Congenital erythropoietic protoporphyria in a Limousin calf

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Bovine congenital erythropoietic protoporphyria is an uncommon genetic defect in Limousin and Blonde d’Aquitaine cattle and is characterized by severe photosensitization.

Cattle with bovine congenital erythropoietic protoporphyria have Hct values within reference range, normochromic teeth, and nonfluorescence of urine; however, whole blood fluoresces under ultraviolet light.

Confirmation of bovine congenital erythropoietic protoporphyria is accomplished by genetic testing.

In March of 1999 a straight-bred Limousin heifer in a 70-cow herd of Limousin and Limousin-cross cattle was observed by the owner to have intense pruritus and exudative dermatitis involving the head and upper aspect of the thorax. The condition was nonresponsive to systemic treatment with tetracycline and topically applied dilute chlorine bleach solution (dosages were not reported). This heifer was subsequently sold at a terminal market. In June of 2000, a second straight-bred Limousin calf with similar clinical signs was identified from the same herd. Because these calves were both sired by the same bull, all calves in the herd sired by this bull may have been at risk for congenital erythropoietic protoporphyria. This second calf was 4 months old, weighed 109 kg (240 lb), and had intense pruritus and dermatitis of the head, ears, and shoulder area. Over a 3-week period, this calf was nonresponsive to systemic treatment with tetracycline, penicillin, corticosteroids, and avermectin, as well as topical treatment with dilute chlorine bleach solution and numerous unidentified over-the-counter topical lotions (dosages, intervals, and brand names were not reported). The owner reported that as a calf, the dam of the second calf had pruritus and dermatitis of the poll area, which decreased in severity with age.

The bull calf was referred to the Tifton Veterinary Diagnostic and Investigational Laboratory at The University of Georgia for evaluation of the dermatologic problem in July 2000. On examination, the calf was in normal body condition (beef body condition score of 5), and rectal temperature, heart rate, and respiratory rate were within reference ranges. Primary skin lesions involved the pinnae and poll with secondary lesions on the muzzle, periorbital region, and dorsal aspect of the thorax. These areas had focal to coalescing and noncontiguous areas of scaling, with severe alopecia and excoriations that were covered with dried serosanguineous exudates (Fig 1). Digital palpation resulted in a heightened sensitivity of the affected areas. No discoloration of the teeth was noted. Differential diagnoses included dermatophilosis, ectoparasitism, mycotic dermatitis, bacterial dermatitis, immune-mediated dermatoses, and types-1, -2, and -3 photosensitivity. Uncommon immune-mediated dermatoses such as erythema multiforme and cutaneous vasculitis have similar histologic lesions but do not cause pruritus, and they typically involve the distal extremities, tail, lips, and oral mucosa in addition to the pinnae.

Hematologic abnormalities included mild neutrophilia (4.3 X 10^3 cells/ml; reference range, 0.6 to 4.0 X 10^3 cells/ml) and mild lymphopenia (1.7 X 10^3 cells/ml; reference range, 2.5 to 7.5 X 10^3 cells/ml). Hematocrit and hemoglobin values were within reference ranges, with mild decreases in mean corpuscular volume and mean corpuscular hemoglobin. Serum biochemical abnormalities included high aspartate aminotransferase (AST; 515 U/L; reference range, 40 to 130 U/L) and creatine kinase (CK; 3145 U/L; reference range, 57 to 280 U/L) activities. Total bilirubin concentration and γ-glutamyltransferase (GGT) activity were both within reference ranges.

A biopsy specimen was obtained from the margin of the ear pinna. Bacteriologic culture yielded Staphylococcus aureus, Pseudomonas spp, Enterobacter spp, and S hyicus. The Pseudomonas isolate was resistant to oxytetracycline and penicillin. The other isolates were susceptible to both drugs. No dermatophyte isolates were isolated from the lesions.

Figure 1—Photograph of skin lesions of a bull calf affected with congenital erythropoietic protoporphyria. Notice the focal to coalescing and noncontiguous areas of scaling, marked alopecia, and excoriations that are covered with dried serosanguineous exudates (arrows).
phytates were isolated. Microscopic examination revealed complex lesions in various stages of development. The earliest lesions (presumed earliest on the basis of absence of vesicles) were moderate to severe acanthosis, hyperkeratosis, and parakeratosis with dermal angiofibroplasia. Exudation of neutrophils and hemorrhage in the dermal papillae with focal intercellular edema were observed in the overlying stratum spongiosum. Numerous focal and confluent intraepidermal vesicles and pustules were present on both surfaces of the ear. Some vesicles were partially lined by basilar epithelium (Fig 2). Vesicles were filled with eosinophilic fluid, cellular debris, and exudate. Necrosis of the epidermis and subjacent dermis was associated with fibrinoid necrosis and thrombosis of dermal vessels. Neutrophilic infiltration and marked edema were present in the subcutis. Ulcerated lesions were umbilicated and partially covered by a serocellular crust. Coccoid bacteria were present in the crust and vesicles adjacent to ulcers. Small pustules were occasionally observed in the stratum corneum. Lesion distribution and histologic findings were compatible with a preliminary diagnosis of photosensitivity. Autoimmune dermatoses have not been reported in cattle, and the lesion distribution in these cases was not consistent with the pattern in other species.1 The presence of numerous intraepithelial vesicles in the ear of the calf in Figure 1. A vesicle (v) has formed in the stratum spongiosum, and coagulative necrosis is present in the epidermis and upper dermis (c). The deep dermis and subcutis are markedly expanded by exudate. A vessel contains a large thrombus (arrowhead). H&E stain; bar = 250 µm.

There was no history of exposure to exogenous phototoxic compounds such as hypericin, fagopyrin, furocoumarin, or phenothiazine that have been associated with primary (type-I) photosensitivity.1 Tetracyclines are capable of causing photosensitization but have not been associated with problems in livestock,2 and the lesions in this case preceded and were not exacerbated by tetracycline treatment. Additionally, total bilirubin and GGT concentrations that are within reference ranges, as in the calf of this report, are not consistent with hepatogenous (type-3) photosensitivity, the most common form of photosensitivity in domestic animals.3 The concurrently high AST and CK activities were interpreted to be the result of capture, transport, and restraint of the calf. The history and biochemical results were suggestive of a tentative diagnosis of photosensitivity caused by aberrant pigment synthesis (type 2) such as congenital erythropoietic protoporphyria and porphyria.4

Protoporphyria is clinically differentiated from porphyria by the absence of anemia and discoloration of the teeth and urine.1 Urine and teeth from cattle with protoporphyria do not fluoresce, but whole blood from affected cattle will fluoresce under Wood’s light.3 Protoporphyria has been reported in Limousin and Blonde d’Aquitaine cattle. Porphyria has been detected in Ayrshire, Holstein, Jamaican, and Shorthorn cattle.1 The presence of numerous intraepithelial vesicles in the ear of this report is noteworthy, because vesicles were not described in previous reports4,5 of bovine protoporphyria, and this lesion differs from subepidermal clefts in calves with porphyria.4 A preliminary diagnosis of bovine protoporphyria was made on the basis of the clinical observations, normal hematologic results, breed, and histologic findings. Blood and urine were not available for examination with Wood’s light. Genetic testing established that the DNA in the whole blood sample submitted from the affected calf was homozygous for the defective allele for the protoporphyria mutation gene.4 The producer was advised of the genetic defect, and testing of the sire and dam was recommended. The affected calf was shipped to a terminal market.

Bovine protoporphyria is an uncommon genetic disorder characterized by development of severe photosensitization in early calfhood.5,6,7 Protoporphyria is an autosomal recessive disease6 that results in a defect in the mitochondrial enzyme (ferrochelatase) that normally catalyzes the chelation of ferrous iron by protoporphyrin to form heme.8 As a consequence of this decrease in ferrochelatase activity, protoporphyrin accumulates in the blood and tissues. A report7 on 3 cases of bovine protoporphyria revealed no major hematologic or serum biochemical changes. Protoporphyrin binds to proteins that are not excreted by the kidney. Therefore, high amounts of protoporphyrin will not be detected in the urine.9 Protoporphyrin is excreted through the bile and into the feces.10 Protoporphyrin is transported to the skin where it becomes photoreactive after absorption of sunlight energy, resulting in erythema, epidermolysis, and exudative dermatitis.10

Clinical management of bovine protoporphyria should be directed in 3 areas. Affected cattle should be
removed from sunlight, and supportive therapy should be initiated to relieve suffering and reduce secondary bacterial dermatitis. The diagnosis should be confirmed with genetic testing of the sire, dam, and progeny. Genetically affected cattle should be sent to a terminal market and should not be retained for breeding or sold for breeding purposes.

Protoporphyria genotype identification test provided by Johnson G, Department of Veterinary Pathology, College of Veterinary Medicine, University of Missouri, Columbia, Mo.

References