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INJECTION-SITE REACTIONS FROM CLOSTRIDIAL VACCINES: A CRITICAL CONTROL POINT?

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Summary

One 550 lb steer was injected subcutaneously twice, once on each side of the neck, with 5 milliliters of Ultrabac 7fi clostridial vaccine with a new 16 gauge, 3/4 inch needle. The injections were given 30 days and 36 hours prior to euthanasia, at which time the two resultant lesions were collected. The lesions were evaluated for tissue damage, and physical descriptors were recorded. The 36-hour injection caused an acute lesion with higher than normal levels of neutrophils and erythrocytes in its center. Within the surrounding skeletal muscle, levels of fibrin and edem a fluid were increased, causing s eparation of the muscle fibers and hemorrhaging. The 30-day injection formed a chronic lesion differing from the 36-hour lesion, primarily by the increased amounts of fibrous connective tissue forming its center. This fibrous connective tissue also extended into surrounding skeletal muscle bundles. The surrounding skeletal muscle also showed signs of degeneration with minimal regeneration. These findings describe the tissue damage that can occur with subcutaneous injection of a clostridial vaccine.

(Key Words: Injection-Site, Muscle Tissue, Clostridial, Cattle.)

Introduction

Livestock producers with effective herd-health programs administer drugs and vaccines on a periodic basis for the prevention and(or) treatment of infectious diseases and spend millions of dollar s annually. The most effective means of building a long-lasting immunity to a particular disease is to recov er from exposure to that disease. However, the risk of herd infection because of a disease outbreak makes this too impractical. Therefore, injections of pharmaceutical products are given, which produce immunity nearly as good as recovering from a disease. Many of these injections are given intramuscularly in the rump between the hooks and pins. A lack of integrati on and communication between the sectors of the beef industry has resulted in many animals receiving multiple injections over their lifespan; in some cases, as many as six clostridial injections. These injections can cause severe tissue damage within the muscles of the top sirloin butt. Because this tissue damage can lead to collagen (connective tissue) formation, a decrease in beef tenderness can result up to 3 inches from the injection site. The occurrence of such muscle tissue damage represents a quality control problem and an economic loss to the beef industry of nearly $55,000,000 per year. In the Face-To-Face Interview Phase of the National Beef Quality Audit (1992), injection-site lesions ranked second, second, third, and second as major quality concerns of purveyors, restaurateurs, retailers, and packers, respectively.

When injections are given, either intramuscularly or subcutaneously, an acute inflammatory reaction occurs v ery rapidly. The severity of the reaction depends on the stimulus incurred. Very little information has been published on injection-site reactions and their effects on the red meat industry. The National Cattleman s Association has been responsible for the majority of this information. Our objective was to collect, evaluate (visually and histopathologically), and characterize lesions result-

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ing from the use of clostridial vaccines in beef cattle.

Experimental Procedures

One 500 lb steer (vaccination history not known) was injected subcutaneously twice, once on each side of the neck, with 5 milliliters of Ultrabac 7fi clostridial vaccine with a new 16 gauge, 3/4 inch needle. The injections were given 30 days and 36 hours prior to euthanasia. The resultant lesions were collected and evaluated at the veterinary diagnostic laboratory at Kansas State University. The selected tissues included haired skin, subcutaneous tissue, and underlying skeletal muscle. The tissues were fixed in 10% neu tral buffered formalin, embedded in paraffin, sectioned at 5 microns (m), and stained with hematoxylin and eosin.

Results

Injection-site reactions were noted on the steer within 24 hours of each injection and resulted in firm, raised, circular areas visible with the naked eye (Figure 1).

The 36-hour lesion was categorized as a dermatitis/cellulitis/stea titis. It was described as an acute (intense) necrosuppurative lesion with edema (swelling), hemorrhage (bleeding), and necrosis (dyin g tissue). A sharp separation was visible between the affected and nonaffected tissue, evidenced by: increased edema, fibrin (building blocks for connective tissue), neutrophilic infiltrates (white cells that fight infection), and hemorrhage. The normal structure of the subcutaneous tissue had been destroyed and showed dense cavitations containing edema, numerous sheets of neutrophils, extravasated erythrocytes within the s ubcutaneous tissue, and the muscle fibers separated by edema fluid. An additional section composed primarily of skeletal muscle had increased amounts of fibrin and edema fluid, was sharply demarcated, and extended into the underlying adipose tissue (steatitis). The junction between the abscess and the skeletal muscle had increased amounts of edema, fibrin, neutrophilic infiltrates, and hemorrhage. Conglomerations of neutrophils, lymphocytes, and plasma cells were found around blood vessels throughout the lesion. In some sections of the lesion, neutrophils and eosinophils extended into the papillary dermis.

Histologically, the 30-day lesion was characterized as dermatitis/myosi tis/cellulitis. It was described as chronic (persistent), lymphoplasmacytic, and fibrosing (forming connective tissue for structural support) with mineralization. The major differences from the 36-hour lesion were the increased amounts of fibrous connective tissue in the center of the lesion with alternatin g loose and dense accumulations of mixed inflammatory cells: lymphocytes, plasma cells, and histiocytes. The center of the lesion was composed of sheets of degenerated neutrophils (amphophilic cellular debris, i.e., greenish pus) surrounded by mixed mononuclear cells, then fibrous con nective tissue with abundant neovascular ization extending outward between the muscle bundles. Scattered degeneration of skeletal muscle had occurred throughout the lesion with minimal regeneration.

Discussion

Injection-site reactions can occur for many reasons and produce various responses with each animal. The pronounced reaction in this steer appears to be a response to both tissue injury brought about by irritation from the injected vaccine and a delayed-type hypersensitivity, which results from repeated exposure to a product. The lesions were comprised mainly of a dense accumulation of lymphocytes and macrophages, which are characteristic of a delayed-type hypersensitivity reaction. This type of reaction is considered to be typical of specific cellular immunity. The lesions appear to have been caused by a combination of physical irritation from the injection, repeated exposure to the vaccine, and possible tissue injury by the adjuvant itself.

The fact that the 30-day r eaction diminished over time demonstrates that injections and the resultant reactions by themselves may not be detrimental to the animal s well-being. However, they may be a critical control point in the production of high quality beef because of the inflammatory response that can leave permanent scarring in the tissues. The appearance of the reactions in this animal indicated that, if the

vaccine were injected intramuscularly, it could result in significant degeneration of skeletal muscle tissue and infiltration of fibrous connective tissue. A resultant blemish would not be revealed until later, when that part of the animal s carcass was cut into roasts or steaks.

This irritating response also could be evidence that the antigenic material was not processed properly. Antigenic material that stimulates an immune response also can cause a localized reaction at the site of injection. Irritating products such as oil of turpentine or oil adjuvant vaccines will cause more severe irritation and injection-site reactions, but the immune response also may be greater. Producers of biological products need to produce less irritating, yet effective, adjuvants. Additionally, contamination can occur through the use of old or dirty needles or when skin is wet and dirty. Using old needles (used more than 5 times) with clostridial vaccine will increase the number of lesions and the weight of the lesions. It also has been reported that in cattle, a threefold increase in bacterial numbers can occur with a used versus a new needle. Also, unused portions of vaccines should never be used at a later time, because they usually are contaminated and can cause an acute postvaccination reaction.

Both sterile and infected abscesses can result from injections, and if they occur in the muscle, then primal cut trim-outs can occur. During the most recent audit (March, 1993), the incidence of injection-site blemishes in top sirloin butts was determined to be 11 %, with an average weight per blemish of 124 grams (over l/4 lb). It has been shown that heavier trim weights were needed when the injections were administered earlier in the animal s life. This implies that either growth of the injection-site lesion corresponds to the animal s muscle growth or the dosage was too large on a per weight basis and the resulting reaction was more severe than normal.

Summary

We recommend that 1) clostridial vaccines be given subcutaneously in the neck with the tented technique using sterile needles and syringes (new or boiled in water for 5 minutes), 2) intramuscular injections for all products be avoided whenever alternate routes of administration are available on the label s directions, and 3) clostridial vaccinations be limited to primary immunization. Properly administered subcutaneous injections keep damage to nearby muscle tissue to a minimum, helping to ensure the production of high quality beef demanded by consumers.

Figure 1. 24 Hour Injection-Site Reaction from Clostridial Vaccine