tial risk of transmission to the infant by nursing, although there have been no reports of documented transmission by this route. There are no recommendations to support routine treatment of asymptomatic pregnant women with histories of remote pre-gestational tick bite who have no evidence of active Lyme disease and who have serologic responses consistent with previously resolved Lyme borreliosis. The antibiotic regimen of choice for prophylaxis of tick bites in pregnant women is amoxicillin 500 mg by mouth three times daily for at least 10 days; acute and convalescent sera are indicated if there is any suspicion that asymptomatic infection has occurred following the bite. In penicillin-allergic patients, cefuroxime axetil 500 mg orally twice a day (if the patient has no cross-reacting hypersensitivity) or erythromycin 500 mg orally four times daily for at least 10 days may be used. Doxycycline or tetracycline should not be used in pregnant or lactating women.

No data exist regarding whether antibiotic therapy should be given for tick bite prophylaxis of congenitally infected infants or children because so few of these infants have been recognized. Because some of the chronic complications of Lyme borreliosis may be immunologically mediated and the immune response of congenitally infected infants to future *B. burgdorferi* infection is unknown, the author currently favors use of antibiotic prophylaxis for congenitally infected children, although these recommendations may change as further data become available (see Table 11–23).

Educational Programs to Increase Lyme Disease Awareness

Educational campaigns to increase awareness of Lyme disease and methods of reduction of human risk are widespread in many hyperendemic areas of North America. The European Union Concerted Action on Risk Assessment in Lyme Borreliosis (EUCALB) has prepared a pamphlet[861] that reviews Lyme borreliosis and risk reduction methods, is available via the EUCALB web site,[862] is intended for use in every European country to increase knowledge about Lyme borreliosis in low-awareness groups, and may also be used to educate tourists to Lyme-endemic areas.

However, even in areas where knowledge of Lyme disease is high, tick-avoidance behavior has often been found to be inadequate, particularly among visitors.[577, 863] A survey of 100 women in a Lyme-endemic area of Connecticut, at either prenatal or postnatal visits, found that although almost all would be concerned about tick bites or Lyme disease, and half reported they were concerned about effects on pregnancy, one fourth had misconceptions about Lyme disease transmission and were concerned about exposure to a person with Lyme disease but were unconcerned about working or playing on their lawns.[864] In a hyperendemic area of New Jersey, a survey of over 300 tick bite victims[863] found that only 58% used proper tick removal methods, only 16% treated their residential property with acaricides for tick control, only 0.6% cleared brush or vegetation from near their residences, and 84% of dog and cat owners allowed their pets to roam outdoors and indoors. Eighty-six percent took personal precautions against tick bites as a result of the bite, compared with estimates of 43% of visitors to recreational areas in New Jersey. A case-control study[496] in Hunterdon County, New Jersey, a hyperendemic area with an incidence of 193 cases per 100,000, found that only 55% of patients with Lyme disease did routine tick checks, 47% wore protective clothing, and 16% used tick repellents. A survey[577] of 304 ferry passengers leaving Martha's Vineyard in 1992, an endemic area with an incidence of over 30 cases per 100,000 and 180,000 visitors annually, found that despite a very good level of knowledge about Lyme disease in 73%, only 58 to 59% limited tick exposure or wore protective clothing, 66% did tick checks, and 40% used tick repellent. Visitors followed tick-avoidance and tick-checking recommendations less often than residents. In a hyperendemic area in the Czech Republic, another study[519] found that despite high awareness of ticks and Lyme disease, 87% of people, including both residents and visitors, had a history of tick bite, and few people used proper tick removal methods. A survey of visitors to the endemic Thetford Forest in southeastern Great Britain, which has 1.5 million visitors per year, found that less than half knew that Lyme disease was transmitted by tick bites, and only 13% recognized an unfed nymphal *I. ricinus* tick.[544] There are a million visitors annually to the Aland Islands of Finland, another highly endemic area.[516] Many popular tourist resorts worldwide are in Lyme-endemic areas, and Lyme disease educational programs in these areas are needed.

Although educational campaigns to increase knowledge about Lyme disease and risk-reduction methods are important, it is also necessary to increase actual observance of risk-reduction methods among both residents of, and visitors to, endemic areas by provision of information that convinces individuals at risk that risk-reduction methods are effective and worthwhile. A dramatic reduction in the incidence of seroconversion of New Jersey outdoor workers occurred after 3 years of educational tick bite recognition programs, although climatic factors may also have played a role.[495] Specific programs targeting tourists and visitors to these areas are needed.[577, 861]

As discussed in the Vaccine section previously, it is essential to educate all recipients of the Lyme vaccine, including women who plan to become pregnant, that continued use of protective methods against tick bites, including personal protective methods, is extremely important because of possible waning of effective vaccine-induced immunity. Such precautions are also essential to decrease risk of acquisition of other tickborne pathogens, including ehrlichiosis and babesiosis, and in some areas of Europe, tickborne encephalitis.

PROGNOSIS

Data indicate that the prognosis of gestational Lyme borreliosis is good if the infection is recognized promptly and treated aggressively with antibiotic therapy aimed at crossing the placental barrier. The prognosis is unknown in gestational Lyme borreliosis that lacks

the typical history of tick bite followed by EM or other symptoms that lead to its recognition. It is uncertain how many episodes of gestational toxemia, spontaneous miscarriage, spontaneous abortion, stillbirth, culture-negative neonatal sepsis, failure to thrive, developmental delay, congenital heart disease, or sudden infant death syndrome may be due to unrecognized gestational Lyme borreliosis. Most studies addressing the issue of gestational and congenital Lyme borreliosis have evaluated pregnancy outcomes after the first prenatal visit or at delivery; although they provide useful data, they may either miss adverse events in early pregnancy or underestimate the fetal mortality rate. Determination of true risk to the fetus and infant of maternal gestational Lyme disease requires prospective studies of all pregnancy outcomes of gestational Lyme disease, long-term follow-up of live-born products of these pregnancies, and improved diagnosis of Lyme disease in affected fetuses, placentas, and infants.

The prognosis for immediate survival of infants who present with fulminant early congenital Lyme borreliosis depends on recognition of the disease and institution of prompt aggressive intravenous antibiotic therapy appropriate for *B. burgdorferi* sepsis, as discussed in the section Therapy. It should be stressed that maximal supportive management alone, including supportive measures for management of severe septic shock and respiratory distress, without appropriate antibiotic therapy, is not sufficient and may result in death of the infant.

The prognosis of infants who present with late congenital Lyme borreliosis depends on the extent of any irreversible damage already present at the time of diagnosis and institution of appropriate antibiotic therapy. It is my opinion that aggressive intravenous antibiotic therapy initially, followed by prolonged oral antibiotic therapy, as discussed in the section Therapy, should at least prevent further clinical deterioration and may lead to improvement in any reversible damage.

Because long-term chronicity of Lyme borreliosis with persistence of spirochetes in immunologically protected sites has been reported in older patients, because it is not known whether fetally acquired *B. burgdorferi* infection may result in similar persistence of the organism in some immunologically protected site, and because the effect of this fetally acquired infection on the way a congenitally infected infant will respond to future *B. burgdorferi* infection is unknown, any evidence of clinical deterioration, particularly in growth and development, hearing, or neurologic status, should be closely reevaluated for possible relation to *B. burgdorferi* relapse or reinfection. If the deterioration is considered to be due to *B. burgdorferi* infection, aggressive antibiotic therapy should be instituted to prevent future clinical deterioration, as reviewed in the sections Diagnosis and Differential Diagnosis, and Therapy.

Because there are insufficient data to allow prognostic predictions of long-term outcome of infants treated for early or late congenital Lyme borreliosis, close follow-up is required for these infants and should include at least pediatric neurology, ophthalmology, otolaryngology, and infectious disease evaluations. Other specialties such as pediatric cardiology, cardiac surgery, gastroenterology, orthopedics, or rheumatology may be indicated, depending on the extent of involvement of these systems.

The index of suspicion should be high that any illness consistent with the late manifestations of Lyme borreliosis reported in children or adults may also theoretically occur in the congenitally infected infant. It will continue to be most important to recognize, treat, and evaluate infants with suspected congenital Lyme borreliosis in order for a more complete description of the syndrome to evolve.

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