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Hematobiochemical and Pathological Studies in Cattle Infected with Lumpy Skin Disease Virus

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Short title: Haemobiochemogram and Tissue Pathology in Lumpy Skin Disease.

ABSTRACT

The recent lumpy skin disease (LSD) outbreak caused significant livestock mortality and economic losses, particularly affecting adult females and exotic animals. This study aims to identify age-related clinical, hematological, biochemical, and pathological alterations in cattle naturally affected with LSD. This study has carried out a clinico-biochemical examination of blood samples received from diseased animals, along with post-mortem examination of the carcass (es) confirmed to have suffered from LSD by PCR and histopathological examinations. Haematological evaluation showed a decreasing trend in haemoglobin, total erythrocyte count, and packed cell volume with increasing age, while total leukocyte count differed significantly among the age groups. Biochemical analysis revealed alterations in serum enzyme activities and protein profile associated with LSD infection. Histopathological examination revealed occasional intracytoplasmic inclusion bodies, dermal vasculitis and marked lymphoid cell depletion in lymph nodes. The findings indicate age-related variations in the haematological response to LSD These findings provide baseline

information that may assist veterinarians in the clinical evaluation and management of LSD under field conditions.

Keywords: Bovine, Biochemistry, Haematology, Lumpy Skin Disease, Pathology.

INTRODUCTION

Lumpy skin disease (LSD) has recently re-emerged as a potential threat to the dairy industry. Being exotic to the Indian subcontinent, the disease appeared furious and devastating during the outbreak. Due to its viral origin, the disease has rapidly spread to a wide population of cattle and water buffalo and crippled the dairy economies. This disease is caused by the LSD virus (LSDV) of the family *Poxviridae,* also known as the Neethling virus, and results in the formation of cutaneous nodules, fever, swollen lymph nodes, and a decrease in milk yield, reproductive losses due to infertility (Yadav 2023). The virus is known to share genetic resemblance with goat pox and sheep pox virus (96% similarity) (Sumana et al. 2020). Though this disease is commonly prevalent in African countries, it has now extended its geographic range widely across many Asian countries, in addition to the European and Caucasian regions. The latest update on the LSD disease outbreak in Asia suggests its first emergence in Bangladesh in 2019, which quickly made its incursion into India, along with China and its surrounding countries by 2020 (Manjunatha Reddy et al. 2023). In India, the disease was first confirmed in 2019 (Sudhakar et al. 2020). However, due to its rapid spreading ability, the infection has been considered a List "A" disease by the World Organisation of Animal Health (formerly the OIE), and transmission largely takes place through biting by mosquitoes like *Aedes* and *Culex*, and ticks like *Ixodid*; however, direct contact transmission is highly unlikely (Bianchini et al. 2023). Economic losses due to this disease are very high, affecting both animal productivity and the leather industry through the loss of quality hides (Namazi and Khodakaram Tafti 2021). This study examines the systemic hemo-biochemogram and pathologic alterations in animals with LSD infections at various ages and stages, to offer better

understand disease and its impact on animal health, besides in handling infections for the future, in addition to inform clinical deviations from the earlier reported cases of LSD both within and outside the Indian subcontinent, if any.

MATERIALS and METHODS

A total of 40 blood samples were collected from LSDV-affected cattle collected at the Veterinary Teaching Clinical Complex, GADVASU, Ludhiana, or submitted by farmers from diseased farms in and around Ludhiana, Punjab, during the outbreak (over a period of 15 days from 01/08/2022 to 15/08/2022). Various haematological parameters and biochemical parameters were evaluated (MYTHIC 18 haematology analyser, Switzerland, Vitros DT60 chemistry system, USA) (Manjunathareddy et al. 2024). Gross and histopathological examination of cutaneous nodules and enlarged lymph nodes noted in a few post-mortem cases were also included in this study. DNA from skin nodule biopsy was extracted using DNeasy Blood and Tissue Kit, Qiagen, according to the manufacturer's instructions, and the extracted DNA was subjected to PCR using primers targeting viral attachment protein P32 gene (Forward: CTAAAATTAGAGAGCTATACTTCTT, Reverse: CGATTTCCATAAACTAAAGTG) (Heine et al. 1999). PCR conditions followed were initial denaturation at 95°C for 5 min, followed by 35 cycles of 94°C for 30 s, 43°C for 30 s, 72°C for 1 min, with a final extension at 72°C for 10 min.

Statistical analysis was performed using SPSS software version 15.0 (SPSS Inc., Chicago, IL, USA). Data were initially assessed for normality using the Shapiro–Wilk test, followed by non-parametric statistical methods for group comparison: Group A (under 3 years, 11 animals), Group B (3-6 years, 25 animals), and Group C (over 6 years, 4 animals). Differences in haematological parameters among the three age groups (<3 years, 3–6 years, and >6 years) were evaluated using the Kruskal–Wallis test, and pairwise comparisons between

groups (<3 vs 3–6 years, <3 vs >6 years, and 3–6 vs >6 years) were performed using the Mann–Whitney U test when overall significance $P < 0.05$ was observed. Bonferroni correction was applied to multiple pairwise comparisons, and a corrected P value <0.0167 was considered statistically significant for the post hoc analyses. Data are presented as mean ± standard deviation (SD), and a P value <0.05 was considered statistically significant.

RESULTS

A) Breed and age. Out of the total number of clinically affected animals (n= 40), the majority were female cows. Exotic breeds of cows suffered mostly in the outbreaks, followed by crossbred animals. Indigenous breeds and the non-descript breed were the least affected (Table 1). The age of the animals (cattle) varied between 1.5 years and 9 years.

Table 1: Breed-wise percent susceptibility of Cattle During the LSD Outbreak

Animals	**Total no. of affected animals (in the study)**	**Breed**	**Percentage**
1. Cattle	40	Holstein–Friesian (exotic)	47.5 %
		Jersey (exotic)	5 %
		Cross bred	32.5 %
		Sahiwal (Indigenous)	12.5 %
		Non-descript breed (Indigenous)	2.5 %

B) Clinical signs. Most of the animals had a history of high fever; there was formation and presence of cutaneous nodules on various parts of the skin (neck, chest, abdomen, udder, limb, perineal area) (Figure 1), inappetence, dyspnea, enlarged lymph nodes, brisket, and limb oedema along with reduced milk yield. Table 2 describes these listed clinical presentations

(symptoms) with their frequency distribution. Amongst all, the formation and presence of cutaneous nodules, drop in milk production, and enlargement of lymph nodes predominated and respiratory signs/distress were least detected.



Fig. 1 Cow affected with LSD showing listlessness and multiple cutaneous nodules

Table 2: Important clinical presentation in LSD affected animals and their incidences*.

Clinical signs	Frequency	Percentage
Skin nodules	35	87.5%
Lymph node enlargement	25	62.5%
Fever	21	52.5%
Anorexia	16	40%
Reduced milk yield	29	72.5%
Edema	10	25%
Respiratory signs	3	7.5%

*(n= 40)

C) Age-associated differences in clinical presentation and haematological findings.

***Animals less than 3 years of age (Group A)*:** This group had clinical presentation similar to commonly noted signs of the disease, which included high fever with nodules on the skin and loss of appetite. There was respiratory distress and lateral recumbency in one case. The affected animals exhibited low haemoglobin and packed cell volume values along with both a relative rise in eosinophil and neutrophil count and modest leucocytosis.

***Animals between 3 and 6 years of age (Group B)*:** Animals from this group experienced high and continual fever (104- 105º F) for nearly a week, nodules on the skin, and inappetence. Unlike the young ones, these animals had enlarged peripheral lymph nodes, edema of the brisket and ventral region, particularly near the midline, including the distal limb, and reduced milk yield. Erythrogram showed leucopenia along with lower haemoglobin and packed cell volume values, indicating anemia. Macrocytic changes in erythrocytes were seen.

***Animals above 6 years of age (Group C)*:** Clinically, the affected animals had fever, nodules on the skin, inappetence, and enlarged lymph nodes with brisket edema. However, since this group included only four animals, as they were only present during the period of study, our interpretation of the findings for this group is limited and interpreted cautiously. . The haematological profile indicated low haemoglobin and packed cell volume, suggesting the presence of anaemia. It is accompanied by an increased neutrophil count. Table 3 describes the changes in the haematological values after natural infection with the lumpy skin disease virus across different age groups presented to clinics during the period of study.

Table 3: Changes in haematological parameters in clinically presented LSD affected animals during the study.

Parameters	**< 3 years age group (% affected)**	**3-6 years age group (% affected)**	**> 6-year age group (% affected)**
Hb			
<8 g/dl	3\11 (27.27%)	11\25 (44%)	2\4 (50%)
8-15 g/dl (normal range)	8\11 (72.27%)	14\25 (56%)	2\4 (50%)
TEC			
Erythropenia (< 5-10×10 ^{6}/µl)	1\11 (9.09%)	7\25 (25%)	1\4 (25%)
Normal range (5-10×10 ^{6}/µl)	9\11 (81.81%)	18/25 (72%)	3\4 (75%)
Erythrocytosis (> 5-10×10 ^{6}/µl)	1\11(9.09%)	0	0
PCV			
<24%	3\11 (27.27%)	11\25 (44%)	2\4 (50%)

24-46 % (Normal range)	8\11 (72.27%)	14\25 (56%)	2\4 (50%)
TLC			
Leucopenia (< 4-12×10^3/µl)	0	12\25 (48%)	0
Normal range(4-12×10^3/µl)	9\11 (81.81%)	10\25 (40%)	3\4 (75%)
Leucocytosis (> 4-12×10^3/µl)	2\11 (18.18%)	3\25 (12)%	1\4 (25%)
DLC			
Neutrophillia	4\11 (36.36%)	7\25 (28%)	4\4 (100%)
Lymphocytosis	1\11 (9.09%)	4\25 (16%)	0
Eosinophils (in the higher range)	5\11	5\25 (20%)	0
Anemia			
Mild	1\11 (9.09 %)	2\25 (8%)	0
Macrocytic hypochromic	1\11 (9.09 %)	4\25 (16 %)	0
Macrocytic normochromic	0	2\25 (8 %)	1\4 (25%)
Normocytic hypochromic	1\11 (9.09 %)	1\25 (4 %)	1\4 (25%)

D) Comparative analysis of haematological parameters of animals affected with LSD during the period of study.

Additionally, we attempted a comparative analysis of haematological parameters (indices) between groups (i.e., between ages). Since a healthy control group was not included in the study group, the observed variations may indicate possible haematological changes associated only with LSD infection under field conditions. Table 4 describes the potential and specific effects of LSD infection. The table showed that the haemoglobin, total erythrocyte count and packed cell volume showed a decreasing trend with increasing age, although the differences among the groups are not statistically significant ($P > 0.05$). Platelet counts were comparable among the 3 groups ($P = 0.977$). Total leukocyte count differed significantly among the age groups ($P = 0.032$). Pairwise comparison revealed that animals in the <3 years group had significantly higher TLC compared to the 3–6 years group (Mann–Whitney U test, Bonferroni-adjusted exact $P = 0.016$), whereas no significance difference were observed between the other age group comparisons. Neutrophil counts differed significantly among the age groups ($P = 0.021$), with pairwise analysis showing significantly higher values in animals aged >6 years

than in those aged 3–6 years (Bonferroni-adjusted exact P = 0.003). Similarly, lymphocyte counts differed significantly among the age groups (P = 0.026), with significantly lower values in animals aged >6 years compared to those aged 3–6 years (Bonferroni-adjusted exact P = 0.004). However, these findings should be interpreted cautiously because the >6-year age group included only four animals, which may limit generalizability. Although eosinophil counts did not differ significantly among the age groups (P = 0.185), the younger age group (<3 years group) showed a relatively higher mean eosinophil count.

Table 4: Haematological values as mean ± SD in the lumpy skin disease-affected animals during the study

Parameters	< 3 years age group	3-6 years age group	> 6-year age group	P value
Haemoglobin	9.79 ± 2.29	8.18 ± 2.20	7.97 ± 2.21	0.16
TEC	6.83 ± 1.81	5.48 ± 1.12	5.28 ± 0.69	0.055
PCV	29.02 ± 6.16	25.20 ± 6.54	24.27 ± 5.89	0.221
Platelet	317.64 ± 174.34	301.07 ± 185.24	328.25 ± 175.62	0.977
TLC	11181.81 ± 7860.13	6484 ± 4646.02	9550 ± 2600.64	0.032
Neutrophil	41.82 ± 22.39	43.20 ± 19.60	77.50 ± 9.98	0.021
Lymphocyte	51.82 ± 21.17	52.64 ± 18.66	21.50 ± 8.85	0.026
Eosinophil	6.36 ± 5.85	4.16 ± 4.07	1 ± 1.15	0.185

Data are presented as mean ± SD. P values represent the overall comparison among the three age groups using the Kruskal–Wallis test. Pairwise comparisons were performed using the Mann–Whitney U test with Bonferroni correction when the overall test was significant

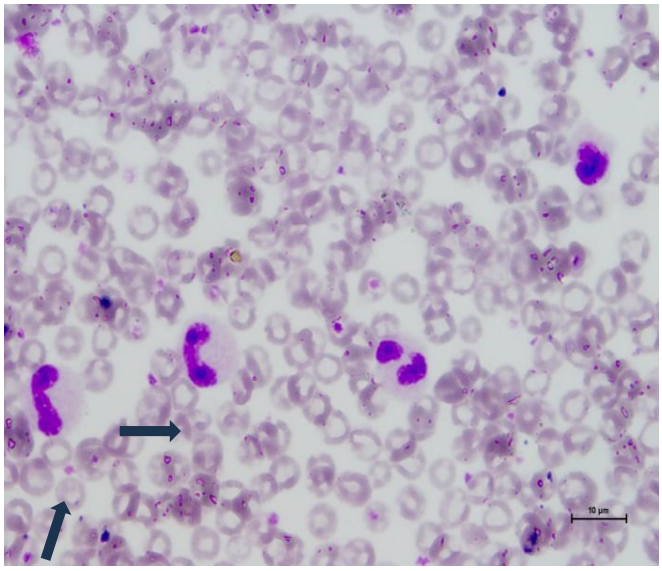
E) Biochemical parameters. Unlike hematologic investigations, serum biochemical analysis was carried out on individual samples without categorising the samples on the basis of age (Table 5).

Table 5. Changes in serum biochemical parameters in LSD affected animals during the study.

Serum Mineral/Enzymes	MEAN± S.D.	Normal range
Ca	4.81±0.395	8.4-11
Mg	1.38±0.385	1.7-3
BUN	14.88 ± 6.07	7.8-25
Creatinine	1.22±0.54	0.6-1.8
GGT	30.55± 3.94	4.9-26
Total protein	6.17± 0.82	6.2-8.2
Albumin	2.4± 0.23	2.3-3.9
AST	212.22± 39.38	45-110
ALT	32.0± 6.30	35-69
ALKP	153.67 ± 106.63	18-153

(n= 40 animals)

F) Blood smear examination of affected cattle: Haematological examination revealed many activated reactive lymphocytes along with the presence of many band cells (Fig. 2A, 2B).



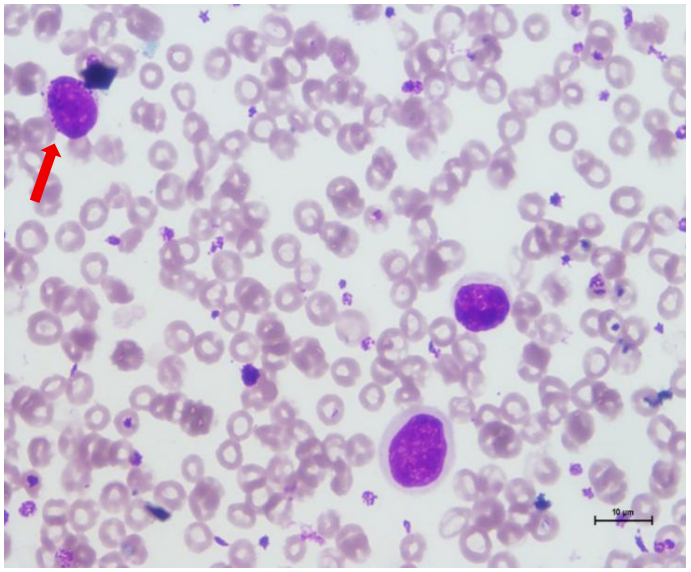


Fig. 2A Blood smear showing band cells (black arrows) (Leishman Stain, 100x oil immersion); **Fig. 2B** Blood smear showing activated lymphocytes (red arrows) (Leishman Stain, 100x oil immersion)

G) Gross and histopathological findings.

Upon gross examination of dead animal(s), the significant lesions noted are multifocal to coalescing, circumscribed, firm subcutaneous nodules, flat to slightly raised in outline, commonly noticed on the neck, dorsal, and lateral body surfaces (Figure 3A). Upon dissection, several to many multifocal red to dark brown necro-haemorrhagic regions were found within subcutaneous or muscle tissues (Figure 3B). The superficial lymph node (s) were found to be edematous with the presence of suffusive haemorrhage (Figure 4A, B).



Fig. 3A Skin showing well-circumscribed (see red circular zone) raised subcutaneous nodules. **Fig. 3B** Dermis with several to many dark brown necro-haemorrhagic regions (arrows)



Fig. 4A Lymph node enlarged and edematous; **Fig. 4B** Lymphnode showing intense haemorrhagic lesions diffusely effacing the cortico-medullary distinction

Histologically, there was epidermal necrosis, intra-epidermal clefting with hair sheath disintegration and dermal edema (Figure 5A). In some places, characteristic eosinophilic intracytoplasmic inclusion bodies in the granulosa (*stratum granulosum*) and prickle cell layer (*stratum spinosum*) were present along with ballooning degeneration of epithelial cells (Figure 5B). Blood vessels of various calibre within the deeper region, especially the reticular dermis and deep dermis, including the hypodermal junction, had marked fibrinoid necrosis and vasculitis, edema, accumulation of both neutrophils and lymphoplasmacytic cells, capillary proliferation, and moderate expansion of the interfibrillar zone (Figure 6). In lymph nodes, there was massive widening of the capsular sinus and widespread presence of fibrino-necrotic materials, including predominant neutrophils and some lymphoplasmacytic cell infiltrates. There was a loss of lymphoid cells from the secondary lymphoid follicle with indistinct cystic cavitation. There was a complete loss of distinction between the capsular sinus and cortex and trabecular sinus. (Figure 7). The medullary cords were inundated with numerous extravasated erythrocytes and fibrino-necrotic materials, with neutrophilic to lymphoplasmacytic cell infiltrations.

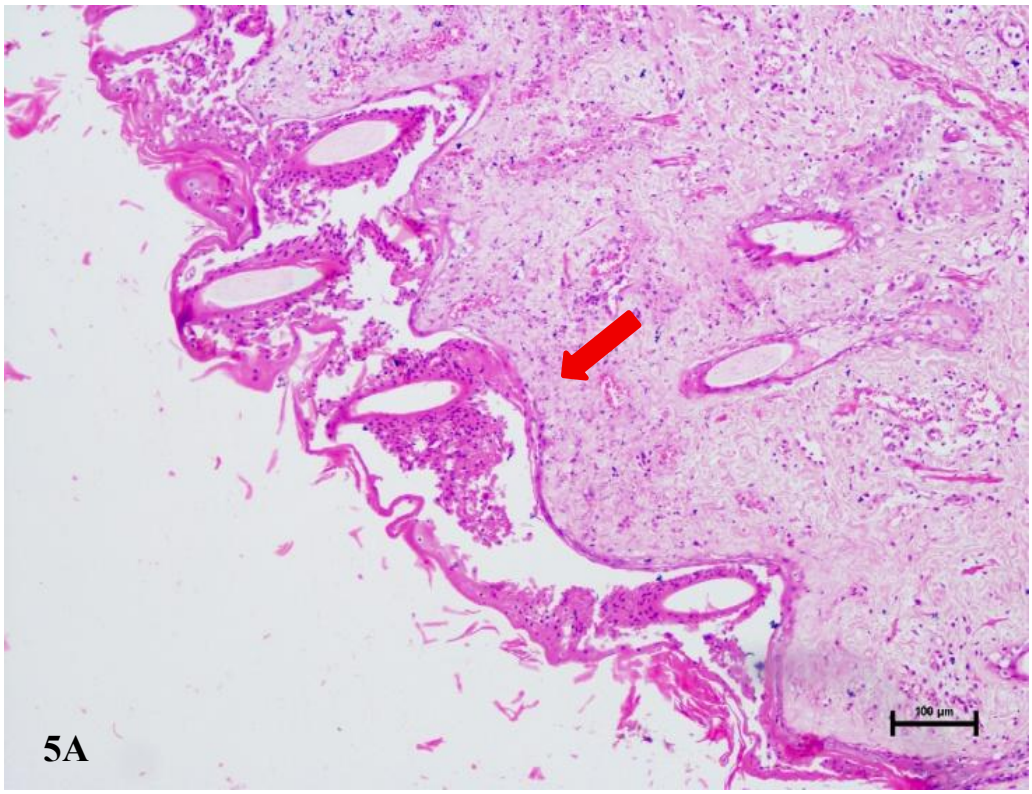


Fig. 5A Skin: Showing epithelial and hair sheath necrosis (arrows) (H.E., x20)

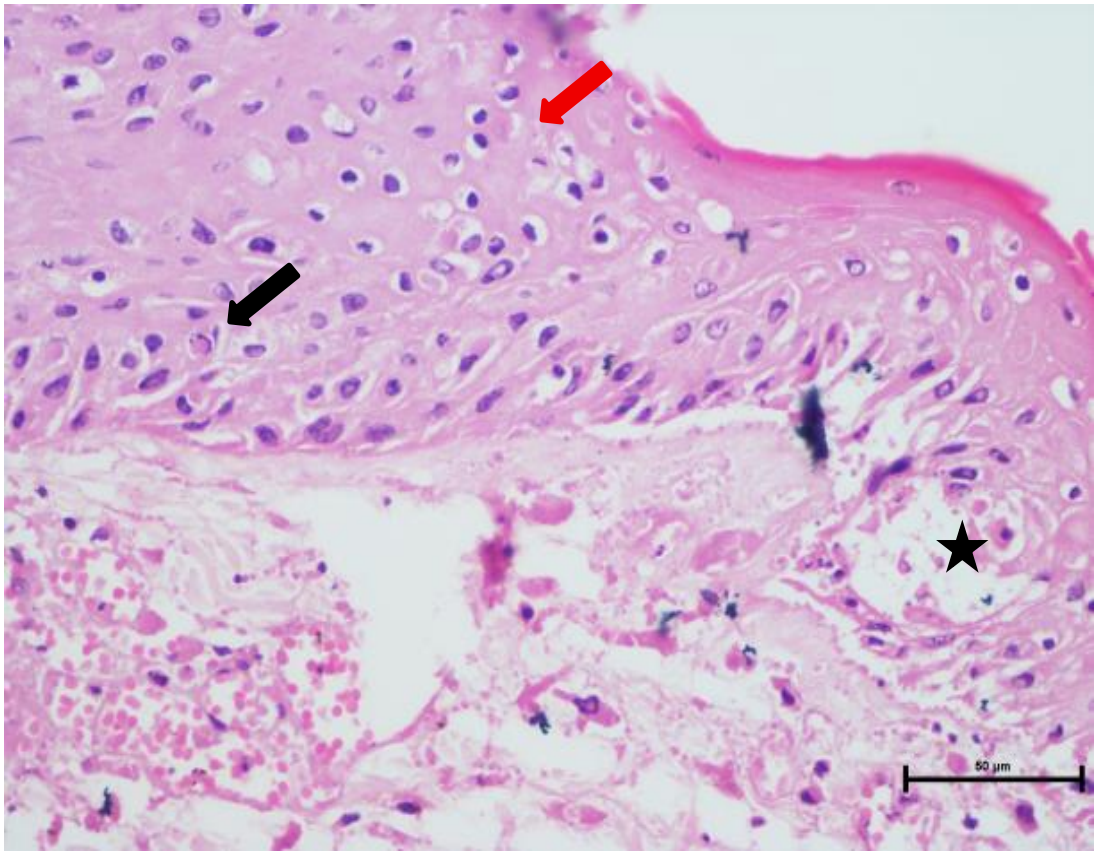


Fig. 5B Skin showing occasional eosinophilic intracytoplasmic inclusion bodies in the *granulosum* layer (black arrows), epidermal ballooning (red arrow). Note the formation of cystic cavitation (see star) in the epidermal layer, besides edematous (E) and vascular changes (H. E., x40)

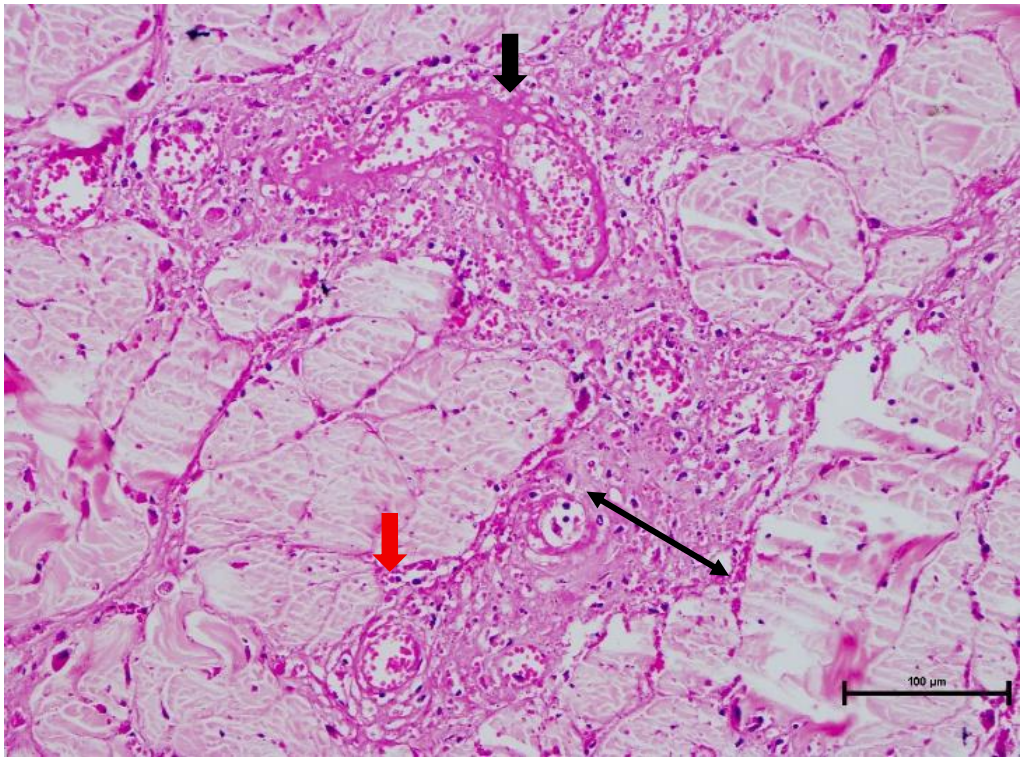


Fig. 6 Skin: Dermis showing intense fibrinoid necrosis of dermal blood vessels (black arrows). Note the expansion of connective tissue stroma (line arrow), and necrotic changes in collagen fibres (red arrow) (H.E., x20)

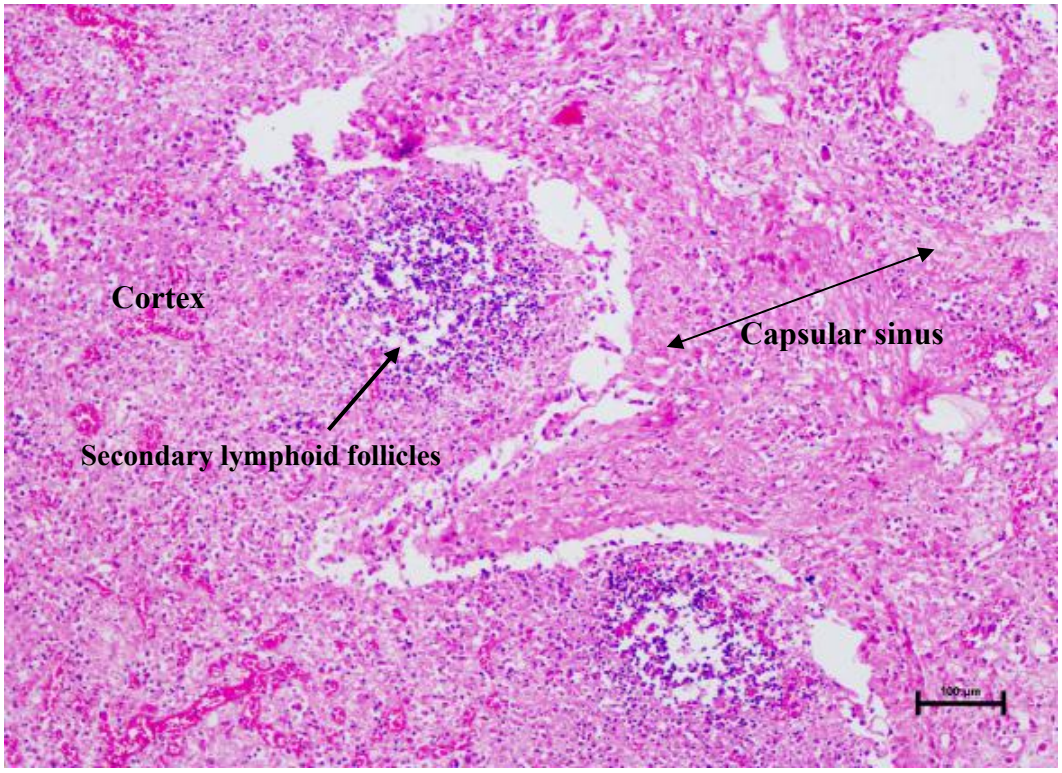


Fig. 7 Lymph node: Showing complete loss of distinction between the capsular sinus and cortex and trabecular sinus. Please note the loss of lymphoid cells from follicles (H. E., x20)

The disease was confirmed at the laboratory level by employing polymerase chain reaction (PCR) using DNA extracts obtained from skin nodule biopsies, targeting P32-specific gene amplification, which confirms capripox virus infection. The resultant PCR-amplified and delivered amplicon corresponds to a 390 bp band size (Fig.8).



Fig. 8 Agarose gel showing distinct and specific amplification of the P32-specific gene from a suspected skin sample, thereby confirming Capripox virus infection. Lane: M: DNA ladder (100 bp); Lane 1 – skin biopsy sample showing positive amplicon; Lane 2: negative control showing no amplification

DISCUSSION

Lumpy skin disease (LSD) is an endemic cattle disease affecting Africa, the Middle East, and Turkey, causing economic losses and affecting food security and imposing strained trading relations between countries (Rossiter and Al Hammadi 2009). Now, this disease has reached India, where it has caused numerous outbreaks in different states and resulted in high morbidity and heavy mortalities. The present investigation, being naive to the Indian state of Punjab, is largely unknown to its progression and impact on animal health has attempted to provide a comparative assessment of hematobiochemical alterations in different ages of animals suffering a natural outbreak of Lumpy skin disease (LSD) virus. It also documents the pathological changes observed in the initial fatal cases, offering valuable firsthand insights into this emerging livestock disease. Clinically, the disease was characterised by the presence of

high fever, proliferative skin nodules, enlarged superficial lymph nodes, brisket edema, subcutaneous swelling of limb edema with varied haematological and serological deviations. These clinical symptoms were previously reported by several workers (Agag et al. 1992; Neamat-Allah 2015; Jalali et al. 2017). The affected animals (<3 yrs of age) exhibited low haemoglobin and packed cell volume values along with a relative rise in both eosinophil and neutrophil count and modest leucocytosis. Eosinophilia is commonly noticed in the first few days of LSD infection (Jalali et al. 2017). In viral disease, a reduced proliferation of lymphocytes is common, allowing more margination of neutrophils with resultant migrations across tissues, temporarily to satiate the immediate tissue demand (Jalali et al. 2017). Furthermore, concurrent vasculitis, inflammation and secondary bacterial infections may further stimulate myelopoiesis, leading to transient neutrophilia (Pascutti et al. 2016; Sanz-Bernardo et al. 2020). Erythrogram results from animals aged between 3-6 years showed similar leucopoenia and erythropenia with slightly more aggressive anemia characterized by lower haemoglobin value and packed cell volume and macrocytic erythrocytosis (RBCs) distributions. Possibly this type of anaemia develops as a result of a strong antiviral response following release of pro-inflammatory cytokines that results in more destruction to bone marrow than the virus itself and thus perhaps contributes to viral persistence in animals (Neamat-Allah 2015; Pascutti et al. 2016). The accompanying leukocytosis suggests that these animals were likely in the later stage of infection (≥8 days post-infection) or had a relatively stronger immune response that delayed disease progression (Jalali et al. 2017). Similarly, in the animals above > 6 years, the erythrogram results showed severe anaemia, due to very low haemoglobin and packed cell volume. This may reflect prolonged viral persistence with sustained inflammatory responses leading to haematopoietic stem cell exhaustion and chronic anaemia, along with Reduced bone marrow responsiveness to erythropoietin, possibly

associated with renal impairment (Morceau et al. 2009; Latimer 2011). Furthermore, all the animals from this group had exhibited neutrophilia.

Biochemical analysis in LSD-affected cattle revealed hepatic stress, indicated by increased AST and GGT enzyme levels (Bal et al. 2022; Shilpa et al. 2022; Yadav 2023). As AST is not liver-specific, its increased level may also suggest damage to the heart/skeletal muscle caused by the virus (Kamr et al. 2022). This was accompanied by disturbances in serum mineral homeostasis, particularly hypocalcemia and hypomagnesemia. Although some studies link mineral decline to renal involvement (Allam et al. 2021), our normal renal function parameters indicated that the observed alterations are consistent with hepatic and metabolic involvement rather than overt renal dysfunction.

According to an experimental study (Sanz-Bernardo et al. 2020), the developed cutaneous nodule in the disease is typically noticed after 6 or 7 days of infection, and ultimately progresses to necrotic lesions. In the present study, the cutaneous lesions consisted of well-circumscribed nodules without obvious crust formation, which may indicate that the lesions were examined possibly by or after 6-7 days of infection and before the possible progression to advanced necrotic changes.

The histopathological lesion revealed trans epidermal degeneration and necrosis along with predominant deep dermal lesions, which consisted of vasculitis associated with vascular degeneration and necrosis. These findings are consistent with previous reports which describes dermal vasculitis as a predominant feature, although the virus exhibits epitheliotropic affinity for the simple squamous epithelium (Sanz-Bernardo et al. 2020; Gammada et al. 2022; Manjunathareddy et al. 2024). The developed vasculitis with concomitant necrosis is believed to be due to the development of infarction as a consequence of thickened tunica media and narrowed blood vessels. Similar lesions were described in cattle in earlier studies (Tageldin et

al. 2014; Abdallah et al. 2018). According to an experimental study (Sanz-Bernardo et al. 2020), the developed cutaneous nodule in the disease is normally noticed after 6 or 7days of infection, which arises as raised, firm, circumscribed nodule(s) and then progresses chronically to become sunken central necrotic lesions and peels off by itself. The dead animal(s) examined by us in the present study were perhaps in the early phase of infection with increased severity and succumbed to infection, had circumscribed cutaneous nodules with prominent lymph node swelling and were probably in the diseased phases, i.e. after the first week of infection. Histological lesions described as damage to papillary and reticular dermis along with ballooning degeneration and presence of intracytoplasmic inclusion bodies were consistent with previously reported work by (Neamat-Allah 2015) and (Sanz-Bernardo et al. 2020). Unlike the previous reports, we noted pronounced extra-cutaneous LSDV lesions only in lymph nodes, and it lacked mucosal lesions.

In conclusion, the present study showed that LSD affected cattle exhibited alterations in haematological and biochemical parameters, with some variations among different age groups. Alterations in the haematological indices and in the serum biochemical profile, particularly a decrease in protein synthesis, changes in hepatic, cardiac, and kidney enzyme profiles, suggest systemic involvement during the course of infection. Although adult animals appeared to show relatively more severe clinicopathological changes, we interpreted these findings cautiously, because of the limited and uneven sample distribution among age groups, particularly in Group C (>6 years; n = 4). However, one limitation of this study is the absence of a healthy control group. Haematological and biochemical values were compared with published reference ranges rather than with values from healthy animals sampled at the same time. Overall, this study provides preliminary field-based information on age-associated haematological and biochemical alterations in LSD-affected cattle in this region, which may help generate substantial data for clinicians and pathologists to look for and also raise

awareness among veterinarians and farmers to gain a quick grasp on the control of these economically awful diseases of livestock. However, we suggest that further studies with larger, more balanced sample sizes, including healthy control animals, are needed to confirm these observations.

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STATEMENT & DECLARATIONS

FUNDING- The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

CONFLICT OF INTEREST- The authors have no conflict of interest.

AUTHOR CONTRIBUTION- S.S. Bal wrote the manuscript, S. Deshmukh did histopathological interpretation and correction of the manuscript, T. Gupta performed PCR, and V. Mahajan analysed biochemical parameters.

DATA AVAILABILITY STATEMENT- Data will be available upon request.

ETHICS APPROVAL

This study involved clinical cases of animals presented for routine diagnosis and treatment of naturally occurring Lumpy Skin Disease. No experimental procedures were performed; all sample collection was part of standard veterinary care. Therefore, formal ethical approval was not required. Animal handling followed accepted veterinary practices.

ABBREVIATIONS

ALKP / ALP Alkaline Phosphatase

ALT Alanine Aminotransferase

AST Aspartate Aminotransferase

BUN Blood Urea Nitrogen

DLC Differential Leukocyte Count

DNA Deoxyribonucleic Acid

GGT Gamma-Glutamyl Transferase

Hb Hemoglobin

HE Hematoxylin and Eosin

IFN Interferon

IL Interleukin

LSD Lumpy Skin Disease

OIE World Organisation for Animal Health (formerly Office International des Epizooties)

PCV Packed Cell Volume

PCR Polymerase Chain Reaction

RBC Red Blood Cell count

SD Standard Deviation

TEC Total Erythrocyte Count

TLC Total Leukocyte Count

TNF Tumor Necrosis Factor

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