Student Report

Tetanus in Feeder Calves

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Introduction

Tetanus is a disease caused by exotoxins released from the gram positive, spore-forming, anaerobic bacteria, *Clostridium tetani*. These exotoxins affect both peripheral and central nerves, resulting in muscle rigidity and often death. *Clostridium tetani* is a frequent habitant of the soil and can be found in the feces of healthy cattle. This article will discuss the history, clinical findings, treatment, and a summary of a field investigation involving 43 feeder calves with tetanus.

Case History

Oklahoma State University received a call from a veterinarian to investigate a tetanus outbreak in 43 feeder calves weighing approximately 250kg each. The calves had been processed in the following manner:

Day 0: The bulls arrived on the farm and were placed in a holding pen.

Day 1: The bulls were vaccinated with modified live IBR, BVD, BRSV, PI_3 and lepto 5-way vaccine. They were also given an intramuscular injection of penicillin.

Day 2: The bulls were given a second injection of the antibiotic.

Day 3: The animals were given a third dose of the antibiotic, ivermectin, 7-way Clostridium, and Clostridium C, D, and tetanus toxoid. They were implanted with a Zearenone growth enhancer, their ears were notched, the animals were branded, and an elastic band was placed just proximal to the testicles using a bloodless castrator.

Days 4-7: The calves were placed in a small pasture.

Day 8: The scrota were amputated below the elastic band to help decrease the incidence of maggots. A second injection of Clostridium C, D, and tetanus toxoid was given intramuscularly. The steers were moved to a 40 acre pasture.

This same regimen had been used for many years on this farm. The only variation in the processing procedure of these calves were: the use of a new bloodless castrator and the removal of the distal scrotas a day or two earlier than usual. The owner claimed the new castrator enabled him to pull the elastic bands tighter, which caused the scrotas to become necrotic faster, therefore, allowing him to remove the distal scrotas on day 4 or 5 rather than waiting until day 6 post-banding.

Tetanus outbreak

Day 1: The first calf was noticed to have a stiff neck, an overactive third eyelid, and stiff muscles on day 13 after arriving on the farm.

Day 2: Veterinarian #1 examined the calf and diagnosed tetanus. He also diagnosed one other calf in the sick pen with tetanus. Two additional calves were found bloated and recumbent in the pasture; they both died. Veterinarian #1 recommended the owner vaccinate all the calves with a different brand of tetanus toxoid; the owner followed this recommendation.

Day 3: Veterinarian #1 recommended treating all sick pen calves with 100 mls of oxytetracycline 100 mg/ml; this was done. He also instructed the owner to administer tetanus antitoxin to all calves. He informed the owner that recovery from tetanus is rare. Eight more calves were showing clinical signs. Veterinarian #2 was consulted; his recommendation was to administer 40 mls of procaine penicillin G intramuscularly once daily to all calves showing clinical signs.

Day 4: All sick pen calves were given 3000 IU of tetanus antitoxin, all other calves were given 1500 IU of the antitoxin. At this time, Veterinarian #1 discontinued the oxytetracycline, but the owner continued administering 40 mls of procaine penicillin G. There were fourteen new cases of tetanus.

Day 5: One sick pen calf died. The owner continued the penicillin injections.

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Day 6: One new calf was showing signs of tetanus. Two calves in the sick pen died.

Day 7: Eleven additional calves were showing clinical signs. The penicillin injections were continued. Veterinarian #3 was contacted for consultation. The animals were examined by Veterinarian #3, who then contacted Oklahoma State University Veterinary Teaching Hospital and requested a field investigation. The ambulatory rotation students and Veterinarian #4 visited the farm. The calves were found to have stiff muscles, "pump-handle" tails, and overactive third eyelids, all signs were exaggerated with the slightest external stimulus. One calf was bloated and recumbent; it died. The owner was convinced that the original tetanus toxoid vaccine was the cause of this outbreak. Therefore, samples of the vaccine were submitted to the Oklahoma Animal Disease Diagnostic Laboratory (OADDL) for culture.

Day 8: Four new calves were showing clinical signs. One calf in the sick pen died. The penicillin treatments were continued. Veterinarian #4 reported all of the vaccine information to the Veterinary Biologics Field Operations Committee.

Day 9: The Veterinary Biologics Committee reviewed the records and testing on that particular lot of vaccine and found all tests and records to be satisfactory, and reported they had not received any other claims of adverse reaction to this vaccine in the past 5 years. Both aerobic and anaerobic cultures were negative. There were no new cases of tetanus.

Summary

Forty-three calves out of 283 purchased and processed showed clinical signs of tetanus. Seven of those 43 died and the remaining 36 calves recovered.

Discussion

Tetanus is a disease associated with contaminated wounds, punctures, or closed cavities (such as the uterus); and in some cases with ingestion of preformed toxin. The environmental conditions play a major role in toxin production. In an aerobic environment the spores are dormant. Once an anaerobic environment is created the spores enter a vegetative phase, however, very little exotoxin is produced. When the vegetative phase is complete, the exotoxin production greatly increases. There are three exotoxins produced: tetanospasmin, tetanolysin, and nonspasmogenic toxin. Tetanospasmin has both central and peripheral effects. The central effect is the blocking of the post-synaptic inhibitory impulses to the motor neurons of the spinal cord. This most likely occurs due to the impairment of the inhibitory transmitter, glycine. The toxin is released into the tissues and is taken up by the local nerve endings and eventually migrates to the ventral roots of the spinal cord. The toxin then spreads along the spinal cord affecting the efferent nerves of the muscles causing the rigidity. The peripheral effect is related to the lack of acetylcholine release from the synaptic sites. Tetanolysin's role is to increase tissue necrosis, therefore, maintaining anaerobic conditions for bacterial multiplication. The role of nonspasmogenic toxin is not yet known.

The incubation period of tetanus ranges from 4 days to several weeks. The average incubation period is 1-2 weeks. Early clinical signs include: spasms of the voluntary muscles, stiff gait, "pump-handle" tail, and an extended head and neck. Muscle spasms can be elicited by external stimuli such as noise, light, and rapid movements. The third eyelid may prolapse and the animal's ears will be erect and pulled toward the poll. Later, spasms occur in the masseter muscles which prevent the animal from opening its mouth. Often they become dysphagic, drool, and bloat due to the inability to eructate and to rumen dysfunction. Death results from respiratory failure which is due to spasms of both the intercostal muscles and the diaphragm, as well as the toxin's direct effect on respiratory centers in the brain.

Laboratory tests are non-specific, therefore, diagnosis is made based on clinical signs.

They key to treating this condition is early recognition of the disease and the immediate institution of therapy. The main therapeutic goals include: eliminating the bacteria, relieving the muscle spasms, neutralizing the toxins, and providing adequate nursing care. Procaine penicillin G at a dose of 22,000 IU per kilogram body weight injected intramuscularly is the treatment of choice for eliminating the bacteria. If an external wound is the route of entry, the wound should be surgically debrided and flushed with hydrogen peroxide to increase the local oxygen content. Tetanus antitoxin should be given within 12 hours after the onset of clinical signs. The recommended dose of tetanus antitoxin is 1500 IU injected intramuscularly as a single dose. A tranquilizer or muscle relaxant should be given to help control the muscle spasms. Finally, the animal should be placed in a dark, quiet stall with minimal external stimuli. If bloating becomes a problem, a temporary rumen fistula should be placed to relieve the rumen gas and serve as a portal for food and water.

The prognosis for cattle is guarded. If recovery occurs, it is a slow process taking from several weeks to several months. A recumbent animal that can be made

to stand after initiating treatment has a better prognosis.

Since this disease involves only exotoxins and neurons, often there are no gross or histopathologic lesions on necropsy.

The calves involved in this tetanus outbreak showed the classic clinical signs of tetanus, however, there is no evidence that the tetanus toxoid vaccine caused this outbreak. It is believed that a combination of the dry, dusty environmental conditions, the new tighter elastic bands, and an inadequate time period for the immune system to respond to the tetanus toxoid vaccine was the cause of this outbreak. The recovery rate on this farm was very high which was most likely due to the early detection of clinical signs and initiation of treatment. Although the tetanus antitoxin in this case was administered too late for some animals, it may have decreased the severity in other animals which may also have contributed to the high recovery rate. In the future, I would recommend administering both tetanus toxoid and tetanus antitoxin when banding the calves. If that is not an option, I would recommend administering the tetanus toxoid along with the respiratory vaccines and then wait one week before banding the calves. This would allow adequate time for the immune system to respond to the tetanus toxoid vaccine.

References

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Increasing Learner Independence in the Workplace - The Impact of the Silver Project

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The SILVER Project - Supporting Independent Learning in Veterinary Extra-Mural Rotations - is a two year National Project supported by funding from the Charter Education Trust. Its aim is to develop educational practice so that students can operate more effectively as independent learners while on work placements. Based on evidence from a wide ranging consultation, a Student Handbook for clinical placements has been produced. In addition, a scheme comprising two new elements of practice had been developed.

- A system has been adopted, to support students in identifying personal learning objectives and communicating these to host practices.
- A system of recording progress has been developed to identify achievement and confirm future development. Piloting of new developments was undertaken during the summer vacation (1995) by students from years 3 and 4 in the Faculty of Veterinary Science at Liverpool University. The pilot groups comprised 25 students in Year 3 (from a year group of 72 and 26 Year 4 students (out of a year group of 62). These students provided a total of 101 placements. The remaining students acted as a control. Evidence regarding the impact of changes was collected from students and practising surgeons, using questionnaires and interviews.

This paper presents an analysis of that evidence. It shows, in both qualitative and quantitative terms how participants responded positively to the changes and identifies how the student learning experience was enhanced. Finally, implications are considered for the profession and the veterinary schools if the scheme were to be expanded.

Keywords: Independent Learning. Personal Learning Objectives

Presented at the XIX World Buiatrics Congress, Edinburgh, Scotland, July 8-12, 1996.

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CLINICAL PHARMACOLOGY: The pharmacokinetic disposition of NUFLOR Injectable Solution was evaluated in feeder calves following single intramuscular administration at the recommended dose of 20 mg/kg. NUFLOR was also administered intravenously to the same cattle in order to calculate the volume of distribution, clearance, and percent bioavailability[1] (Table 1).

TABLE 1. Pharmacokinetic Parameter Values for Florfenicol following I.M. Administration of 20 mg/kg Body Weight to Feeder Calves (n=10)

Parameter	Median	Range
C_{MAX} (µg/mL)	3.07*	1.43 - 5.60
T_{MAX} (hr)	3.33	0.75 - 8.00
T ½ (hr)	18.3**	8.30 - 44.0
AUC (µg•min/mL)	4242	3200 - 6250
Bioavailability (%)	78.5	59.3 - 106
Vd_{ss} (L/kg)***	0.77	0.68 - 0.85
Cl_t (mL/min/kg)***	3.75	3.17 - 4.31

* harmonic mean
** mean value
*** following I.V. administration

C_{MAX} Maximum serum concentration
T_{MAX} Time at which C_{MAX} is observed
T ½ Biological half-life
AUC Area under the curve
Vd_{ss} Volume of distribution at steady state
Cl_t Total body clearance

Florfenicol was detectable in the serum of most animals through 60 hours after intramuscular administration, with a mean concentration of 0.19 µg/mL. The protein binding of florfenicol was 12.7, 13.2, and 18.3% at serum concentrations of 0.5, 3.0, and 16.0 µg/mL, respectively.

MICROBIOLOGY: Florfenicol is a synthetic, broad-spectrum antibiotic active against many gram-negative and gram-positive bacteria isolated from domestic animals. It is primarily bacteriostatic and acts by binding to the 50S ribosomal subunit and inhibiting bacterial protein synthesis. *In vitro* and *in vivo* activity has been demonstrated against commonly isolated bacterial pathogens involved in bovine respiratory disease, including *Pasteurella haemolytica, Pasteurella multocida,* and *Haemophilus somnus.*

The minimum inhibitory concentrations (MICs) of florfenicol for each of these organisms was determined using isolates obtained from natural infections from 1990 to 1993 (Table 2).

TABLE 2. MIC Values of Florfenicol Against Bacterial Isolates from Natural Infection of Cattle

Organism	Isolate Numbers	MIC_{50}* (µg/mL)	MIC_{90}* (µg/mL)
Pasteurella haemolytica	398	0.50	1.00
Pasteurella multocida	350	0.50	0.50
Haemophilus somnus	66	0.25	0.50

*The minimum inhibitory concentration for 50% and 90% of the isolates.

INDICATIONS: NUFLOR Injectable Solution is indicated for treatment of bovine respiratory disease (BRD), associated with *Pasteurella haemolytica, Pasteurella multocida,* and *Haemophilus somnus.*

RESIDUE WARNINGS: Animals intended for human consumption must not be slaughtered within 28 days of the last treatment. Do not use in female dairy cattle 20 months of age or older. Use of florfenicol in this class of cattle may cause milk residues. Do not use in veal calves, calves under one (1) month of age, or calves being fed an all-milk diet. Use in these classes of calves may cause violative tissue residues to remain beyond the withdrawal time.

WARNINGS: NOT FOR HUMAN USE. KEEP OUT OF REACH OF CHILDREN. This product contains materials that can be irritating to skin and eyes. Avoid direct contact with skin, eyes, and clothes. In case of accidental eye exposure, flush with water for 15 minutes. In case of accidental skin exposure, wash with soap and water. Remove contaminated clothing. Consult a physician if irritation persists. Accidental injection of this product may cause local irritation. Consult a physician immediately. The Material Safety Data Sheet (MSDS) contains more detailed occupational safety information.

For customer service, adverse effects reporting, and/or a copy of the MSDS, call 1-800-932-0473.

CAUTION: Not for use in cattle of breeding age. The effects of florfenicol on bovine reproductive performance, pregnancy, and lactation have not been determined. Intramuscular injection may result in local tissue reaction which persists beyond 28 days. This may result in trim loss of edible tissue at slaughter. Tissue reaction at injection sites other than the neck are likely to be more severe.

ADVERSE EFFECTS: Inappetence, decreased water consumption, or diarrhea may occur transiently following treatment.

TOXICOLOGY: A 10X safety study was conducted in feeder calves. Two intramuscular injections of 200 mg/kg were administered at a 48-hour interval. The calves were monitored for 14 days after the second dose. Marked anorexia, decreased water consumption, decreased body weight, and increased serum enzymes were observed following dose administration. These effects resolved by the end of the study.

A 1X, 3X and 5X (20, 60, and 100 mg/kg) safety study was conducted in feeder calves for 3X the duration of treatment (6 injections at 48-hour intervals). Slight decrease in feed and water consumption was observed in the 1X dose group. Decreased feed and water consumption, body weight, urine pH, and increased serum enzymes, were observed in the 3X and 5X dose groups. Depression, soft stool consistency, and dehydration were also observed in some animals (most frequently at the 3X and 5X dose levels), primarily near the end of dosing.

A 43-day controlled study was conducted in healthy cattle to evaluate effects of NUFLOR administered at the recommended dose on feed consumption. Although a transient decrease in feed consumption was observed, NUFLOR administration had no long-term effect on body weight, rate of gain, or feed consumption.

DOSAGE AND ADMINISTRATION: NUFLOR Injectable Solution should be administered by **intramuscular** injection to cattle at a dose of 20 mg/kg body weight (3 mL/100 lbs). A second dose should be administered 48 hours later. Do not inject more than 10 mL at each site. **The injection should be given only in the neck musculature.**

NOTE: Intramuscular injection may result in local tissue reaction which persists beyond 28 days. This may result in trim loss of edible tissue at slaughter. Tissue reaction at injection sites other than the neck are likely to be more severe.

NUFLOR DOSAGE GUIDE 3.0 mL/100 lb Body Weight	
ANIMAL WEIGHT (lbs)	NUFLOR DOSAGE (mL)
100	3.0
200	6.0
300	9.0
400	12.0
500	15.0
600	18.0
700	21.0
800	24.0
900	27.0
1000	30.0

Recommended Injection Location

Do not inject more than 10 mL per injection site

Clinical improvement should be evident in most treated subjects within 24 hours of the first injection. If a positive response is not noted within 24 hours of the second injection, the diagnosis should be re-evaluated.

STORAGE CONDITIONS: Store between 2°-30°C (36°-86°F). Refrigeration is not required. The solution is light yellow to straw colored. Color does not affect potency.

HOW SUPPLIED: NUFLOR Injectable Solution is packaged in 100 mL (NDC 0061-1116-04), 250 mL (NDC 0061-1116-05), and 500 mL (NDC 0061-1116-06) glass sterile multiple-dose vials.

REFERENCE: 1. Lobell RD, Varma KJ, et al. Pharmacokinetics of florfenicol following intravenous and intramuscular doses to cattle. *J Vet Pharmacol Therap.* 1994; 17:253-258.

February 1996
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Abstract

Which Seropositive Animals Actually Transmit Bovine Leukosis?

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During eradication campaigns it happens that newly acquired animals supposedly seronegative are actually seropositive. According to the present legislation in the EU and others countries a herd is immediately declared leukosis positive even if only one animals is seropositive and the whole eradication procedure starts again with the first testing possible four months after this positive animal was eliminated. In the experiment conducted cattle in various stages of bovine leukosis - only seropositive, sero-, antigen and haematologically positive - were placed in contact with seronegative animals. From cattle only seropositive which contacted the virus at an immunocompetent stage there is obviously no transmission possible, even after two years of intimate contact, whereas transmission of the bovine leukosis virus to neighboring cattle occurs within a few months if the donor is sero-against both gp and p24 antigen), antigen and haematologically positive. Such cattle were obviously infected vertically, shortly after birth or during a period of stress such as transportation. The findings are particularly relevant after some time.

Proceedings, XIX World Buiatrics Congress, Edinburgh, Scotland, July 8-12, 1996.

Efficacy Of Oral Tilmicosin For the Control of Pneumonic Pasteurellosis in Young Milk Replacer Fed Calves

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Abstract

Prophylactic treatment, with tilmicosin at 50mg/Kg protected six 10 day old Jersey calves from experimental challenge with *Pasteurella haemolytica* and *Mycoplasma bovis*. Treatment was started 2 days before challenge and was administered as a 0.075% solution in milk, twice daily, until the end of the trial, 3d post challenge. Four control calves that received no treatment with tilmicosin showed moderate clinical signs within 7h post challenge and were all killed by 18h post challenge. Clinical signs included tachypnoea, depression, sternal recumbency, inappetance and pyrexia.

The mean projected clinical score was 40.8 compared with 0.5 for treated calves. At post mortem examination mean pneumonic consolidation scores were 9.25± 3.9 and the lesions were red, hepatised and oedematous.

Post mortem examination of the 6 treated calves, killed healthy at 3d post challenge, revealed pneumonic consolidation (mean score 2.8± 1.1) and lesions that were red/gray hepatised in appearance. The lesions were considered to be resolving. *P. haemolytica* was reisolated from lung tissue of all four and *M. bovis* from 2 control calves. Neither microorganism was reisolated from the lung tissue of the 6 treated calves. Palatability of milk was unaffected by tilmicosin treatment.

Poster Session, XIX World Buiatrics Congress, Edinburgh, Scotland, July 8-11, 1996.

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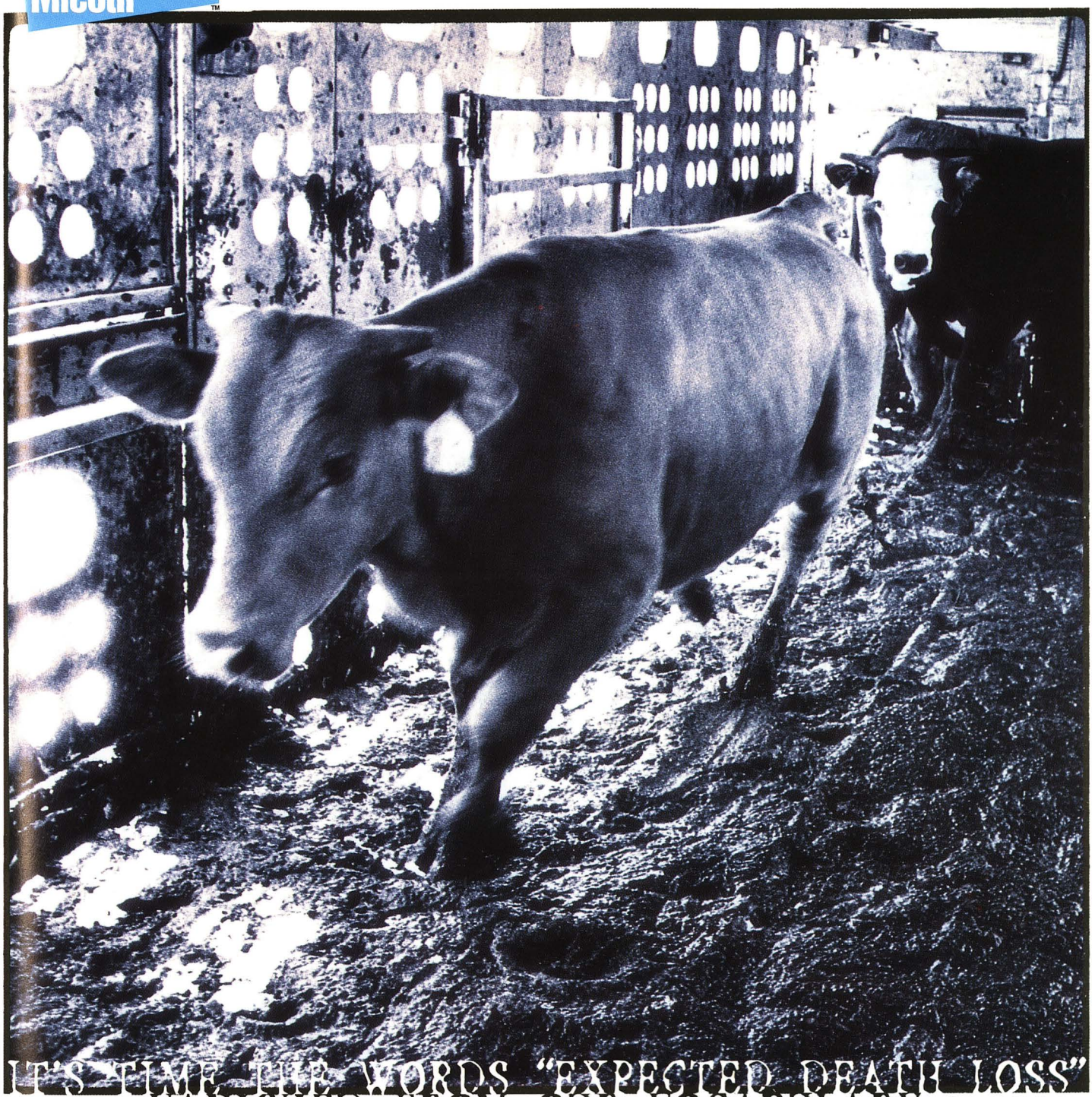

IT'S TIME THE WORDS "EXPECTED DEATH LOSS" VANISHED FROM OUR VOCABULARY.

It's time we stopped just accepting widespread illness as part of the business. Time we were serious about doing something to stop BRD before it gets too far. Time we began using a treatment that reduces death loss to a point where it's almost negligible.

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