

Case Report – Chronic Bovine Traumatic Reticuloperitonitis: an Unusual Presentation

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Abstract

A two-year-old Angus bull presented with chronic weight loss and numerous masses in the submandibular, retropharyngeal and cervical regions. Physical examination and laboratory work were inconclusive, but needle aspiration and drainage of one of the masses revealed abscessation. The cause of the abscesses was unknown, and the bull was treated empirically with procaine penicillin for one week. His condition progressively deteriorated, therefore he was euthanized. Postmortem examination revealed chronic traumatic reticuloperitonitis (TRP) with extensive abscessation of the diaphragm, submandibular, retropharyngeal and cervical lymph nodes.

Diagnosis in this case was elusive because the history and clinical signs were non-specific, and the peripheral lymph node abscesses were not considered a typical finding associated with TRP. It is unknown whether an antemortem diagnosis and more aggressive treatment would have resulted in a different outcome, given the chronicity of the case at presentation.

Keywords: bovine, traumatic reticuloperitonitis, hardware disease, abscess

Résumé

Un taureau Angus de deux ans a été admis avec une perte de poids chronique et de nombreux amas submandibulaires, rétropharyngés et cervicaux. L'examen physique et les analyses de laboratoire n'étaient pas conclusifs bien que l'aspiration par aiguille et le drainage d'un des amas laissait penser à un abcès. La cause des abcès n'était pas connue et le taureau a été traité empiriquement avec de la pénicilline de procaine pendant une semaine. La condition de l'animal s'est détériorée progressivement et le taureau a été euthanasié. L'examen post mortem a montré une réticulopéritonite traumatique chronique (RTC) avec de nombreux abcès

au niveau du diaphragme et des nodules lymphatiques submandibulaires, rétropharyngés et cervicaux.

Le diagnostic dans ce cas restait nébuleux car les antécédents et les signes cliniques étaient non-spécifiques tandis que la présence d'abcès au niveau des nodules lymphatiques périphériques n'est généralement pas associée à la réticulopéritonite traumatique chronique. Il n'est pas certain si un diagnostic précoce et un traitement plus agressif auraient sauvé l'animal étant donné l'état chronique du cas à sa présentation.

Introduction

Traumatic reticuloperitonitis (TRP), or hardware disease, is a sporadic disease of ruminants caused by ingestion of foreign material and perforation of the reticulum wall by a foreign object. Contamination of the abdominal cavity and subsequent local or diffuse peritonitis may occur. The diaphragm, pericardium, heart, liver, and rarely the spleen, may also be penetrated and become involved in the inflammatory process.

Cattle are affected much more commonly than small ruminants due to their indiscriminant feeding behavior and more frequent exposure to foreign material in their feed. Cattle are most commonly exposed to foreign material due to the mixing and grinding process involved when preparing forages for their ration, and dairy cattle are particularly at risk due to being fed indoors throughout the year. TRP occurs much less frequently in cattle fed exclusively on pasture. One review of 1400 necropsies found 93% of TRP cases occurred in cattle greater than two years old, and 87% of those cases were in dairy cattle.¹

Foreign body perforation can occur with any type of sharp object (metal, wood, glass), but by far the most common material is sharp metal. Wire pieces and nails are perfect for perforation and migration⁹ because they are usually sharp and linear. After being swallowed and entering the rumen, the object is moved by ruminal contractions and falls to the floor of the reticulum.

It then catches in the "honeycomb" internal lining of the reticulum, and continuous reticular contractions lead to perforation of the wall. Perforation generally occurs on the cranioventral aspect of the reticular wall where most foreign objects tend to gravitate. Following penetration of the wall, an acute local peritonitis invariably occurs due to contamination of the cranial abdomen with gastrointestinal contents. Even though all cases of TRP begin with acute local peritonitis, a variety of clinical disease courses may ensue depending on the chronicity of the condition and the organ(s) involved.

Typical clinical presentations for TRP can be divided into acute local peritonitis, chronic local peritonitis, diffuse peritonitis, or other sequelae such as pericarditis, organ abscessation, or vagal indigestion. The clinical signs of acute local peritonitis may be noticed as early as 12-24 hours after perforation of the reticulum. It can vary in presentation, but the most consistent clinical and historical findings are fever, tachycardia, evidence of cranial abdominal pain, decreased reticuloruminal motility, decreased manure output and a sudden drop in appetite and milk production.¹³ Signs of cranial abdominal pain may include a slow or cautious gait, abducted elbows, reluctance to move or lie down, standing with an arched posture, occasional grunting during rumination/defecation/urination, or resisting ventral flexion of the back when the withers are pinched. In uncomplicated cases the fever and tachycardia generally resolve after three to five days.^{6,13} Resolution of acute local peritonitis is often characterized by the development of fibrous adhesions which gradually contract into thin strands over a period of weeks to months, and reticuloruminal motility is restored.¹

Chronic local peritonitis can result if the foreign body or infected tract persists. Signs are similar to those of acute local peritonitis, but are not as severe. Body temperature and heart rate often return to normal, which can make diagnosis uncertain.^{1,6,13} The animal may or may not demonstrate the aforementioned signs of cranial abdominal pain, and appetite and milk production recover partially. Reticuloruminal motility usually remains decreased, there is reduced manure output, and both hair coat and body condition can become poor.

Diffuse peritonitis is an uncommon clinical presentation of TRP because of the natural ability of cattle to localize peritoneal injury and form adhesions. It is characterized by severe systemic disease, toxemia, gastrointestinal tract stasis, dehydration and shock. The disease course is usually short, with recumbency and death within 24 to 36 hours.¹³ Factors believed to predispose cattle to developing diffuse peritonitis include any activity around the time of perforation of the re-

ticulum, such as calving, forced exercise, or transport. These activities cause the animal to be more physically active and thereby disrupt the formation of adhesions necessary to localize the peritonitis.

Many sequelae to TRP are possible, causing a variety of clinical manifestations. The sequelae and clinical course of TRP are directly dependent on the site of perforation of the reticulum, depth of penetration of the foreign body, and organ(s) involved in the inflammatory process. Recognized sequelae include traumatic reticulopericarditis, organ abscessation (including perireticular, splenic, hepatic, diaphragmatic, pleural and mediastinal abscesses), several syndromes of vagal indigestion, diaphragmatic herniation, sepsis (with resultant endocarditis, embolic pneumonia, nephritis, septic arthritis, or amyloidosis), and sudden death due to laceration of the heart, coronary artery, or left gastroepiploic artery.^{1,2,6,8,10,11,13,14} Clearly, numerous clinical presentations of TRP and its sequelae are possible, making it an elusive disease to diagnose in some instances. According to the literature search, there is no formal report of suppurative lymphadenopathy of the submandibular, retropharyngeal, or cervical lymph nodes secondary to TRP.

Differential diagnoses to consider when working up a potential case of bovine TRP include pneumonia, lung abscess, abomasal ulcer, hepatic abscess secondary to other causes, indigestion, diaphragmatic hernia, laminitis, or lymphosarcoma of the abdomen, abomasum, or heart. This bull had a unique presentation, making it difficult to come to a clear diagnosis. When presented with a young Angus bull with chronic weight loss and abscesses in the submandibular and retropharyngeal region, the list of differentials should include trauma to the skin, oral foreign body or abscess with regional drainage to peripheral lymph nodes, pharyngeal foreign body or abscess, actinomycosis, actinobacillosis, enzootic bovine leukosis, cutaneous lymphosarcoma and tuberculosis.

Diagnosis of TRP, especially if the disease is acute, is often done by physical examination and personal impression alone. Once the disease is in the subacute or chronic stages, clinical signs are less clear and performing diagnostic techniques can provide additional useful information. Hematologic tests such as a leukogram, fibrinogen concentration and plasma protein concentration can be performed, in addition to abdominocentesis, metal detection, laparoscopy, radiography and ultrasonography. In cases of traumatic reticulopericarditis, the use of pericardiocentesis, electrocardiography and thoracic ultrasound may also be added.

Changes in an animal's total and differential leukocyte count can occur with TRP, although these changes depend on the stage and severity of the disease. In acute TRP, a neutrophilia (>4000 cells/uL) is

the most common response seen, sometimes with a regenerative left shift (>200 immature neutrophils/uL). This will last for three to five days in uncomplicated cases of TRP, at which point the counts begin to return to normal.^{1,13} In chronic TRP the counts may return to normal after several days or weeks, although sometimes these animals maintain a moderate neutrophilia and monocytosis for chronic periods.¹ Severe cases that involve the pleura or pericardium tend to generate higher total leukocyte counts (14,000-20,000 cells/uL), and cases that progress to diffuse peritonitis show a leukopenia (total cell count <4000 /uL) with a degenerative left shift (greater absolute number of immature neutrophils than mature neutrophils). Overall, leukogram changes that occur with TRP can be variable and must be interpreted with other findings to arrive at a diagnosis.

Elevations of plasma fibrinogen (>1000 mg/dL) and total plasma protein levels (>10 g/dL)³ tend to occur fairly consistently with TRP. These parameters begin to rise just a few days after the onset of acute TRP, and usually maintain consistent levels in chronic cases. Caution must be used to account for dehydration in the animal, thus it is recommended that a ratio of plasma protein to fibrinogen of less than 10:1 be used as a finding consistent with TRP.¹² It should also be kept in mind that elevations in fibrinogen or plasma protein are not specific to TRP.

Abdominocentesis and analysis of peritoneal fluid can be a valuable tool for diagnosing peritonitis, as long as the peritonitis is not extremely localized. Because of the marked fibrinous response and localization of peritoneal lesions in cattle, failure to obtain fluid on abdominocentesis does not preclude the presence of peritonitis. If fluid is obtained, visual examination for color and turbidity should be performed. A total nucleated cell count of greater than 6000/uL, total protein concentration greater than 3.0 g/dL, and a differential cell count with greater than 40% neutrophils and less than 10 % eosinophils is consistent with peritonitis in cattle.^{7,15} Also, bacterial culture and sensitivity can aid in both diagnosing and formulating a treatment plan for TRP. A mixed bacterial population is usually encountered, including coliforms, *Arcanobacterium pyogenes* and anaerobes.¹³

Additional diagnostic modalities are available for confirming TRP. Metal detection is a basic test that can be used *via* electronic metal detector, but it is non-specific since many normal dairy cows are positive for metal over the reticular area. Other more advanced imaging modalities, although expensive and not always feasible in a farm animal setting, may be appropriate in valuable animals and can help to achieve an accurate diagnosis and prognosis for surgery. Laparoscopy with a flexible fiberoptic laparoscope can be an

excellent diagnostic aid for detecting TRP. Abdominal radiography of the reticulum is an accurate diagnostic, which can be performed standing in a referral hospital setting or in dorsal recumbency if a portable unit is all that is available in the field. Ultrasonography is a feasible, available modality which has the advantages of providing detailed information about the contour of the reticulum and its motility, visualizing perireticular abscesses and visualizing neighboring organs. However, unlike radiography, ultrasonography cannot visualize magnets or metallic foreign bodies. Ideally, an appropriate combination of the above diagnostics should be applied in each case to obtain the most information about the location of the foreign body and the extent of inflammation involved.

Treatment of TRP depends on the stage of the disease, sequelae involved, value of the animal and medical and surgical facilities available. Treatment generally begins with medical management, and may or may not require surgical intervention. Medical management alone is often successful, possibly owing to the fact that in approximately half the cases the foreign body does not remain in the wall of the reticulum but returns to the lumen within a few days.^{1,4}

Medical management includes administration of a forestomach magnet, parenteral antibiotics and confinement to a small stall or stanchion. A good-quality magnet will attract and stabilize ferromagnetic foreign bodies that have perforated but not passed through the reticular wall. If the foreign body has only perforated the wall superficially, a magnet can sometimes return the object to the lumen of the reticulum where it will remain indefinitely. However, it is unlikely that a magnet will extract a firmly embedded foreign body from the reticular wall.¹ Also, one should ascertain whether the animal has received a magnet previously as there is a small risk that administering a second magnet could lead to trapping of the ruminoreticular fold between the two magnets. If the history is unclear whether the animal has received a magnet in its lifetime, a compass may be placed over the cranioventral abdominal area to determine whether a magnet is present in the reticulum.

Antibiotics should be administered and should ideally be based on culture and sensitivity of abdominocentesis fluid. However, if a decision is to be made empirically a broad-spectrum antibiotic should be used, based on the fact that these are usually mixed-population infections. Antibiotics commonly used include ceftiofur, oxytetracycline and penicillins.^{1,13} Consideration should be taken to choose an antibiotic with a relatively short pre-slaughter/harvest withhold time so the animal may be salvaged if treatment is unsuccessful. Lastly, strict stall rest is important to encourage adhesion formation at the site of perforation.

Surgical treatment is generally reserved for valuable animals or those not responding to medical management after several days. A left flank exploratory laparotomy and rumenotomy is performed,^{4,5} usually allowing the surgeon to accurately characterize the location of the perforation, nature of the foreign body, and presence of perireticular abscesses or adhesions. If possible, the foreign body is removed during the rumenotomy, with care taken not to disrupt any adhesions.

When considering treatment, harvest is an option that should be considered in animals of lesser value that have not responded to medical management. Often even in acute, seemingly uncomplicated cases, animals may later experience debilitating forestomach outflow problems such as vagal indigestion.⁶ Thus, harvest is a reasonable option in a production animal setting where time, labor, and/or financial constraints may limit medical management of the case. The limitations of harvest are twofold and must be considered before being pursued. First, the pre-harvest withhold times for the broad-spectrum antimicrobials mentioned above must be recognized and may extend beyond the life expectancy of an animal with complicated TRP. Also, animals with complications such as diffuse peritonitis or multiple lymph node enlargement are likely to be condemned at harvest. Humane on-farm euthanasia should be considered if the animal's welfare has become compromised.

The prognosis for TRP depends on the severity and chronicity of the disease, and sequelae involved. In acute, non-complicated cases that are treated as soon as clinical signs present, the recovery rates are high (80-90%)¹ with either medical or surgical management. However, the recovery rate for surgical cases is likely to be much lower if only complicated cases are selected for surgery and mild cases are treated medically. If this is the case, recovery rates of 84% for conservative medical management and only 47% for surgical cases has been reported.¹ TRP with diffuse peritonitis is usually a terminal disease and the prognosis for life is considered poor.⁶ Chronic TRP or those cases with sequelae such as vagal indigestion also have a poor prognosis.⁴

The following report will present a case of chronic TRP in a black Angus bull. Because an antemortem diagnosis remained elusive in this case, the report will review clinical presentations, diagnostic modalities and treatment options for TRP. Also, differential diagnoses for the unusual clinical signs encountered in this case will be discussed.

History

A two-year-old Angus bull (weighing approximately 1100 lb; 500 kg) presented to our large animal

ambulatory service for gradual weight loss of approximately four months duration and numerous masses that the client had noticed in his submandibular region several days before presentation. The client estimated the bull had lost several hundred pounds of weight. Examination of the owner's records indicated the bull had received regular preventative veterinary care since birth, including dewormings and vaccination for bovine respiratory disease, leptospirosis and infectious bovine keratoconjunctivitis. The bull had no previous health issues, and no treatments had been administered to date for his current condition. The bull's intended use was for breeding purposes, and his first breeding season with the herd that year had been successful.

Clinical Findings

On initial physical examination, the bull was bright and alert. He had a normal body temperature (102.0°F; 38.9°C), mild tachycardia (88 beats per minute) and a normal respiratory rate (32 breaths per minute). Heart and lung sounds were normal. There were numerous firm, round subcutaneous masses of varying size scattered bilaterally in the submandibular and retropharyngeal regions (Figure 1). Similar masses were palpable extending bilaterally down the neck. There was one rumen contraction of moderate intensity per minute, with no abdominal distension. When pinched over the withers, the bull consistently demonstrated a small degree of ventroflexion, but this was difficult to interpret due to restraint in the squeeze chute. His stance and posture appeared normal. Rectal examination was unremarkable and manure appeared normal.

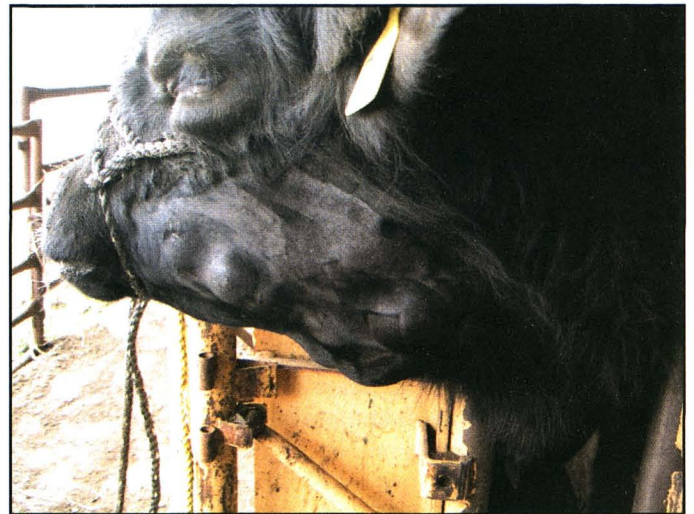


Figure 1. Initial presentation: numerous firm, round, non-painful masses bilaterally in the submandibular and retropharyngeal areas. The masses were palpable down both sides of the neck.

Evaluation of the oral and pharyngeal cavities was unremarkable. The prescapular and prefemoral lymph nodes, as well as internal pelvic lymph nodes palpated per rectum, were normal. The bull had a body condition score of 4 (scale 1-9; 1=extremely thin and 9=obese), which was low for an animal grazing good pasture.

The submandibular and retropharyngeal masses were further investigated. They were clipped and aseptically prepared, and needle aspiration of the contents revealed a thick, yellow, homogenous, purulent material with no detectable odor. A sample of the discharge was submitted to our hospital's microbiology laboratory for aerobic culture and antimicrobial sensitivity. One of the masses was lanced and drained, and digital exploration of the open mass confirmed a thickly encapsulated abscess.

Initial differential diagnoses included trauma to the skin with subsequent subcutaneous abscessation, an oral or pharyngeal abscess, oral or pharyngeal foreign body, actinomycosis, actinobacillosis, enzootic bovine leukosis, cutaneous lymphosarcoma, paratuberculosis (Johne's disease) and tuberculosis. The signalment and history of the animal, as well as the unremarkable oral examination, provided useful information to rule out several differentials. There were no signs of a foreign body, abscess or draining tract in the oral or pharyngeal cavities. No soft tissue inflammation of the tongue suggestive of actinobacillosis was detected. Careful palpation of the mandible revealed no bony lesions compatible with actinomycosis. Enzootic bovine leukosis was unlikely due to the young age of the bull, and the lack of lymphadenopathy in locations commonly seen with adult lymphosarcoma. Paratuberculosis was also unlikely due to the bull's young age, lack of diarrhea and the absence of paratuberculosis in the herd's history. Cutaneous lymphosarcoma is a rare condition, as is bovine tuberculosis in this country. The bull and the remainder of the herd had tested negative six months earlier for tuberculosis *via* intradermal purified protein derivative tuberculin (PPD) injection in the caudal tail fold.

Thus, an updated list of differentials at that point included trauma and actinobacillosis, because actinobacillosis is occasionally known to cause submandibular lymph node abscessation with or without inflammation of the tongue. TRP was discussed as a possibility, but was considered low on our list of differentials due to the animal's atypical presentation.

Laboratory Findings

To assess the bull for systemic disease, blood was obtained for clinical chemistry, complete blood count and fibrinogen concentration. Hemogram results were within reference ranges with the exception of the leu-

kocyte differential (Table 1). Although absolute counts were normal for total white blood cells, neutrophils and lymphocytes, the differential revealed a mild relative neutrophilia (47%, normal range 15-45%) and mild relative lymphopenia (41%, normal range 45-75%). Fibrinogen was moderately elevated (1594 mg/dL, normal range 300-775 mg/dL). Clinical chemistry revealed normal electrolyte levels, normal liver enzymes (AST and GGT) and normal CPK. Total protein was not reported. Culture of the aspirated purulent material resulted in no growth.

Therapeutic Management

While awaiting results of the bloodwork and aerobic culture of the abscess discharge, empirical treatment with systemic procaine penicillin (10,000 IU/lb or 22,000 IU/kg IM q 12 h) was elected and the bull was confined to stall rest. An oral magnet was not administered. Penicillin was chosen due to its broad spectrum of coverage and its efficacy against pyogenic bacteria such as *Arcanobacterium pyogenes*. The bull received penicillin for one week, at which point the owner reported the bull's condition to be about the same. Penicillin was discontinued and a follow-up appointment was made for re-examination. At the time of re-examination approximately two weeks after initial presentation, the farmer reported the bull's condition had deteriorated and his appetite had decreased significantly. Physical examination was similar to initial presentation (afebrile, mild tachycardia, masses still present in submandibular/retropharyngeal areas). However, rumen contractions were of lower intensity and were much less frequent, and the bull had continued to lose weight. The owner granted permission to euthanize the bull, and a necropsy was performed by the pathology service at our large animal hospital.

Table 1. Initial blood laboratory values obtained on presentation. All laboratory work was performed in-house.

	Angus bull	Normal range*
Fibrinogen	1594 mg/dL	300-775 mg/dL
White blood cells	7,618 / μ L	4000-12000 / μ L
Neutrophils	3,573 / μ L (47%)	600-4000 / μ L or 15-45%
Band cells	0 / μ L	0-120 / μ L or 0-2%
Lymphocytes	3116 / μ L (41%)	2500-7500 / μ L or 45-75%
Monocytes	532 / μ L (7%)	25-840 / μ L or 2-7%
Eosinophils	380 / μ L (5%)	0-170 / μ L or 2-20%

*Normal bovine reference ranges for the clinical laboratory at New Bolton Center, University of Pennsylvania School of Veterinary Medicine, 2005.

Postmortem examination revealed the bull had TRP, diaphragmatic abscesses and chronic abscesses of the cervical, retropharyngeal and submandibular lymph nodes. A foreign body (2 inch [5 cm] nail) was found in the wall of the reticulum causing a focal, chronic, mural reticulitis with organized granulation tissue (Figure 2). Extensive fibrous adhesions were encountered in the cranioventral peritoneal cavity. Although there were multifocal intramuscular abscesses in the diaphragm (Figure 3), no abnormalities were found within the pleural cavity, pericardium, heart, or lungs. There was severe, chronic, necrosuppurative and pyogranulomatous lymphadenitis (abscessation) of the submandibular, retropharyngeal and cervical

lymph nodes (Figure 4). These abscessed lymph nodes ranged in size from 1 to 3 inches (approximately 3 to 8 cm) in diameter, and extended bilaterally down the neck approaching the thoracic inlet. Due to the close proximity of the continuous chain of abscesses from the diaphragm to the cervical lymph nodes and cranially to the retropharyngeal and submandibular lymph nodes, it was proposed that the abscessation of these lymph nodes was secondary to drainage from the abscesses in the diaphragmatic area. That is, impaired drainage of the abscessed lymph nodes in the diaphragmatic, thoracic and caudal cervical regions may have contributed to chronic, progressive retrograde abscessation up the lymphatic chain on the neck. *Arcanobacterium pyogenes* was isolated from the abscesses.

Discussion

The diagnosis of TRP in this case was made at necropsy. TRP had been briefly discussed as a possible differential, but an antemortem diagnosis remained elusive because of the animal's atypical presentation. In particular, the lack of fever or marked tachycardia, lack of signs of cranial abdominal pain and presence of moderate-strength rumination at initial presentation (cud chewing, rumen contractions) were misleading. Also, the lack of marked changes in the animal's leukogram and a history of being kept on pasture rather than being confined made TRP less likely. Finally, the submandibular and retropharyngeal masses were not considered a typical clinical finding with TRP.

In hindsight, however, the author recognizes several aspects of the animal's clinical presentation which were consistent with a diagnosis of chronic TRP. A history of chronic weight loss with physical examina-



Figure 2. Reticulum: chronic, focal, mural reticulitis with a thick region of organized granulation tissue at the site of perforation. Metallic foreign body (5 cm. nail) was found intralesionally.



Figure 3. Diaphragm (viewed from abdominally): extensive, multifocal intramuscular abscessation. No perforation of the thoracic or pericardial space was found.



Figure 4. Retropharyngeal and cervical lymph nodes: severe, chronic, necrosuppurative and pyogranulomatous lymphadenitis (abscessation).

tion findings of mild tachycardia and a mild decrease in rumen contractility are all compatible with this diagnosis. Also, the elevated fibrinogen concentration and the animal's deterioration in spite of parenteral antibiotics were suggestive of the presence of a persistent penetrating foreign body in the reticulum. The lack of marked changes in the animal's vital signs and leukogram should not be considered inconsistent with chronic TRP, as these can return to normal several days to weeks after the acute stages of the disease. Although the bull's weight loss, subtle physical examination findings and elevated fibrinogen were non-specific signs, it is well documented that signs of chronic TRP are not as severe and specific as those of acute TRP. Even chronic weight loss alone, in an otherwise clinically normal animal, should be enough to consider TRP as a differential.

Consideration should be given to additional diagnostics that could have been run in the field had TRP been more closely considered as a differential. Radiographs and laparoscopy were not available and would not have been feasible in this setting. However, abdominocentesis and/or ultrasound of the cranioventral abdomen were both simple and feasible options that may have provided very useful information about the chronic localized peritonitis that was occurring around the reticulum. Also, simple metal detection with an electronic metal detector could have provided evidence of metallic foreign body, though not necessarily evidence of TRP.

Had a diagnosis of TRP been more closely considered, a magnet could have been administered. Upon questioning the owner further after the diagnosis was made at necropsy, she verified that the bull and his herd mates had not received magnets at any point in their lives. Hence, this would have been a safe, simple and affordable treatment for this bull. However, in hindsight it is questionable whether administration of a magnet so late in the disease process would have made a difference in the outcome of this case. Given the chronicity of the case at presentation and the advanced sequelae (extensive abscessation from the diaphragm to the submandibular region), the bull's condition may not have improved if a magnet were to stabilize the foreign body safely in the lumen of the reticulum. Also, as discussed above, it is unlikely that a magnet can extract a foreign body that is firmly embedded in the wall of the reticulum as this one was. Nonetheless, it is good clinical practice to administer a magnet any time TRP is considered even a remote differential, provided the animal has not previously received a magnet.

In addition to managing the case medically, surgery could have been performed if an antemortem diagnosis of TRP had been made. However, the recovery rate for rumenotomy as a treatment for TRP depends

directly on the time of surgery relative to initial penetration of the reticular wall. As mentioned previously, surgery is often performed on animals that have been treated medically for a few days after the first signs of acute TRP have appeared, but have not recovered. Since this bull's clinical signs had likely been advancing for months, it is questionable whether rumenotomy and removal of the foreign body so late in the disease process would have made a difference in the outcome.

The abscessed peripheral lymph nodes were a particularly unique feature of this case, and perhaps should be considered as a possible sign of chronic TRP in the future. The specific mechanism leading to this abscessation has not been confirmed, although the proposal by the pathologists that chronic retrograde abscessation of the lymphatic chains may have led to these extensive peripheral lesions is intriguing. A literature search did not yield any reported cases of this pathologic process in cattle or other livestock. Other theories to consider include septic spread of bacteria to this peripheral region of the body, or an unrelated coincidental traumatic or infectious process that occurred in this region of the head or neck. If similar abscesses are encountered in cattle in the future, the history and physical examination findings can help to rule out other differentials for peripheral lymphadenopathy or abscessation. Also, additional diagnostic imaging modalities, such as ultrasound or radiography, may help to confirm the extent of the abscessation and the presence of localized peritonitis in the cranioventral abdomen.

Conclusions

Chronic traumatic reticuloperitonitis can be difficult to diagnose in cattle. It may present with only a few non-specific clinical signs such as weight loss, anorexia, or lethargy with or without abnormal bloodwork results. Suppurative lymphadenopathy / abscessation of the submandibular, retropharyngeal and cervical lymph nodes may occur secondary to chronic TRP and abscessation of the diaphragm.

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Abstracts

Microbiological and histopathological findings in cases of fatal bovine respiratory disease of feedlot cattle in western Canada

Calvin W. Booker, Sameeh M. Abutarbush, Paul S. Morley, *et al*
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The aim of this study was to describe the microbiologic agents and pathologic processes in fatal bovine respiratory disease (BRD) of feedlot cattle and to investigate associations between agents and pathologic processes. Ninety feedlot calves diagnosed at necropsy with BRD and 9 control calves without BRD were examined, using immunohistochemical (IHC) staining and histopathologic studies. *Mannheimia haemolytica* (MH) (peracute, acute, and subacute cases) and *Mycoplasma bovis* (MB) (subacute, bronchiolar, and chronic cases) were the most common agents identified in fatal BRD cases. Significant associations ($P < 0.10$) were

detected between microbiologic agents and between agents and pathologic processes. When IHC staining was used, 25/26 (96%) of animals that were positive for bovine viral diarrhoea virus (BVDV) were also positive for MH; 12/15 (80%) of animals that were positive for *Histophilus somni* (HS) were also positive for MB; and all of the animals that were positive for HS were negative for MH and BVDV. This quantitative pathological study demonstrates that several etiologic agents and pathologic processes were involved in fatal BRD of feedlot cattle.

The effect of bovine viral diarrhoea virus infections on health and performance of feedlot cattle

Calvin W. Booker, Sameeh M. Abutarbush, Paul S. Morley, *et al*
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The aim of this study was to investigate the effect of bovine viral diarrhoea virus (BVDV) infections (unapparent acute infections and persistent infections) on the overall health and performance of feedlot cattle. Calves from 25 pens (7132 calves) were enrolled in the study. Overall and infectious disease mortality rates were significantly higher ($P < 0.05$) in pens categorized at arrival as positive for type I BVDV and lower in pens that were positive for type II BVDV than in negative pens. Mortality attributed to BVDV infection or enteritis was significantly more common ($P < 0.05$) in the

pens containing persistently infected (PI) calves than in pens not containing PI calves (non-PI pens). There were no statistically detectable ($P \geq 0.05$) differences in morbidity, overall mortality, average daily gain, or the dry matter intake to gain ratio between PI and non-PI pens. Although type-I BVDV infections in feedlots appear to contribute to higher mortality rates, the presence of PI calves alone does not appear to have a strong impact on pen-level animal health and feedlot performance.