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STREPTOCOCCUS UBERIS INDUCED SEPTICAEMIA ASSOCIATED WITH RUMINAL IMPACTION, ABOMASAL PERFORATION AND INTESTINAL VOLVULUS IN A COW

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Abstract: A six-year-old Holstein Friesian crossbred female cow was presented to the Veterinary Clinical Complex with the history of falling while grazing that progressed to lateral recumbency. On general clinical examination, the animal was found to be weak, unresponsive and showed signs of dehydration with sunken eyes and dry mucous membranes. The left paralumbar fossa appeared markedly distended and on ballottement the rumen felt firm and doughy with no evidence of normal ruminal contractions. Despite supportive treatment, the overall condition indicated a grave prognosis and the cow died. On post-mortem examination, pulmonary oedema and congestion, bloat line in oesophagus, ruminal impaction with rumenitis, ulcerative abomasitis and intestinal volvulus at the level of ileum along with oedematous and haemorrhagic mesenteric lymph nodes were observed. The epicardial and endocardial surfaces of heart had numerous petechiae and ecchymoses. Blood smears revealed numerous cocci arranged as chains. Samples collected from the heart blood swab for microbiological culture yielded *Streptococcus spp*. The purified PCR product was sequenced and the resulting nucleotide sequence was subjected to similarity analysis using BLAST. The sequence analysis revealed ≥ 99% homology with *Streptococcus uberis*. The combination of mechanical digestive disturbances and compromised mucosal integrity likely facilitated systemic bacterial invasion, culminating in septicaemia. The findings emphasize the importance of early recognition and aggressive management of gastrointestinal disorders in cattle to prevent secondary systemic complications. Furthermore, this report highlights the pathogenic potential of *S. uberis* beyond its commonly recognized role in mastitis, warranting consideration in cases of bovine septicaemia with concurrent gastrointestinal lesions.

Keywords: Cow, ruminal impaction, intestinal volvulus, abomasal perforation, *Streptococcus*, septicaemia

1. INTRODUCTION

The genus *Streptococcus* comprises Gram-positive, catalase-negative cocci that occur singly, in pairs or most commonly in chains and includes numerous species that function as commensals as well as opportunistic and obligate pathogens in humans and animals. In cattle,

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members of the *Streptococcus bovis / Streptococcus equinus* complex (SBSEC), including *S. bovis*, *S. equinus*, *S. lutetiensis* and *S. infantarius*, constitute an important component of the normal rumen microbiota and play a central role in carbohydrate fermentation through lactic acid production. Under normal ruminal conditions, the population density of these organisms is tightly regulated by rumen pH, motility and microbial competition. Alterations in rumen environment caused by dietary imbalance, ruminal stasis, impaction, rumenitis or acidosis can lead to overgrowth of SBSEC organisms, resulting in epithelial irritation, mucosal damage and increased permeability of the ruminal wall [Nagaraja and Lechtenberg, 2007]. Gastrointestinal emergencies such as ruminal impaction, perforating abomasal ulcers and intestinal volvulus are known to predispose animals to bacterial translocation due to ischemic, inflammatory and necrotic injury of the gastrointestinal wall. Once the mucosal barrier is compromised, these organisms may translocate into the portal or systemic circulation, where they can initiate septicaemia characterized by widespread endothelial injury, vascular leakage, disseminated haemorrhages and multiorgan dysfunction. These organisms have been frequently associated with septicaemias in bovines, especially in neonatal and young calves, particularly under conditions of stress or immunosuppression [Smith, 2015].

S. uberis is phylogenetically distinct from SBSEC organisms and is widely recognized as an environmental pathogen in cattle, with the bovine gastrointestinal tract serving as an important ecological reservoir. Despite its presence in the gastrointestinal tract, *S. uberis* is not typically associated with primary gastrointestinal disease. Instead, its epidemiological importance lies in its ability to act as a source of infection for the mammary gland. The predominant route of infection involves transfer from faeces to the environment, followed by colonization of the teat end and subsequent ascension into the mammary gland, resulting in intramammary infection and mastitis [Krömker and Leimbach, 2017]. The present report documents a rare and informative case of septicaemia caused by *S. uberis* in an adult cow associated with ruminal impaction, abomasal perforation and intestinal volvulus.

2. CASE HISTORY AND CLINICAL EXAMINATION

A six-year-old Holstein Friesian crossbred female cow was presented to the Veterinary Clinical Complex with a history of sudden collapse while grazing, followed by rapid progression to lateral recumbency. The animal had shown no prolonged signs of illness prior to the acute episode. On clinical examination, the cow was found to be severely depressed, weak and unresponsive to external stimuli. Marked dehydration was evident, as indicated by

sunken eyeballs, prolonged skin tenting, dry oral and nasal mucous membranes. The left paralumbar fossa was markedly distended, producing a visible abdominal asymmetry. On ballottement, the rumen was firm and doughy in consistency and auscultation revealed complete absence of normal ruminal contractions, suggestive of severe ruminal stasis or impaction. Deep abdominal palpation elicited signs of discomfort, indicating visceral pain. Rectal examination revealed absence of faecal material in the rectum, further supporting the diagnosis of gastrointestinal obstruction. Based on the severity of clinical signs, rapid deterioration and poor response to initial supportive and symptomatic treatment, the prognosis was considered grave. The animal succumbed within a short period following presentation.

3. MATERIALS AND METHODS

A complete necropsy was performed in accordance with standard post-mortem examination protocols at the Department of Veterinary Pathology, Veterinary College and Research Institute, Orathanadu, Tamil Nadu. Necropsy was initiated within two hours after death. The carcass was examined systematically and gross lesions were documented. Representative samples from major organs, affected tissues and heart blood swabs were collected aseptically, for further confirmation. Impression smears were prepared from heart blood and selected organs and subjected to gram staining for direct microscopic examination. Heart blood samples were inoculated on blood agar and MacConkey agar media for isolation and identification of the etiological agent using standard microbiological techniques.The pure culture obtained was subjected to genomic DNA extraction (Qiagen DNeasy Blood and Tissue Kit) according to the manufacturer's instructions. The extracted DNA was subjected to PCR amplification targeting the 16s rRNA gene using universal primers: 27F (5′–AGAGTTTGATCMTGGCTCAG–3′) and 1492R (5′–TACGGYTACCTTGTTACGACT T –3′). The PCR reaction mixture (25 µL) consisted of template DNA, primers, dNTPs, Taq DNA polymerase and reaction buffer with MgCl2. Amplification was carried out with an initial denaturation at 95°C for 5 minutes, followed by 30–35 cycles of denaturation at 95°C for 30 seconds, annealing at 55°C for 30 seconds and extension at 72°C for 1 minute with a final extension at 72°C for 7 minutes. The PCR products were analysed by agarose gel electrophoresis and the amplified product was purified and subjected to Sanger sequencing. The obtained sequence was analysed using NCBI BLAST at the National Center for Biotechnology Information database [Zadoks et al., 2003].

4. RESULTS

4.1. GROSS PATHOLOGICAL FINDINGS

The condition of the carcass was fair and partial rigor mortis was observed. Marked abdominal distension and moderate rectal prolapse were observed **(Figure 1 and 2)**. The conjunctival mucous membranes were markedly congested. Subcutaneous tissues contained adequate fat reserves and revealed numerous diffusely distributed petechial and ecchymotic haemorrhages **(Figure 3)**. A bloat line was observed in the oesophagus, characterized by congestion of the proximal segment and pallor of the distal portion **(Figure 4)**. The tracheal lumen contained abundant blood-tinged frothy fluid indicating pulmonary oedema and the tracheal mucosa was severely congested. Both lungs were diffusely mottled reddish and showed patchy areas of collapse interspersed with regions of emphysema. The interlobular septa were prominent. On cut section, copious blood-tinged frothy fluid exuded from the pulmonary parenchyma. Heart had extensive petechial and ecchymotic haemorrhages on both epicardial and endocardial surfaces (**Figure 5**).

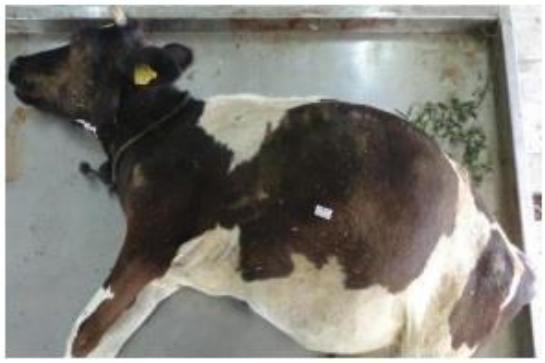

Figure 1: Carcass having marked abdominal distension.

Figure 2: Carcass having moderate rectal prolapse.

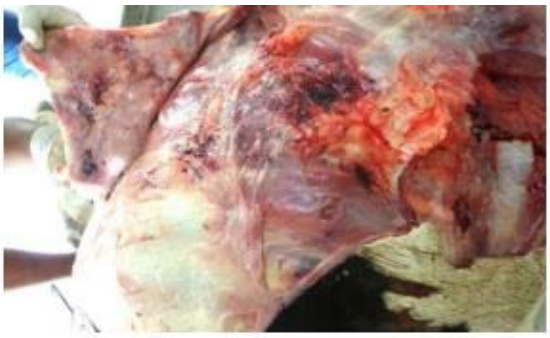

Figure 3: Subcutaneous tissues showing numerous diffusely distributed petechial and ecchymotic haemorrhages, characteristic of septicaemic vascular injury.

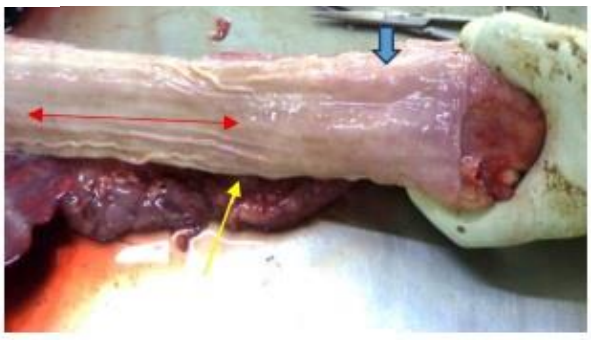

Figure 4: Oesophagus showing bloat line (thin arrow) characterised by congested proximal mucosa (thick arrow) and pale middle and distal portion of the oesophageal mucosa (double headed arrow).

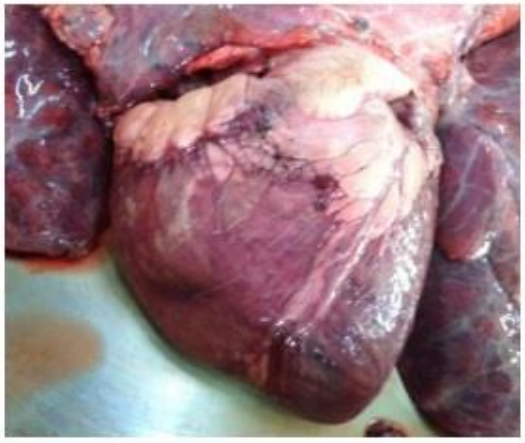

Figure 5: Epicardial surface of the heart showing petechial and ecchymotic haemorrhages.

Figure 6: Markedly distended rumen containing greenish fibrous, dry, firm and caked ingesta.

The liver was moderately enlarged, markedly pale and yellowish in colour, with rounded margins, suggesting fatty change. The gall bladder was distended with a large volume of thin greenish bile consistent with anorexia. The kidneys were pale with mild petechiations, and the renal capsule peeled off easily. The rumen was markedly distended compressing the diaphragm and thoracic organs. It contained greenish fibrous, dry, firm and caked ingesta along with phytobezoars **(Figure 6)**. The ruminal mucosa was moderately congested. The omasum was similarly distended and impacted with dry contents. The abomasum exhibited a large, focally extensive perforating ulcer measuring approximately 10 cm in length, extending through the mucosa and muscularis and was covered with blood clots and fibrinous exudate **(Figure 7)**. Approximately, two feet of the ileum was twisted around its mesenteric attachment, indicating intestinal volvulus **(Figure 8)**. The affected intestinal segment contained bloody luminal contents and the mucosa was intensely haemorrhagic and necrotic. The mesentery and omentum supplying the affected segment showed marked vascular congestion and dilation. The mesenteric lymph nodes were enlarged, diffusely reddish and oedematous, reflecting intense antigenic stimulation and systemic dissemination of infection. The spleen appeared congested on cut section,

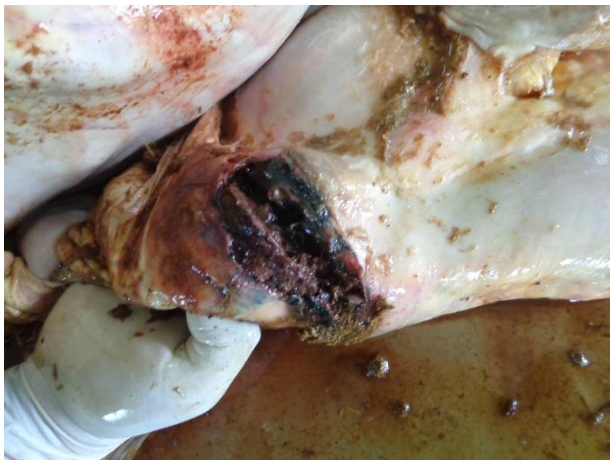

Figure 7: Abomasum showing a large, focally extensive perforating ulcer measuring approximately 10 cm in length, extending through the mucosa and muscularis into the serosa and covered with blood clots and fibrinous exudate.

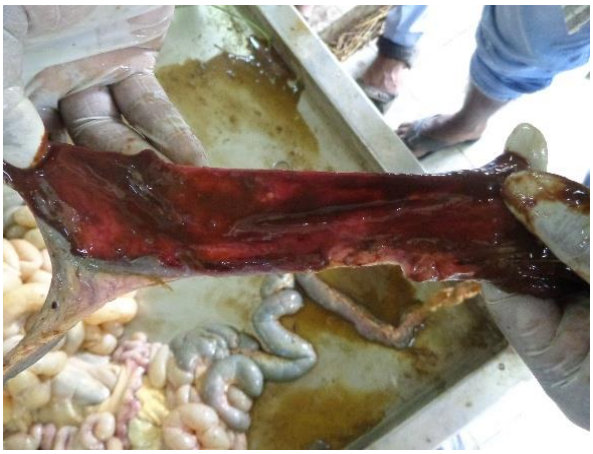

Figure 8: Mucosal surface of the intestinal segment involved in volvulus showing diffuse and severe haemorrhage.

4.2. Microbiological Findings

Gram-stained impression smears prepared from heart blood revealed numerous gram-positive cocci arranged predominantly in chains, consistent with streptococcal organisms. Microbiological culture of aseptically collected heart blood yielded colonies identified as *Streptococcus spp.* based on gram reaction **(Figure 9) and** colony morphology **(Figure 10)**. These findings provided definitive evidence of streptococcal septicaemia. PCR amplification of the 16S rRNA gene using universal primers produced a distinct amplicon of approximately 1500 bp, confirming amplification of bacterial DNA. The purified PCR product was sequenced and the resulting nucleotide sequence was subjected to similarity analysis using BLAST. The sequence analysis revealed ≥99% homology with *Streptococcus uberis*. Based on the high sequence similarity and alignment results, the isolate was conclusively identified as *Streptococcus uberis*.

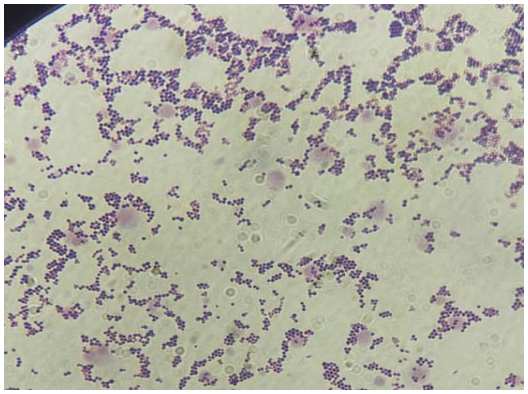

Figure 9: Gram-stained impression smears. revealing numerous purple-coloured spherical gram-positive cocci arranged predominantly in chains, consistent with streptococcal organisms.

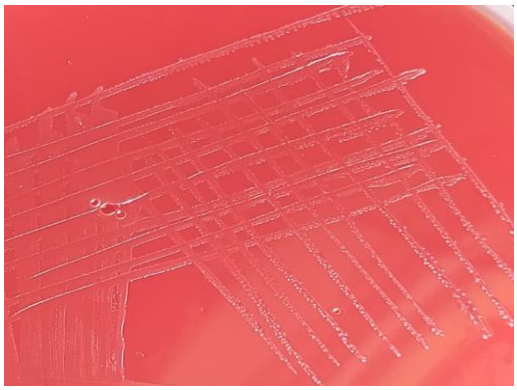

Figure 10: Microbiological culture of aseptically collected heart blood showing small, convex, translucent colonies on blood agar colonies consistent with *Streptococcus spp.*

5. DISCUSSION

Members of the *Streptococcus bovis / Streptococcus equinus* complex are facultatively anaerobic [Herrera et al., 2009], recognized as major lactic acid–producing bacteria in the rumen and play a crucial role in normal ruminal fermentation. The rumen contains a highly diverse population of bacteria, fungi and protozoa capable of digesting fibre and subsequently *via* anaerobic fermentation produce proteins, volatile fatty acids and vitamins needed by the ruminants. The ruminal population of *S. bovis*/*S. equinus* complex in cattle remains low under normal feeding (e.g., roughage diet), but increases with introduction of concentrate or high-quality forage [Clarke et al., 2016]. In addition to the major *S. bovis*/*S. equinus* complex of organisms, several studies have demonstrated the presence of *S. uberis* in bovine faeces, confirming that this organism is capable of surviving and persisting within the gastrointestinal tract rather than being a transient contaminant [Sherwin et al., 2021]. The majority of infections remain localized to the mammary gland, with only occasional reports suggesting the possibility of lymphatic or hematogenous spread [Tomazi et al., 2022]. Systemic infection and septicaemia caused by *S. uberis* in cattle are considered rare. The extra-mammary infections, including septicaemias, are uncommon and generally occur under exceptional circumstances, such as severe infection or compromised host immunity [Krömker and Leimbach, 2017]. Although *S. uberis* possesses several virulence factors that facilitate adhesion, immune evasion and nutrient acquisition, these characteristics primarily support its role as a mastitis pathogen rather than a systemic invasive organism [Ward et al., 2009; Chen

et al., 2021]. Pure culture of *S. uberis* was derived from the heart blood swab confirming it as the cause of septicemia. Post mortem translocation of micro-organisms to heart generally occur around 4-8 hours after death. Since, the heart blood swab was collected well before 4 hours of death, it ruled out the possibility of bacterial translocation. This case represents a rare case of *S. uberis* induced septicaemia in an adult Holstein Friesian crossbred cow, arising secondary to severe ruminal impaction complicated by intestinal volvulus and abomasal perforation. Intestinal volvulus was considered to be the primary lesion that blocked the movement of ingesta towards large intestine. This could have caused stasis of the contents and increased backward pressure resulting in ruminal impaction as well as abomasal perforation. The blood-tinged frothy fluid in the trachea and lungs indicating pulmonary oedema and mottled reddish lungs with emphysema seen reflect acute circulatory failure and endothelial damage, commonly associated with septicaemic shock. Heart had extensive petechial and ecchymotic haemorrhages on both epicardial and endocardial surfaces. Generalized petechiae and ecchymoses in the subcutis, epicardium and endocardium, along with congested conjunctival mucous membranes, are classic gross indicators of septicaemia and disseminated vascular injury [Zachary and McGavin, 2012]. These findings were consistent with endothelial damage and increased vascular permeability resulting from circulating bacterial toxins during septicaemia.

Ruminal impaction leads to ruminal atony, prolonged ingesta retention, altered fermentation patterns and mucosal ischemia, which collectively disrupt normal rumen ecology [Radostits et al., 2007]. Once the mucosal barrier is breached, SBSEC organisms disseminate systemically, resulting in acute septicaemia. Damaged mucosa allows the translocation of bacteria into portal circulation, a recognized mechanism in ruminants with severe digestive disorders. The cause for ruminal impaction in this case was attributed to the intestinal volvulus observed. It could have resulted in acute vascular compromise, ischemic necrosis and loss of mucosal integrity, allowing intestinal bacteria to translocate into mesenteric lymphatics and systemic circulation. The presence of a large, focally extensive perforating abomasal ulcer (~10 cm) extending through the muscularis represents another critical portal of infection. Abomasal perforation is a well-documented cause of peritonitis and septicaemia, particularly in adult dairy cattle subjected to gastrointestinal stasis, stress or concurrent ruminal disorders [Palmer et al., 1984]. In this case, abomasal perforation likely exacerbated bacterial proliferation and systemic inflammatory response. Perforating abomasal ulcers often coexist with ruminal dysfunction and can precipitate rapid systemic deterioration [Braun et

al., 2019]. Hepatic findings of moderate enlargement, pallor, yellowish discoloration and rounded edges suggest hepatic lipidosis, commonly accompanying prolonged anorexia, negative energy balance and septicaemia. Renal pallor with petechiations also aligns with systemic circulatory disturbance and toxaemia. The differentials considered in this case included common gastrointestinal pathogens including clostridium and salmonella. Absence of lesions including hemorrhagic or necro-haemorrhagic enteritis, pulpy kidneys consistent with clostridial infection and fibrino-necrotic (diphtheritic) enteritis, button ulcers in colon and caecum consistent with salmonella infection ruled out the possibility of clostridium and salmonella. The demonstration of numerous cocci arranged in chains in blood smears and the successful isolation of *Streptococcus spp.* from heart blood provided supportive evidence of streptococcal septicaemia. However, histopathology was not performed on the rumen, abomasum, ileum, lung and heart and this was a limitation in our study in interpreting the mucosal injury and septicaemic vascular damage.

Available literature indicates that systemic dissemination is not a common feature of *S. uberis* infection. Opportunistic behaviour of *S. uberis* has been suggested by reports of infections in other species, indicating its potential to cause invasive disease under compromised conditions [Chen et al., 2021]. The pathogenic potential of *S. uberis* is supported by several virulence-associated mechanisms. The organism possesses adhesion factors that enable colonization of host epithelial surfaces, particularly mammary epithelial cells, and may allow limited intracellular persistence [Fessia and Odierno, 2021]. Genomic analyses have identified genes associated with immune evasion, including mechanisms that reduce susceptibility to phagocytosis and complement-mediated killing, which could facilitate survival during transient bacteremia [Ward et al., 2009; Chen et al., 2021]. In addition, the inflammatory response elicited during infection contributes to tissue damage and breakdown of epithelial and endothelial barriers, thereby enhancing the likelihood of bacterial dissemination into systemic circulation [Fessia and Odierno, 2021].

6. CONCLUSION

This case of *S. uberis* associated septicaemia illustrates a multifactorial pathogenesis, wherein ruminal impaction-initiated rumen dysfunction and microbial imbalance, intestinal volvulus caused acute ischemic mucosal damage and abomasal perforation provided an additional portal for bacterial invasion. These lesions collectively facilitated systemic dissemination of opportunistic streptococci, resulting in acute septicaemia and death. This report underscores the importance of early diagnosis and aggressive management of ruminal impaction and

intestinal obstruction in adult cattle to prevent acute systemic outcomes and adds valuable documentation to the limited literature on *S. uberis* associated septicaemia in adult bovines.

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