Epidemiologic Studies

ROBERT E. SHOPE, M.D.
Moderator

The discussion evolved around a series of questions about the tick, the vertebrate host, the distribution of Lyme disease, and surveillance.

The Tick

What is the distribution and population density of ticks transmitting the Lyme spirochete? Data on tick distribution are scarce. *Ixodes dammini* appears to be limited to sea-level ecosystems, whereas *I. pacificus* populations are adequate up to 7,000 feet elevation. Three cases of Lyme disease had their exposure above 5,000 feet in the Sierras of northern California. The nympha tick is very small and not generally recognized by the public. Qualitative tick surveys in Minnesota done in the late 1950s and early 1960s by the Minnesota Department of Natural Resources found *I. dammini* in an eight-county area. More recently, qualitative studies showed the tick extending west and somewhat south from that area. Recently a physician detected a case in Mahnomen County, considerably west of the known distribution of *I. dammini* and actually identified the tick on the patient. Data on exposure in North America are inadequate and can be expected to vary depending on how one looks for ticks, how concentrated ticks are in the woods, and other variables too complicated to analyze as yet.

How should we characterize tick density? The terms “high, moderate, and low” tick density were defined. Greater than ten *I. dammini* per animal was considered high, five to nine moderate, and four or less low density. For data to be comparable from one study to another, examination of deer for ticks should be done uniformly, starting at the ears and progressing to the head and neck, ten minutes per animal. Ticks were found to be most concentrated on the ears.

Does the adult stage of the tick transmit to people? Sporadic cases of Lyme disease have been detected in virtually every month of the year in the United States north from Maryland. Most of these cases had ECM, implying that the exposure was quite recent in reference to onset of disease and that the vector was the adult tick in cases of late fall and spring ECM.

Can ticks other than *I. dammini* and *I. pacificus* be vectors of the Lyme spirochete in the U.S.? *Amblyomma americanum* has now been implicated in two cases of ECM. The first of these was in Arkansas where a female tick was found on a worker who developed ECM but failed to seroconvert. *A. americanum* is an extremely common tick in the South and southeastern U.S. If this tick were to become a significant vector, Lyme disease could develop into a much more serious and widespread health threat.

Four cases of Lyme disease from Tennessee were reported to CDC in 1983. A 13-year-old boy camped in south central Tennessee over the Labor Day holiday,
then returned to his home in Atlanta, Georgia, where a week after exposure he developed ECM. Three weeks later he had a titer of 1:256 by immunofluorescence. He was treated with tetracycline and did not develop complications. The other three cases did not seroconvert but were seen at Vanderbilt University Hospital where classic ECM lesions were noted. An additional three cases from Tennessee are known but not officially reported. The identity of the vector in Tennessee is unknown, but might well be *I. scapularis*, a tick closely related to *I. dammini*. The vector also might be *A. americanum* or even *Haemaphysalis leporispalustris*.

Can male ticks transmit the Lyme spirochete? *I. ricinus* males do not engorge. *I. dammini* males have been found on people and on infrequent occasions have bitten workers during field studies in New Jersey. Small amounts of blood were sometimes observed in dissected male *I. dammini*, but there was general consensus of the symposium participants that the male is not a significant vector of the Lyme spirochete.

What is the role of the shrew in Lyme disease? The shrew is a common animal in New England, although not readily caught in Sherman traps. One shrew was reported to carry 117 ticks; 31 of 35 ticks examined from this animal were infected with spirochetes. Serological tests of shrews were not done. It was pointed out that Lyme disease is highly focal, and that if the 117 ticks from that shrew had fallen off in one site, this would become a highly potent small focus with large numbers of questing nymphs.

Do larval ticks transmit the Lyme spirochete? Not very many larval ticks have been examined; experience so far indicates that recently hatched and unfed larvae are not infected, although spirochetes have been seen in larvae after feeding on field mice.

**The Vertebrate Host**

What is the specificity of immunofluorescence and ELISA tests of animal sera? The testing of animal sera for antibody poses problems of specificity. Until more experience is gained, the results can only be interpreted as "antibody to spirochetes." Leptospires or spirochetes other than the Lyme spirochete could account for the observed reactions in wild animals.

Does the antibody in the vertebrate host correlate with infection of ticks taken from the animal? There does not seem to be a direct correlation between presence of spirochetes in ticks taken from an animal and antibody in the animal. Infected ticks were found on seropositive mice, but also on seronegative mice. Presumably spirochete-carrying ticks are not always transmitters. The duration of antibody in animals is not known. Probably tests of animals for spirochetemia offer a more realistic marker of active foci than tests for antibody.

A new approach to the collection of blood from mice used pediatric vacuum tubes pre-loaded with 8 ml of Kelly's medium to receive 0.1 or 0.2 ml of rodent blood in the field. Culture for spirochetes is the most sensitive technique for detecting the Lyme spirochete, but fresh Giemsa-stained smears offer an alternative. Organisms appear to fluoresce in darkfield microscopy and the Giemsa method has the advantage of speed for a survey.

**Distribution of Lyme Disease**

Are there foci known to the participants not already cited? The disease is known only in Europe, North America, and Australia. The conference attendees were not able to name other foci; however, some areas of the world such as the Soviet Union...
were not represented. It was noted that the Soviet literature cites cases of "Lyme disease." The Soviet infections are in the southwestern USSR, near the Caucasus.

It was agreed and emphasized that the residence of Lyme disease patients did not necessarily represent the site of exposure. Many patients travelled, both in the series of cases in New Jersey and in Minnesota. If residence data were used to map the disease there would have been an epidemic in Minneapolis-St. Paul, which clearly did not represent a focus of transmission. These observations highlight the need for tick and wildlife infection data to validate the locations of foci identified by case reports.

Serosurvey of dogs was cited as useful to locate foci, but travel history of dogs also is important, since some dogs are taken into enzootic areas for hunting.

What is the relationship of hunting to Lyme disease? Do hunters explain the increased prevalence in males over females? Precise data of disease in hunters are lacking but there are anecdotal reports of Lyme disease in hunters and game wardens. Hunters, however, clearly make up only a small number of Lyme disease patients. In Minnesota about 90 percent of cases each year occur before the hunting season begins. Outdoor exposure is a major risk factor in Lyme disease and males presumably have greater outdoor exposure than females.

Surveillance

How should state health departments design a surveillance program? Should they gear their laboratories to extensive serological testing or utilize clinical diagnoses and reserve the laboratory resources for specialized applications? Lyme disease is no longer a syndrome, but neither is it a completely defined diagnosis. Serological test results were not very helpful for defining cases in Minnesota. The degree to which this failure resulted from cases aborted by antibiotic treatment is not known. In any case, we still rely on a non-serological case definition. It remains important to define endemic areas, especially important for the physician who can treat ECM to prevent meningitis, carditis, and arthritis. A state newsletter should be used to publicize known endemic areas and to encourage reporting of ECM (an especially important facet of the case definition) and other manifestations of the disease.

The states should, however, provide serological diagnosis especially for cases with joint, cardiac, or central nervous system disease. The case definition should be continually reviewed to include possible new syndromes which can be found to correlate with positive serological test results. Serological results, even if imperfect, should be a factor in the case definition.

There is a continued need for a serological or biochemical test to detect infection early, analogous to the use of IgM for a single-serum early diagnosis of hepatitis A.

Retrospective serological studies can be useful to determine if the disease is increasing in prevalence or spreading to new areas.

Control

What pragmatic measures can the state health departments take to control Lyme disease? It appears to be highly significant that this question remained unanswered.