6. Summary

Adaptation of *Borrelia afzelii* and *Borrelia burgdorferi* sensu stricto, pathogens of the Lyme disease, in diverse natural rodent reservoir hosts

Both, birds and rodents, are competent reservoir hosts for *Borrelia burgdorferi* sensu stricto. Nevertheless, this genospecies infects questing ticks less frequently in Central Europe than do *B. afzelii*- and *B. garinii*-spirochetes, the other pathogenic spirochetes. Because each of the genospecies is transmitted by *Ixodes ricinus*, a vector with a broad host array, one would expect that *B. burgdorferi* s.s. is more likely to be transmitted to a competent host than the more host adapted genospecies (Levine et al. 1985, Olsen et al. 1995, and Richter et al. 2000). Similarly a higher rate of double-infections with *B. burgdorferi* s.s. in ticks would be expected. *B. burgdorferi* s.s., however, is not the most prevalent genospecies in questing ticks in nature. For each questing nymph collected in the Stadtpark of Göttingen that is infected by *B. burgdorferi* s.s., more than four ticks are infected by *B. afzelii* and more than ten by *B. garinii*. This difference in prevalence of *B. afzelii* and *B. burgdorferi* s.s. might be influenced by certain characteristics of their hosts.

The reservoir competence of mono- and double-infected rodents and the transmission dynamics of multi-passaged *B. afzelii* and *B. burgdorferi* s.s. may reveal the influence of the host on the prevalence of *B. burgdorferi* s.l. in questing ticks. Woodmice, *Apodemus sylvaticus*, and mongolian jirds, *Meriones unguiculatus*, were infected with *B. afzelii* or *B. burgdorferi* s.s. by means of mono-infected nymphs. The infectivity of these hosts for ticks was compared by xenodiagnosis throughout an eight-month period. *B. afzelii*-infected hosts were more infectious for their vector ticks than *B. burgdorferi* s.s.-infected hosts and more ticks acquired spirochetes from jirds than from woodmice. Woodmice, however, remained infectious for ticks for a longer period than jirds.

Brown rats, *Rattus norvegicus*, were also infected by means of infected nymphs with one of the three pathogenic genospecies. Subsequent xenodiagnosis revealed an initially higher infectivity of *B. afzelii*-infected rats for their vector ticks than *B. burgdorferi* s.s.-infected rats. However, *B. burgdorferi* s.s.-infected rats remained more infectious to xenodiagnostic ticks after seven months. After re-infection with the same genospecies, infectivity for vector ticks increased again, thus, rats did not develop an immunity against *B. burgdorferi* s.l. Brown rats infected nearly the same number of ticks either with *B. afzelii* and *B. burgdorferi* s.s. throughout the entire time span but far fewer ticks acquired *B. garinii* serotype 6-spirochetes from rats.

To examine how genospecies interact in multi-infected hosts, different rodents were infected with either *B. afzelii* or *B. burgdorferi* s.s. and subsequently super-infected with the other genospecies after a period of two or eight weeks. *B. afzelii* predominated in xenodiagnostic ticks fed on super-infected woodmice or jirds. Jirds infected xenodiagnostic vector ticks with *B. burgdorferi* s.s. solely if this genospecies super-infected them during the chronic stage of *B. afzelii*-infection. The absolute amount of specific antibodies in the serum of super-infected hosts did not correlate with the predominantly transmitted genospecies.

Subsequently, we determined which genospecies predominated in the adult tick if the larva and the nymph fed on differently infected hosts. The predominant genospecies in single-infected adult ticks depended on the kind of host on which the nymph had fed.

To determine which genospecies will infect a vector tick after a second host passage of the pathogen, xenodiagnostic ticks from super-infected jirds were permitted to infest house mice, *Mus musculus*. This simultaneous exposure of hosts to *B. afzelii* and *B. burgdorferi* s.s. resulted in xenodiagnostic ticks infected mainly by *B. afzelii*. If the host of the first passage infected their vector ticks predominantly with *B. burgdorferi* s.s., this genospecies could be found more frequently in the xenodiagnostic larvae of the house mice but were mostly lost in the resulting nymphs. Only from one house mouse, more xenodiagnostic ticks acquired *B. burgdorferi* s.s.- than *B. afzelii*-spirochetes.

The predominance of *B. afzelii* in questing ticks compared to that of *B. burgdorferi* s.s. may also be explained by more rapid transmission from the infected nymph to its host. Infected nymphs were allowed to feed on hairless house mice for a defined period of time, followed by xenodiagnosis two weeks later. Neither of the genospecies was transmitted earlier than 24 hours after *I. ricinus* nymphs had started their bloodmeal. *B. afzelii,* however, was transmitted more efficiently compared to *B. burgdorferi* s.s.

Lyme disease spirochetes that specialize in particular kinds of reservoir hosts in nature, such as *B. afzelii*, are better adapted to those hosts than are more generalist pathogens, such as *B. burgdorferi* s.s., and they are better adapted to those hosts than to a laboratory model. The specialist *B. afzelii* is more efficiently transmitted than the generalist *B. burgdorferi* s.s.