Q FEVER

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Q fever was first identified in Iowa, in both man and animal, in 1957. Subsequently the disease was demonstrated to occur enzootically among Iowa dairy cattle and, perhaps more important, constitute an occupational hazard of some degree for farmers and certain industrial groups in the state. Following initial studies designed to document the existence of Q fever in Iowa, a number of investigations have been executed in an attempt to demonstrate the prevalence and incidence of the disease in man and animals. Likewise, an effort has been made to evaluate the public health significance of Q fever in Iowa. During the course of these studies, several laboratory and field investigational procedures have been evaluated and demonstrated to be particularly applicable to the study of Q fever. These various Q fever studies have been conducted with the assistance and cooperation of the Iowa and U. S. Departments of Agriculture, Iowa State Department of Health, Iowa State Hygienic Laboratory, College of Veterinary Medicine — Iowa State University, and many practicing veterinarians and physicians. This paper is presented in the form of a brief review of the subject and a summary of the Iowa Q fever investigations.

HISTORICAL

Derrick first identified Q fever in 1935 following an investigation of an outbreak of an obscure respiratory disease among meat plant workers in Brisbane, Australia. Because the disease was not well understood and posed a "query" or "question," he named the malady "Q fever." Following initial isolation, the etiologic agent was named *Rickettsia burneti.* However, subsequent studies revealed the organism to be somewhat unique as regards antigenic structure, resistance and cultural characteristics; consequently, the name of the agent was eventually changed to *Coxiella burneti.*

The Q fever rickettsia was identified in the United States in 1938 when isolated from Montana ticks (*Dermacentor andersoni).* In 1941 the first naturally occurring case of human Q fever was reported in this country. The first recognized outbreak occurred in the United States in 1946 and involved a number of packing plant workers in Texas; a second similar outbreak was observed in Chicago the same year. Endemic Q fever was reported in the region of Artesia, California in 1948. Since that time, particularly during the last five years, the disease has been reported in man and/or animals from a number of states including Wisconsin, Illinois, New Jersey, Pennsylvania, Idaho, Michigan and Iowa. Indications are, Q fever is ubiquitous and may be found when and wherever a search is made.

World War II served to promote Q fever from the realm of medical obscurity to a position of international medical and public health significance. The disease proved to be of considerable military consequence in many European and African areas. Many allied troops in the Mediterranean area were infected and rendered temporarily non-combatant. German occupation forces in Greece were severely af-

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Most of the research data summarized in this paper have been previously published elsewhere in more complete form; reprints of such technical articles are available from the Institute of Agricultural Medicine.

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fected, and referred to the disease as the "Balkan grippe." More recently the French military in North Africa have reported Q fever. The disease is presently recognized in more than fifty countries on five continents and is under consideration by the World Health Organization as a problem of global importance.

Coxiella burneti is a rickettsia and as such may be defined as a microscopic, pleomorphic, intracellular parasite characterized as occupying a position between the smallest bacteria and the filtrable viruses. However, *C. burneti* is unique in several respects as compared with the type organism, *R. prowazeki. C. burneti is* filtrable, considerably more resistant to chemical and physical agents, and does not induce the production of agglutinins to the Proteus organisms (Weil-Felix reaction). The pronounced resistance of the Q fever rickettsia, particularly as regards dessication, is an important factor in the epizootiology-epidemiology of Q fever.

Q FEVER IN ANIMALS

Early efforts to demonstrate the Q fever infection-transmission cycle in nature resulted in the isolation of *C. burneti* from several species of ticks. Derrick succeeded in identifying a natural transmission cycle between ticks and bandicoots (a small Australian bush rodent), and postulated a relationship between ticks, bandicoots and cattle. Man was thought to become infected by tick bite or exposure to infectious tick feces on cattle hides. Continuing investigation served to emphasize the epidemiological relationship between human infections and contact with dairy cattle. Huebner investigated dairy cattle as a possible reservoir of human infection and succeeded in isolating *C. burneti* from the milk of suspect infected cows.

Subsequent studies demonstrated the domestic ruminant species, cattle, sheep, and goats, to be naturally susceptible to Q fever infection and that these species constitute a primary human exposure source. Although the pathogenesis of the disease in domestic ruminants is not well understood, limited information is available. Indications are that the disease occurs most frequently, if not exclusively, among sexually mature female animals; further, bovine infections appear to be restricted to dairy cattle. Investigators have called attention to the possibility that the apparent selective susceptibility of sexually mature, female dairy cattle to Q fever infection may be a function of hormonal influence and related to intensive dairy breeding practices. Infected ruminants shed enormous numbers of rickettsia in the fetal membranes and vaginal dejecta at parturition. Likewise, such animals shed rickettsia in their milk for varying periods of time following parturition. The udder is undoubtedly the primary site of infection in the bovine and serves as the source of cyclic genital infections associated with pregnancy.

Infected ruminants do not exhibit signs of illiness; detailed examinations of known infected cattle have failed to identify any consistent clinical signs. Recent Russian literature reports rhinitis, conjunctivitis, anorexia, abortion and decreased milk production as signs of bovine Q fever infection; the existence of clinical signs in the bovine in Russia and the absence of such a syndrome in this country and various other countries may be due to a variation in rickettsial strains. Transmission of the disease among cattle occurs by direct contact with infectious materials and/or exposure to infectious aerosols. Under certain ecological conditions infected ticks may serve as a source of bovine infection. Although organisms are intermittently shed in the milk of infected dams, nursing young escape infection by virtue of their age resistance.

Infected animals may be identified only by laboratory tests involving the demonstration of specific antibodies or isolation of the organism. Serologic procedures include the complement fixation and capillary agglutination tests. The complement fixation serologic technique is complex and has certain well-defined technical disadvantages when applied to Q fever; further, this method is particularly unsuitable for testing animal sera. The Luoto capillary agglutination test is a rapid, valid and reliable method of testing both animal and human sera for Q fever. In addition, the capillary agglutination test procedure can

be applied to milk specimens. The laboratory isolation of *C. burnetti* is expensive, complex and somewhat hazardous for the laboratorian; this procedure is practical only in well-equipped infectious disease laboratories. Because the disease in domestic ruminants is devoid of clinical sigificance, little effort has been made to evaluate therapeutic agents; however, aureomycin therapy has proven ineffectual in the control of mammary shedding of *C. burneti* in dairy cows.

A number of other animals have been shown to be susceptible, either naturally or experimentally, to Q fever infection. Although many susceptible species are recognized, available evidence clearly implicates the domestic ruminant species as the primary reservoir of infection for man. Other susceptible animals include the mouse (field and house), porcupine, cotton tail rabbit, pigeon, sparrow, parakeet, cat and dog. Horses have recently been implicated as a source of human infection in Rumania.

Q FEVER IN MAN

Human Q fever infections, following an incubation period of fourteen to twenty-six days, are characterized by abrupt onset, fever, chills, severe headache, nausea, myalgia, and pulmonary symptoms. Compared to other rickettsial diseases, Q fever is unique in that patients do not develop a typical rickettsial skin rash. Pulmonary involvement, which is reported in approximately 50% of the cases, develops by the fifth day of clinical illness, and is signaled by a mild, dry cough and chest pain, this disease usually associated with roentgenological evidence of localized pneumonitis. The course of the disease varies, in most cases between ten days and one month, the more protracted cases occurring among individuals of the older age groups. Human Q fever is a disease of morbidity rather than mortality; few patients die unless the case is complicated by secondary infection or pre-existing heart disease. Preliminary evidence suggests the occasional occurrence of fatal, post-acute rickettsial endocarditis, particularly among aged persons. British investigators have called attention to chronic Q fever infection; however, this form of the disease is little understood and seldom recognized. Oxytetracycline therapy has been found effective for alleviating clinical symptoms and preventing relapse.

Most human infections occur via the respiratory route following exposure to infectious aerosols. Such aerosols are most frequently encountered in and about barns or dairies housing infected animals. The ability of *C. burneti* to withstand prolonged dessication facilitates the long term contamination of animal quarters with rickettsia laden dust. Available epidemiologic evidence suggests raw milk contaminated with *C. burneti* may, under certain conditions, serve as a source of human infection. Several investigators have studied the effect of milk pasteurization procedures on the Q fever rickettsia. The flash method of pasteurization (161° F-15 sec.) has been found to destroy *C. burneti* in milk; although vat pasteurization methods (143° F.-30 min.) do not consistently render contaminated milk free of rickettsia, the number of surviving organisms is probably reduced to near or below the level constituting an infectious dose.

Clinically, human Q fever infections may resemble, and must be differentiated from influenza, brucellosis, psittacosis, non-icteric leptospirosis, infectious hepatitis and primary atypical pneumonia. Available serologic tests include complement fixation and capillary agglutination procedures. Although the complement fixation test has been more commonly employed, recognition of antigenic variations be tween rickettsial strains limits the applicability of this technique; the Luoto capillary agglutination test is not subject to influence by antigenic variations. The Weil-Felix test is not applicable to the serodiagnosis of Q fever. *C. bureti* may be isolated from the blood of infected patients during the febrile period; less frequently isolations may be made from urine or sputum.

IOWA Q FEVER STUDIES

A statewide bovine Q fever serologic study was conducted during the period November, 1956 to June, 1957. Survey specimens consisted of randomly selected bovine blood specimens submitted to the Iowa State-Federal Brucellosis Laboratory.

Specimens were tested by the capillary agglutination test. Of 11,799 samples tested, 84 or .71% were found positive. When computed on a herd basis, 3.25% of herds tested were found to contain one or more positive animals. The geographic distribution of positive herds revealed foci of enzootic Q fever in the Northwest and East Central sections of the state. Of twenty-five infected dairy herds identified during the study, four were closely studied for approximately five months. Radial spread of infection within the study herds was observed; of twenty-five replacement cows added to the herds, 40% were serologically positive for Q fever upon retesting the herd. *C. burneti* was isolated from the milk of nine infected cattle.

In an effort to refine bovine Q fever survey methods, pooled herd milk samples, made available through a dairy and local health department, were collected and tested by the Luoto capillary agglutination test. Herds identified as positive by this technique were then studied in detail. The testing of pooled herd milk specimens by this method was demonstrated to be a valid, reliable and efficient method of testing large bovine populations for evidence of Q fever infection. Subsequent investigations revealed a correlation between the antibody titer of milk specimens and the shedding of *C. burneti* in the milk. Q fever udder infections were frequently found to involve less than all four quarters; further, the infection status of the individual udder quarters was demonstrated to be relatively stable. Indirect evidence was obtained of specific Q fever antibody production by the udder.

Efforts to evaluate the public health significance of Q fever in Iowa have included serologic surveys of "high risk" and control occupational groups, detailed epidemiologic investigations of suspect acute cases and surveillance of individuals known to have routine contact with infected cattle. Of a total of 210 blood specimens collected from veterinary practioners from various sections of the state, fifteen or 7.14% were found to be Q fever positive; serologic positivity by geographic area varied from zero to 8.5%. By comparison, .24% of 5,318 blood specimens submitted to the Iowa State Hygenic Laboratory for brucella serology were positive for Q fever, whereas .16% of 6,411 routine premarital specimens were found positive. No positive specimens were found among 29 blood samples collected from individuals known to have daily contact with infected cattle or 66 specimens collected from members of a dairy breeders organization. Epidemiologic investigation of suspect cases has resulted in the identification and confirmation of twenty-two episodes of acute human Q fever infection in Iowa. Of the total, fourteen cases occurred among farmers and three cases among slaughterhouse employees; the remaining five cases involved a policeman, student, truckdriver, factory worker and milk processer.

SUMMARY

Q fever, like trichinosis, is an example of a zoonotic disease characterized by little or no veterinary clinical importance and definite public health significance. Experience has proven such diseases to be considerably more difficult to control than is the case with zoonotic diseases having both veterinary and human clinical importace. In certain areas of the country, particularly the far west, Q fever has become a public health problem of considerable concern; in many other areas the disease, although known to be present, does not appear to represent a problem of any magnitude. Concerning the latter areas, it is always possible the level of infection in the animal reservoir will increase to the point of "spilling over" into the human population with epidemic results..

(The bibliography for this article is available upon request from the authors.)

End

HYGROMYCIN INEFFECTIVE IN SHEEP. Scientists of the University of Illinois have concluded after a three month study that it would be a waste of the practitioner's time to attempt to clear parasitic nematodes from sheep with hygromycin. It neither eliminates them nor does it do anything to foster weight gain of survivors.