

Preliminary Report of Human Staphylococcal Infection Associated With Mastitis in Dairy Cattle

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THE emergence of strains of antibiotic-resistant staphylococci producing epidemics and endemics of suppurative disease in hospital patients and hospital personnel and spreading from them into the community prompted the Public Health Service and the National Research Council to sponsor the first National Conference on Hospital-Acquired Staphylococcal Disease, held in Atlanta, Ga., September 15-17, 1958. At this meeting Dr. Leroy E. Burney, Surgeon General of the Public Health Service, and others emphasized the hazard of antibiotic-resistant epidemic strains spreading to the community (1).

Staphylococci a Frequent Cause of Mastitis

Staphylococci have long been recognized as important in the etiology of mastitis in dairy cattle. Investigations have also revealed that these organisms are frequent inhabitants of apparently normal bovine mammary glands (2). Improper use of milking machines and other poor husbandry practices can cause trauma to glandular tissue, development of infection, and

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spread of pathogenic organisms through the herd (3, 4). A wide variety of antibiotics are frequently and often indiscriminately used by dairymen to treat animals suffering from mastitis. This creates an environment suitable to the development of pathogenic staphylococci resistant to antibiotics and an opportunity for cross-infection in the herd.

Recognizing this problem, the division of animal husbandry of the Hawaii Board of Agriculture and Forestry and the division of sanitation and bureau of laboratories of the Hawaii Department of Health conducted a limited survey to determine what bacteriophage types of coagulase-positive staphylococci are present in the milk of some dairy cattle on Oahu. During this survey, epidemic strain phage type 80/81 was found in the milk from four dairy cows—three in one herd.

The following report, believed to be the first of its kind to appear in the literature, describes investigations that associate human infection with mastitis caused by type 80/81 in dairy cattle.

Cows and Humans Found Infected

Upon finding that mastitic mammary secretions from at least three cows in one dairy herd contained staphylococcus phage type 80/81, it was deemed advisable to separate these animals from the commercial herd and culture additional milk samples from them as well as other animals in the herd showing evidence of mastitis. The dairy employees were also given bacteriological examinations.

Nasal cultures were performed on 11 employees working directly with the cattle. These workers were questioned about current and past disease indicative of staphylococcal infection. Six of these men were found to have paronychia on one or more fingers. This was attributed to frequent contact with disinfectant solution (chlorhexidine diacetate) necessary during milking. Specimens for culturing were also taken from the finger lesions. Only one employee gave a history of a frequent occurrence of furuncles or other diseases that could be attributed to staphylococcal infection. This employee had a large draining furuncle on his back

at the waistline, approximately 3 inches lateral to the spinal column. Exudate was collected from this lesion the same day that nasal culturing was performed. In addition, samples of disinfectant solutions used in the milking parlor and swabs from hose nozzles frequently handled by the employees were taken for bacteriological examination.

Nasal cultures from four employees yielded coagulase-positive *Staphylococcus aureus*, with one strain identified as phage type 80/81. This strain was from the anterior nares of the employee whose furuncle exudate also yielded type 80/81. Staphylococci were not isolated from any of the other specimens.

The antibiogram of these human 80/81 strains—resistant to chlortetracycline, oxytetracycline, tetracycline, and dihydrostreptomycin but susceptible to penicillin, chloramphenicol, oleandomycin, bacitracin, neomycin, carbomycin, and novobiocin—was identical to all of the bovine 80/81 strains isolated except that the bovine strains had some resistance to penicillin.

Infection in the Dairyman's Family

Further questioning of the employee found to have type 80/81 infection revealed that he had frequently experienced boils and sore throat during the previous 9 months, starting 3 months after his initial employment by the dairy. He further stated that his wife was currently afflicted with a boil and that his only child, an 18-month-old boy, had been experiencing a chronic sore throat for approximately 3 months and had only recently responded to medical therapy. (It was subsequently learned that the boy had responded to oleandomycin.)

The entire family was advised to seek medical care, and they elected to go to one physician. The father was given a course of TAO (tri-acetyloleandomycin), 1 gm. per day for 4 days. Cultures of nose and throat specimens taken shortly thereafter were negative for staphylococci, and there was no clinical evidence of new furuncle formation. Two weeks later the patient was given a course of chloramphenicol (same dosage schedule as TAO) which was again followed by negative nose and throat cultures. The second course of antibiotics was

thought to be advisable as a prophylactic measure since it was learned that the other members of the patient's family were also infected.

S. aureus phage type 80/81 was isolated from a furuncle on the right labium majus of the wife but not from nose or throat cultures. Subsequent cultures of nose and throat specimens following a course of chloromycetin were also negative, and her furuncle had healed.

Staphylococcus type 80/81 was isolated from the throat but not from the nose of the child. The antibiogram of this isolate was identical to those of the strains obtained from the mother and father. Another nose and throat specimen taken from the child 1 week after 2.5 gms. of chloromycetin had been administered yielded no staphylococci. Additional culturing of the dairy employee and his family is being planned.

Subsequently, two other employees were found to have experienced boils, but, unfortunately, they were discovered too late to obtain exudate for culturing. Additional nasal cultures from both of these men gave negative results.

Cultures of Milk Samples

One of the three cows originally found to be shedding staphylococcus type 80/81 in her milk was sent to slaughter before additional milk samples could be obtained. An additional milk sample from each of the other two animals yielded type 80/81. One of these animals was slaughtered because of low productivity attributed to severe mastitis. The remaining infected animal was treated with intramammary infusions of neomycin under the direction of a veterinarian. After two such treatments, staphylococcus type 80/81 was not detected in milk samples taken from all four quarters, but in 10 days this animal was again found to be excreting staphylococci type 80/81 from one quarter. There was no clinical evidence of mastitis at this time and the milk appeared normal, but the animal was slaughtered because of greatly decreased milk secretion. Pathological and bacteriological examinations of the mammary gland are being performed.

Although it would have been highly desirable, it was not feasible to culture milk samples from every lactating cow in the herd because of the

comparatively large number of animals and the lack of laboratory facilities and personnel. Milk specimens collected from 100 cows or about 10 percent of the herd did not yield staphylococcus type 80/81.

Twenty-one bulk raw milk specimens were collected at different times from the holding vats at the dairy. Milk is cooled and stored in large tanks prior to shipment by tank trucks to the processing plants for pasteurization. Coagulase-positive *S. aureus* was isolated from 17 of these specimens, 13 of which were phage-typable. Two of the typable strains, isolated on separate occasions from the same vat, were identified as the antibiotic-resistant type 80/81 with antibiograms identical to the bovine 80/81 strains originally found. Type 6/42E/47/42B/42D/44A was found in five milk samples, and 42D in three samples. The three remaining isolations were of different types. The types other than 80/81 found in milk are not common to those found in man in Hawaii, and all were susceptible to the antibiotics tested, according to a personal communication from M. Levine and R. H. Tanimoto, bureau of laboratories, Hawaii State Health Department. The finding of phage type 80/81 in the bulk milk samples may indicate that animals not previously detected are shedding this organism or that one of the employees not known to be harboring 80/81 contaminated the milk. Investigations are currently being conducted to detect this source.

Source of Infection Unknown

The available information allows only speculation as to the original source of staphylococcus type 80/81 infection in the dairy herd studied. Coagulase-positive staphylococci have been found commonly in mastitic secretions of a large number of cows in the dairy herd under investigation. Although adequate records are not kept on individual animals by the dairy management, it was learned that prior to the discovery of type 80/81 staphylococci at the dairy, a wide variety of antibiotics had been used by intramammary infusion for the treatment of cows with mastitis. It is possible that the resistant strains developed in bovine mammary glands and are unrelated to the strains of

staphylococci isolated from the dairyman and his family. It is also possible that the human staphylococcal infection was contracted from the cows. The infected employee spent most of his working hours in the hospital barn where cows, including the ones found to be secreting type 80/81 staphylococci, were housed for treatment of mastitis and other ailments.

The third possibility is that the dairyman, or one of his family, contracted type 80/81 infection from an outside source and infected the cows. Except during the birth of his child 18 months previously, none of the family had a history of recent hospitalization. The hospital where the child was born, 9 months before symptoms of staphylococcal disease were evident in the father or mother (and 14 months in the child), has not been known to have a staphylococcal disease problem. Nevertheless, the child or his mother may have acquired the organisms in the hospital and remained asymptomatic carriers, or the family infection could easily have been acquired outside the hospital.

Phage type 80/81 has been the most common type associated with staphylococcal infection in humans in Hawaii. During 1958, phage type 80/81 accounted for 30 percent of coagulase-positive strains identified by the laboratory of the Hawaii State Department of Health. The next most frequent type found accounted for only 5.5 percent (M. Levine and R. H. Tanimoto, personal communication). Similar findings have been reported from other areas (5). Data on phage types found in cattle in Hawaii are limited to a relatively small number of herds and samples.

Increased Virulence and Communicability

Varying opinions appear in the literature concerning the communicability and virulence of staphylococcus type 80/81 as compared with other staphylococci. Blair states (5): "There appears to be little question that staphylococcus of type 80/81 probably possess enhanced virulence and a high degree of communicability . . . and is capable of producing a variety of clinical forms of staphylococcal disease." Wentworth and associates describe family infections persisting for as long as 4 years and requiring extensive medical care and hospitaliza-

tion. The cost to one family for antibiotics and medical care, exclusive of hospitalization, was estimated in excess of \$1,500 (6). Spink presents evidence that infections with antibiotic-resistant strains present more difficult therapeutic problems and appear to be causing a higher case fatality rate than infections with sensitive strains (7). Anderson (8) and Dowling (9) in separate reports recognized the seriousness of the antibiotic-resistant strains but pointed out the need for more information and better methods of determining invasiveness, pathogenicity, and virulence of individual strains.

The virulence and communicability of staphylococcus type 80/81 for dairy cattle and other domestic animals are not yet known, but it should be considered a dangerous organism with potential for causing serious disease in animals and subsequent economic loss to animal industry.

There are definite public health implications in finding staphylococci in dairy cattle similar to the human epidemic strains. Undetected infected animals may present an occupational health hazard and act as foci of infection for rural communities. The ability of Hawaiian strains to produce heat-stable enterotoxins has not been investigated, but this possibility reaffirms the necessity for strict enforcement of refrigeration requirements for raw bulk milk and enforcement of presently accepted time and temperature combinations used in pasteurizing milk.

Summary

Three cows in one dairy herd were found to have mammary glands infected with the antibiotic-resistant staphylococcus phage type 80/81.

Subsequent investigations revealed one dairy

employee and his family to be suffering from staphylococcal disease caused by the same type. This organism was also found in 2 of 21 raw bulk milk samples collected at the dairy.

Treatment of the human cases is described as well as the therapeutic failure in preventing the excretion of type 80/81 in the milk of one dairy cow.

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