

Is There An *E. Coli* 0157:H7 in Your Practice?

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Abstract

There have been documented outbreaks of human illness due to *E. coli* 0157:H7 since 1982. The clinical symptoms include severe abdominal pain and cramps; watery diarrhea followed by grossly bloody diarrhea; fever in about 1/3 and vomiting in 1/2 of the cases, and some deaths associated with renal failure may occur. The implicated vehicles of the outbreaks have been ground beef, raw milk, cold sandwiches, roast beef, and person-to-person contact. *E. coli* 0157:H7 is the most commonly detected strain of *E. coli* among at least 50 serotypes of this organism that have been found to produce vero toxins which can cause the previously mentioned clinical signs. The main reservoir of these organisms is the intestinal tract of animals. These bacteria have been isolated in every region of the United States and have been found in fecal samples in dairy cattle, cow/calf operations, and feedlot animals. Is there an *E. coli* 0157:H7 in your practice? We will discuss this probability along with diagnostic approaches and policies being developed in regulatory agencies to address this issue.

Introduction

During the winter of 1993, cases of severe food-borne disease occurred in the Pacific Northwest. The outbreak occurred in several locations, with the total number of cases reaching 400. Of these, 125 were hospitalized, 29 or more patients developed acute renal failure, and all but eight of those required hemodialysis. Three young children died during this outbreak of food poisoning that was linked to microbial contamination of beef with *E. coli* 0157:H7.¹ Although this outbreak has received much deserved public attention, it is not an aberration in reporting. *E. coli* 0157:H7 was first identified in 1982 when it was determined to be the etiology of a multi-state outbreak of hemorrhagic colitis also associated with ground beef patties sold by a different national fast food chain.² Other recent outbreaks of *E. coli* 0157:H7-related disease have been associated with contaminated apple cider, unpasteurized milk, mayonnaise, and municipal water supplies. Because the largest clinical events have been surrounding contaminated meat, a fundamental change has occurred in how the public views the issue of food-borne disease and the safety standards required to prevent its occurrence. The veterinarian will become a focal point in Preharvest Food Safety regarding on-farm quality assurance sur-

rounding residues of pesticides, herbicides, hormones, antibiotic, and microbial contamination of milk and meat.

Verotoxins

By far, the majority of strains of *E. coli* isolated from feces is part of the normal intestinal flora and they play an important role in maintaining optimal intestinal physiology. However, within this group of bacteria, there are strains that are pathogenic and cause diarrhea. *E. coli* that cause diarrhea do so by different mechanisms which have resulted in the following classifications: a) enteropathogenic (EPEC), enterotoxigenic (ETEC), enteroinvasive (EIEC), and verotoxigenic (VTEC).³ Canadian investigators demonstrated that toxins produced by strains of *E. coli* serotype 0157:H7 were cytotoxic for vero cells; hence, the name "verotoxins." Additionally, isolation of this pathogen was closely related with hemorrhagic colitis syndrome (HC) in humans.

Two clinically important verotoxins (VT) produced by *E. coli* (VT1 and VT2) are members of a family of many similar cytotoxins. The verotoxins are subunit toxins constituted by an A (active) subunit and several B (binding) subunits. The verotoxins bind to the receptor on the surface of a cell via the B subunit. The A subunit is then internalized in the cell and cleaved to an active fragment that inhibits cellular protein synthesis. *E. coli* 0157:H7 is often the most frequent serotype of VTEC isolated. The predominance of serotype 0157 reported is undoubtedly biased because of the wide use of methods adapted only for this serotype. It should be noted that more than 57 other serotypes that produce verotoxins have been described.⁴

Potential Human Pathogens In Healthy Cattle and Other Farm Animals

A study conducted by German scientists employed a common biotechnology technique (DNA-DNA colony hybridization using specific gene probes for VT1 and VT2) to examine 2,100 *E. coli* strains from the feces of healthy animals. Ten out of 82 milk cows, 20 out of 212

beef cattle, and five out of 75 pigs were reported to carry genes for VT1, VT2 or both toxins. Several of the serotyped isolates have been described to be pathogenic for humans (0157:H7, 082:H8, 0116, 0113, 0126 and 091).⁵

In a portion of the National Dairy Heifer Evaluation Project conducted by Veterinary Services (USDA:APHIS), 6,894 heifer calves in 1,068 dairy herds were sampled in 28 states. The study reported a prevalence of isolating *E. coli* 0157:H7 in calves of 3.6/1,000. *E. coli* 0157:H7 was found among calves from two weeks of age to >12 weeks of age; however, no culture positive fecals were found among 633 calves sampled during the first week of life. Culture positive calves were present in all regions of the U.S., and the herd prevalence was estimated to approach 5%.⁶ No information concerning the capability of these isolates to produce verotoxins was reported.

A study presented at the 14th Annual Western Food Animal Disease Research Conference (Moscow, ID), estimated the herd prevalence of *E. coli* 0157:H7 in the state of Washington. The organism was isolated from 10 of 3,750 fecal samples (0.28%). This represented 5 of 60 dairy herds examined (8.3%). Post-weaning heifers had a higher prevalence than other age groups. It was reported that using current technology, fecal slurry, bulk tank milk, and milk filters were not reliable samples for screening a herd's status with regard to the presence or absence of *E. coli* 0157:H7.⁷ Discussions during this presentation brought out new information generated by Washington State University that there appeared to be no difference in the prevalence of *E. coli* 0157:H7 in animals raised on dairies, in beef feedlots, and cow/calf operations. Thus, there was no reason to think that it's any less common in any other cattle groups.

Coliform mastitis occurs on every dairy around the world and is of major significance because it has become a prevalent form of clinical mastitis. A predominant isolate from many of these clinical cases is *Escherichia coli*. There have been concerns expressed about the possibility that the cows being culled due to coliform mastitis are contaminating the food chain with *E. coli* 0157:H7. There are no reports in the scientific literature that address this concern. We have examined a total of over 500 isolates from field cases of coliform mastitis (California, Arizona, Oregon, and Texas) for the presence of either the VT-1 and/or VT-2 gene. When employing a colony blot hybridization technique, 16 isolates were positive for either or both of the verotoxin probes. However, when these same isolates were examined after chromosomal DNA extraction and vacuum blot hybridization, they were all VT-1 and VT-2 probe negative. This initial report is the first that has examined clinical coliform mastitis cases for the presence of the VT-1 or VT-2 gene. The fact that the results from the colony blot

hybridization technique could not be verified by the DNA extraction technique is an indication that this and other rapid screening methods may yield false positive results and inaccurately indicate that an important human pathogen exists in the mammary gland of the cull cow. However, this study should not be over interpreted to mean that there are no verotoxin-producing organisms in the bovine mammary gland. This study is an indication that if there are verotoxin-producing organisms in the mammary gland, it is a rare event.

Discussion

As our society grows further away from its agricultural roots, there will continue to be less and less understanding of the complex management practices required to produce healthy, cost efficient foods of animal origin. The veterinary profession must maintain its third party credibility among the producer, processor, and consumer in the role of ensuring safe food products as they leave the farm.

Is there an animal shedding an *E. coli* 0157:H7 in your practice area? Probably. Is this organism causing notable mortality rates among dairy or beef animals? Probably not. However, the manner in which these animals are housed, fed, and brought to the market place will be under intense investigation because of human health considerations. This intense scrutiny will also include the veterinarian and the practices of animal health that have been recommended by this health professional. It is now clearer than in any other time in the past that our profession must step up its efforts to maintain animal health and well-being in order to assure the safety of the food chain on the farm. *E. coli* 0157:H7 is only the first of many potential microbial or chemical contaminants of concern to public health officials and consumers. The practicing veterinarian must continue to educate herself/himself regarding these issues.

References

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