, its spread beyond Africa began with occurrences in Israel, gradually extending to Eastern Europe, the Middle East, Russia, the Balkans, and more recently to South and East Asia [8]–[11]. This ongoing spread poses a significant threat to countries like Afghanistan, Pakistan, India, and even those with large cattle populations like Australia [10]–[12]. Transmission of LSD occurs through diverse vectors, including mosquitoes, biting flies, lice, ticks, and wasps, as well as direct contact of infected animals or exposure to polluted feed and water sources [5], [13]. The disease booms in hot and humid weather, particularly during rainy summers and autumns and in low marshy lands, creating ideal conditions for its spread [9], [14].

High comorbidity rates and low death rates characterize LSD. Depending on the host’s immune response, acute or prolonged clinical illness may manifest in infected animals [13]. In the acute stage, clinical indicators include a high body temperature, bulimia, lymphadenopathy, rhinitis, and characteristic skin lesions; in the chronic stage, poor output, infertility, and other consequences arising from the infection [13]–[17]. These impacts contribute to economic losses through reduced milk productivity, low-grade hides and meat, abortions, and occasional deaths [13]–[17].

Effectively controlling LSD necessitates a combination of measures, such as rigorous quarantine, limiting animal movement, immunizing against live attenuated vaccines, isolating and euthanizing afflicted animals, disposing of carcasses properly, cleaning and disinfecting the area, and controlling insects [14], [18], [19]. Genomic information is crucial in tracing infections, identifying mutations, and developing control strategies [20]–[22].

The livestock sector, including cattle farming, is vital in improving living standards, especially in developing regions like Bangladesh [23]–[25]. In 2019, Bangladesh experienced its first LSD outbreak, which affected numerous cattle populations nationwide, presenting a novel threat to livestock well-being. Subsequent outbreaks in 2020 spread rapidly across different regions, impacting thousands of cattle and causing around 50 deaths in the northern and northeastern provinces of the country [26]. Despite efforts to conduct detailed epidemiological and pathological studies, there remains a significant lack of crucial information at both district and national levels [27], [28]. However, diseases like LSD pose tremendous challenges to livestock farmers, highlighting the need for robust disease surveillance and control measures to safeguard both animal health and economic stability. As a result, this study targeted to investigate the prevalence of LSD in Bangladesh’s Rajshahi district and address various issues related to livestock management.

2. Methodology

2.1. Study Area

Rajshahi District is situated in north-western Bangladesh, bordered by the district of Naogaon to the north, Natore District to the east, Chapai Nababganj District to the west, and a small part of Kushtia District and the Padma River to the south. The district is divided into nine upazilas (subdistricts), including Tanore, Paba, Bagha, Bagmara, Puthia, and Godagari, which were chosen for this study. The study areas are depicted in Fig. 1. Between September 1, 2020, and December 30, 2022, a total of 39 small household cattle farmers and 99 cattle (N = 99) were analyzed.

2.2. Impacted Farmhouse Inspection and Data Acquisition

We developed and used a pre-structured questionnaire for data collection during the fieldwork. The researcher sent one questionnaire to every affected farm or family and interviewed each successive farm’s owner or responsible party. The socioeconomic information included the total number of cattle on the farm, the number of animals affected by LSD, and the percentage of cattle that died from illness. We noted the age, sex, and animal type (milk-producing cow, dry cow, pregnant heifer, calf, and bull), along with observations about limb swelling, intra-herd farm hygiene, mosquito curtains, and any administered treatments. After consulting the OIE manual to match the skin lesions’ features, we made a provisional diagnosis of LSD. We calculated the average percentage of skin nodules on body surfaces by visually estimating their coverage.

2.3. Morbidity Rate

The percentage of individuals in a specified topographical area who get a specific disease within a given period is known as the morbidity rate. It shows the frequency with which a disease appears in a particular area, encompassing illness or disease states, including injury, sickness, and disability. This classification includes both acute and chronic illnesses. Typically, we express the morbidity rate as a percentage.

Morbidity Rate

\[
\text{Morbidity Rate} = \frac{\text{Number of Cases of Disease} \times \text{Disability}}{\text{Population}} \times 100
\]

2.4. Mortality Rate

A mortality rate indicates the rate of death within a specific population over a defined time period. Metrics for morbidity and mortality share a mathematical similarity, differing in whether researchers aim to evaluate death rates or disease incidence. The following formula can be used to estimate the mortality rate within a particular population over a specified time frame:

Mortality Rate =

\[
\frac{\text{Number of Cases of Death} \times \text{Over a Period of Time}}{\text{Population}} \times 100
\]

2.5. Case-Fatality Rate

The percentage of individuals who pass away from a disease is represented by the case-fatality rate (cases). This metric serves to gauge the severity of a condition. The formula for calculating the case-fatality rate is as follows:
2.6. Data Management and Statistical Analysis

We entered all the collected data into an Excel sheet and conducted a descriptive analysis using Microsoft Office Excel and SPSS. The finding is considered significant if its probability value is less than 0.05.

3. Results

3.1. Distribution of LSD-Affected Animals in Rajshahi

There is a lack of adequate epidemiologic information regarding LSD in Bangladesh. Therefore, this research focused on investigating LSD in six upazilas of the Rajshahi district in Bangladesh using field study techniques. From 1 September 2022 to 30 December 2022, 39 small household cattle farmers from Tanore, Paba, Bagha, Bagmara, Puthia, and Godagari upazilas in Rajshahi District conducted the research, observing a total of 99 cattle (N = 99). The study found that LSD had the highest morbidity rate (71.42%), mortality rate (7.14%), and case fatality rate (10%) in Tanore and Puthia upazilas in Rajshahi. On the other hand, Godagari upazilla recorded the lowest morbidity rate (50%) (Fig. 2). Notably, this study recorded no mortality rate in Paba, Bagha, and Godagari upazilas. The case fatality rates in the selected areas were 10%, 9.09%, and 10% in Tanore, Bagmara, and Puthia upazilas, respectively.

3.2. Distribution of LSD According to Sex and Age

The study found that newly mature female animals (2–4 years old) were more susceptible to LSD infection, with a rate of 36.23%, compared to other age groups (Table I). Young bull cattle aged 2–4 years followed closely, with an infection rate of 33.33%. The infection rate also significantly affected young animals, especially calves. Bull calves (<2 years old) and heifer calves (<2 years old) experienced infection rates of 33.33% and 20.28%, respectively. In contrast, older cattle of both sexes showed lower susceptibility to LSD. Bulls (>4 years old) and cows (>4 years old) were affected by LSD at rates of 10% and 9%, respectively. Notably, calves of both sexes accounted for the majority of animal deaths. One bull calf (<2 years old) and three heifer calves (<2 years old) died due to LSD. The p-value for affected male animals was 0.0023, and for female animals, it was less than 0.0001 (Table I).
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### TABLE I: DISTRIBUTION OF LUMPY SKIN DISEASE ACCORDING TO SEX AND AGE

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age (Years)</th>
<th>Total number studied</th>
<th>Affected animals</th>
<th>Animals died</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>&lt;2</td>
<td>14</td>
<td>33.33%</td>
<td>1</td>
<td>0.0023</td>
</tr>
<tr>
<td></td>
<td>2–4</td>
<td>11</td>
<td>33.33%</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;4</td>
<td>5</td>
<td>10.00%</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>&lt;2</td>
<td>18</td>
<td>20.28%</td>
<td>3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td>2–4</td>
<td>42</td>
<td>36.23%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;4</td>
<td>9</td>
<td>9.00%</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

![Fig. 3. Occurrence of limb swelling related to age categories in cattle with the infection.](image)

![Fig. 4. Effects of intra-herd hygiene on LSD-affected cattle.](image)

3.3. Distribution of Limb Swelling According to Age Groups

This study found that LSD-positive young, mature cattle aged 2–4 years had the maximum limb swelling rate (18.18%), followed by the group under two years at 16.16%. These rates significantly differed from the older age group (>four years), which had a rate of 3.03% (Fig. 3). Notably, this study did not consider sex as a variable (p-value < 0.0001).

3.4. Effects of Intra-Herd Farm Hygiene on LSD

The study discovered that households with poor hygiene had a higher rate of cattle (42.43%) with LSD infection compared to those with good (1.01%) and medium (25.26%) hygiene (Fig. 4). However, it's important to note that the number of farms maintaining good hygiene practices was significantly low (p-value < 0.0001).

3.5. Using Mosquito Curtains in the Shed of Cattle at Night

The study also investigated the owners’ usage of mosquito nets on the farm at night. Surprisingly, most animal owners (89.74%) in the research areas did not use mosquito nets at night in their sheds (Fig. 5). Only about 10.25% of owners used mosquito nets.

4. Discussion

Lumpy skin disease (LSD) is a prevalent ailment among cattle in many regions worldwide, remarkably in Africa, where infected cattle act as usual carriers of the virus [29]. This highly contagious virus has been a significant financial burden on the cattle industry. LSD was initially documented in various African and Middle Eastern countries and later extent to Europe. However, in 2019, the World Health Organization (WHO) confirmed the existence of LSD’s in the Indian subcontinent, including India [30], China [31], and Bangladesh [32], where epidemiological data on LSD remains scarce. Consequently, this study designed to enhance our understanding of LSD in Bangladesh through field research. Using field study methods, we investigated LSD across six upazilas in Bangladesh’s Rajshahi district. We observed 99 small nodules (15–45 mm) on the entire body surfaces of the 99 suspected LSD-infected cattle examined, primarily on the neck and trunk regions [33]. These raised nodules are affected in the epidermis and dermis layers of the skin. Epidermal microvesicles developed into large vesicles that ruptured rapidly, leading to ulcerated areas infested with pathogens. This condition resulted in bacterial pneumonia, secondary infections, tracheal stenosis, and mastitis [34]. The ulcerated nodules healed slowly, resulting in months of incapacity for the affected animals. The rectal temperature ranged from 103 to 106.6 °F on average, accompanied by leg edema, particularly in the hock region, and mild lymphadenopathy [33]. Local lymph nodes are enlarged to ten times their original size, becoming edematous, congested, and infected with cellulitis [35].

The previously reported morbidity rate ranged from 2% to 85% [33]. In this study, the percentages of cattle...
affected by LSD were approximately 71.42%, 70%, 61.53%, 68.75%, 71.42%, and 50% in Tanore, Paba, Bagha, Bagmara, Puthia, and Godagari upazilas, respectively (Fig. 2). On the other hand, Biswas et al. found LSD prevalence rates of 63.33% and 52.38% in Monirampur and Abhaynagar Upazilas, respectively [33]. In the Badalgachi of Naogaon, Haque, and Gofur noted a prevalence rate of 49%, while in Dinajpur, Bangladesh, Sarkar et al. reported a prevalence of 41.06% [36, 37]. Conversely, Hasib et al. found a 10% incidence on industrial farms, with epidemic frequency ranging from 63.33% to 4.22% [38]. Cattle breed, host sensitivity, immunological condition of the herd, and insect or mechanical vector transmission all impact morbidity and mortality [39]. Biting flies and mosquitoes are the main biological transmitters of the disease, peaking in tropical nations like Bangladesh from July to October [40].

In this study, we observed mortality rates within the expected range despite evaluating fewer animals and conducting a shorter study. In endemic areas, mortality rates typically hover around 10%, leading to substantial economic losses [41]. However, in Tanore and Puthia, the rate of mortality was 7.14%, while it was 6.25% in Bagmara (Fig. 2). Notably, this study did not record any mortality in Paba, Bagha, or Godagari upazilas. Previous research by Biswas et al. found 1.59% and 3.33% mortality rates in the upazila of Abhaynagar and Monirampur, respectively [33]. At the same time, Haque and Gofur reported a mortality rate of 0.5%, while earlier studies showed mortality rates ranging from 0.99% to 2.12% [23], [37], and [42]. In contrast, the rate of fatality rates can range from 1% to 5% in endemic areas and may even reach up to 40% in epidemic areas [41]. In terms of case fatality rates, the study found 10% in Tanore and Puthia, and 9.09% in Bagmara (Fig. 2). Biswas et al. observed a case fatality rate of 5.26% in Monirampur and 3.03% in Abhaynagar, while Haque and Gofur noted 1% case fatality rate [33, 37]. While this study did not conduct an economic analysis, it noted significant financial losses due to draft power loss, clinical management, and vaccination costs, approximately 32 USD per animal [33].

This study observed a higher exposure to LSD infection among female animals aged two to four (36.23%) compared to other age groups (Table I). Specifically, young female animals aged 13–36 months showed a higher susceptibility (39.24%) than other age categories, with a significant difference (P < 0.05) compared to younger and older groups [33]. LSD affected 36.23% more female animals than males. A seroprevalence study in Uganda [43] also noted that female cows over 25 months had more infections than male calves. The length of exposure to the LSD virus increases the animal’s infection risk. High-yielding Holstein-Friesian cows may experience worsened LSD symptoms [44]. Our study observed young male cattle, but the susceptibility was higher in bull calves (33.33%) compared to older bulls (10%). Biswas et al. reported infection rates of 6.73%, 48.08%, and 6.73% in male animals aged 0–12 months, 13–36 months, and over 36 months, respectively, while Haque and Gofur found a 14.2% infection rate [33, 37]. A significant portion of male cattle became infected when age was not considered. Heavy labor fatigued the male animals, not biological factors [23, 45]. Furthermore, draft male animals could not protect themselves from biting flies, which could transfer LSD infection by attaching to the host body [33]. Compared to other age groups, Table I shows that both male (34.45%) and female (24.13%) calves contracted the infection. Calves that were housed closely and given special attention were able to avoid insect bites during the night [46]. However, most farmers lacked adequate biosecurity training. The living conditions on farms were inadequate, frequently failing to isolate sick animals. Usually, young calves are more prone to the disease, experiencing severe skin lesions due to a low transfer of immunity and poor health [47]. While the exact reasons need further investigation, rearing calves with sick mothers increased their sensitivity to LSDV, and malnourished calves succumbed to the viral infection.

This study revealed that LSD-positive young cattle aged 2–4 years had the highest rate of limb swelling (18.18%), which was notably different from other age groups, where it was 16.16% for cattle aged less than two years and 3.03% for those over four years (Fig. 3). Biswas et al. also observed that LSD-positive young cattle had the highest incidence of limb swelling (12.02%) within the 1–3 year age range [33]. In LSD-infected cattle, limb edema, lameness, and a reluctance to move were commonly observed [48]. Deep, subcutaneous, or intramuscularly inflamed skin nodules that extend to tendons and sheaths may cause lameness and arthritis [49]. Cellulitis, phlegmon, or joint swelling can also cause arthritis and lameness in cattle [35]. It’s vital to understand that age may cause limb swelling.

Mechanical vectors like flies and mosquitoes boom in environments with poor intra-herd hygiene. The ratio of cattle with LSD infection was higher in households with poor hygiene management (42.43%) than in households with good hygiene management (1.01%) and medium hygiene management (25.26%) (Fig. 4). Similarly, Biswas et al. discovered that farms with poor sterile management practices had a higher proportion of LSD-infected cattle (47.54%) compared to those with good (2.73%) and medium (9.29%) hygienic management practices [33]. Sub-par biosecurity measures, inadequate farm waste handling, and a dense presence of biting flies near the feedlot are likely the leading causes of viral transmission [50].

Recent studies have pinpointed intra-herd pest management and inadequate vaccination as potential factors contributing to the spread of LSD. Nonetheless, findings from this survey reveal that a significant majority of cattle owners (89.74%) do not utilize mosquito nets in their cattle shelters during the night (Fig. 5). Similarly, research by Biswas et al. highlighted that 97.81% of cattle owners do not deploy mosquito curtains in their livestock shelters during the night. Implementing mosquito nets, fly-repellent systems, and smoke generators can shield farm animals from biting flies and mosquitoes [33]. Infected insects bite, causing the LSD virus to replicate within blood and skin cells, leading to detectable viremia typically six days post-infection. Subsequently, skin nodules emerge on the surface roughly seven days after exposure [33]. Elevated virus concentrations are present in both skin lesions and blood, suggesting the potential for mechanical transmission by insects to other healthy animals [33]. However, LSD transmission through direct physical contact is rare [44].
5. CONCLUSION

Based on the comprehensive study conducted in the Rajshahi district regarding lumpy skin disease (LSD) in cattle, several conclusions and recommendations can be drawn to address the current situation and prevent further spread of the disease:

1. **Awareness and Education:** Launching a nationwide awareness campaign is crucial to educating farmers, veterinarians, and other stakeholders about LSD, its transmission modes, clinical signs, and preventive measures. This campaign should emphasize the importance of early detection, reporting, and proper management practices.

2. **Farm Hygiene and Management:** The study highlights the significant role of farm hygiene in LSDV distribution. Encouraging and assisting farmers in adopting good hygiene practices such as regularly cleaning cattle houses, proper waste disposal, and maintaining vector control measures (like mosquito nets) can reduce the risk of LSD transmission.

3. **Veterinary Services and Training:** Strengthening veterinary services in rural areas and providing training on LSD diagnosis, treatment, and prevention strategies can improve the overall management of the disease. This includes training on proper vaccination protocols, where available.

4. **Genomic Surveillance and Research:** Conducting extensive epidemiological studies nationwide, along with the isolation, identification, and genome sequencing of LSDV strains from various regions, can provide valuable insights into the disease’s dynamics and help develop targeted control measures.

5. **Targeted Vaccination Programs:** Where feasible and appropriate, implementing targeted vaccination programs for cattle populations at high risk of LSD infection, such as newly mature female animals and young bull cattle, can help reduce disease prevalence and its economic impact.

6. **Collaboration and Monitoring:** Collaborating with international organizations, neighbouring countries, and local authorities to share information, best practices, and surveillance data can strengthen disease monitoring and control efforts on a broader scale.

7. **Economic Impact Assessment:** Continuously assessing the financial impact of LSD on the cattle industry will help policymakers prioritize resources, allocate funding for research and control measures, and develop sustainable strategies to mitigate losses.

By combining these strategies and engaging various stakeholders in a coordinated effort, it is possible to effectively manage LSD outbreaks, protect vulnerable cattle populations, and safeguard the dairy industry’s economic stability.

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