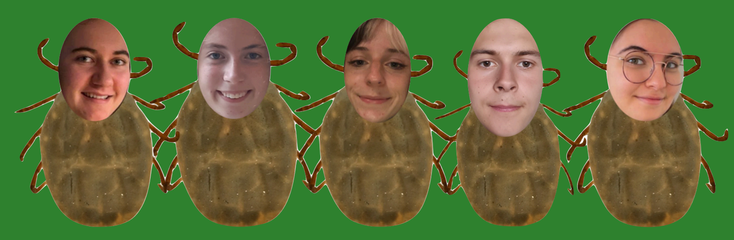
Borrelia Burgdorferi

Responsible for Lyme disease



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Borrelia Burgdorferi introduction and structure

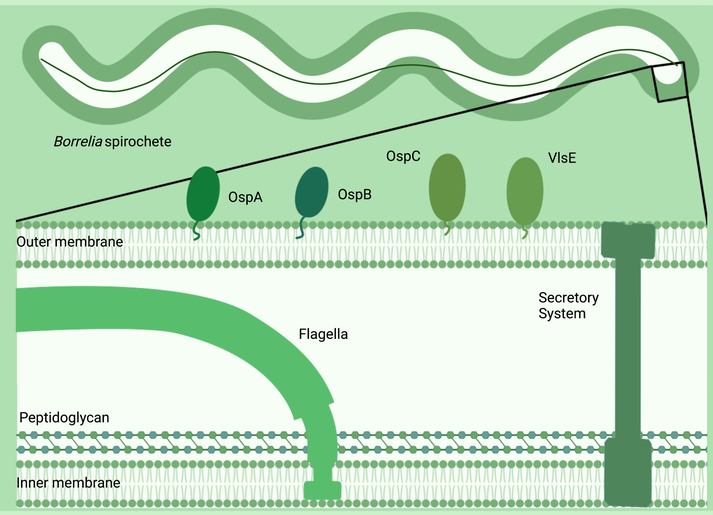
Location : Mainly in the northern hemisphere

Family : Spirochaetaceae

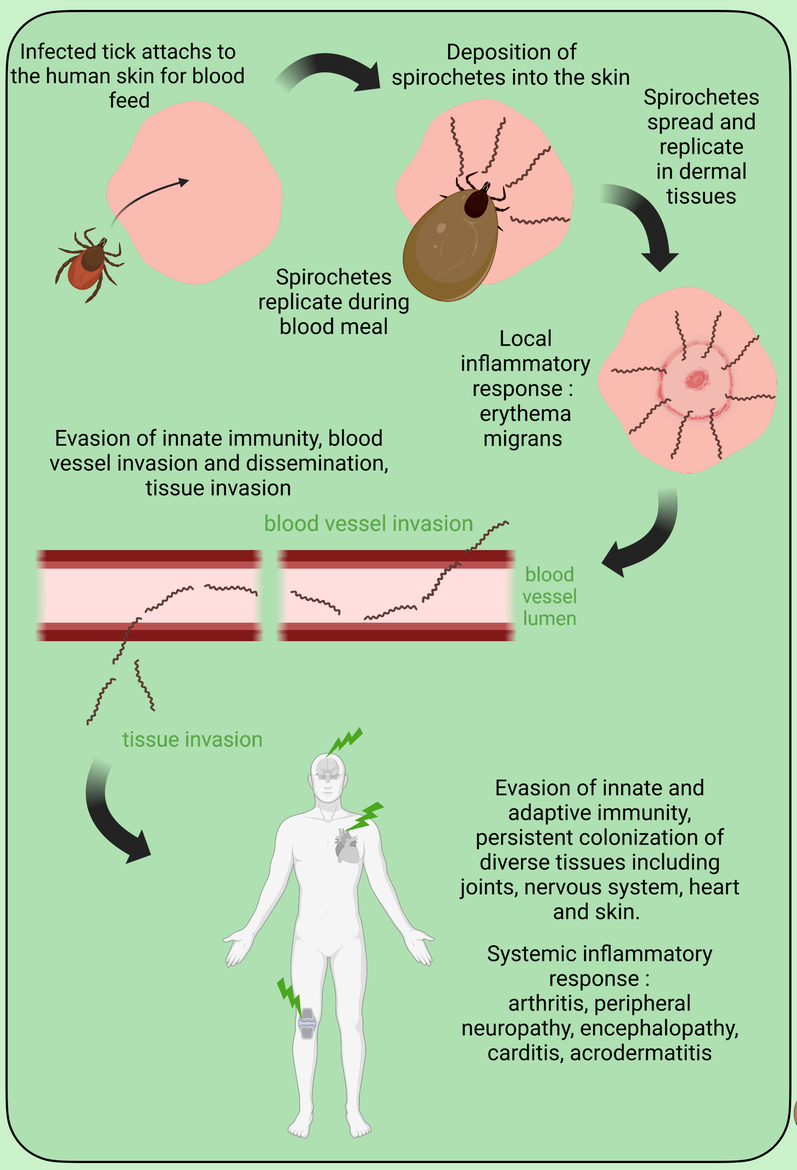
Length : Mean length of 20µm

Vector : Blacklegged tick

Gram : Negative-like (does not appear pink in gram test)
Capsule : - Inner membrane
- Peptidoglycan
- Outer Membrane (outer leaflet has immunoreactive glycolipids)
Flagella in the periplasmic space
Metabolism : Microaerobic
Chromosome : linear



Life cycle and flight from Immune System



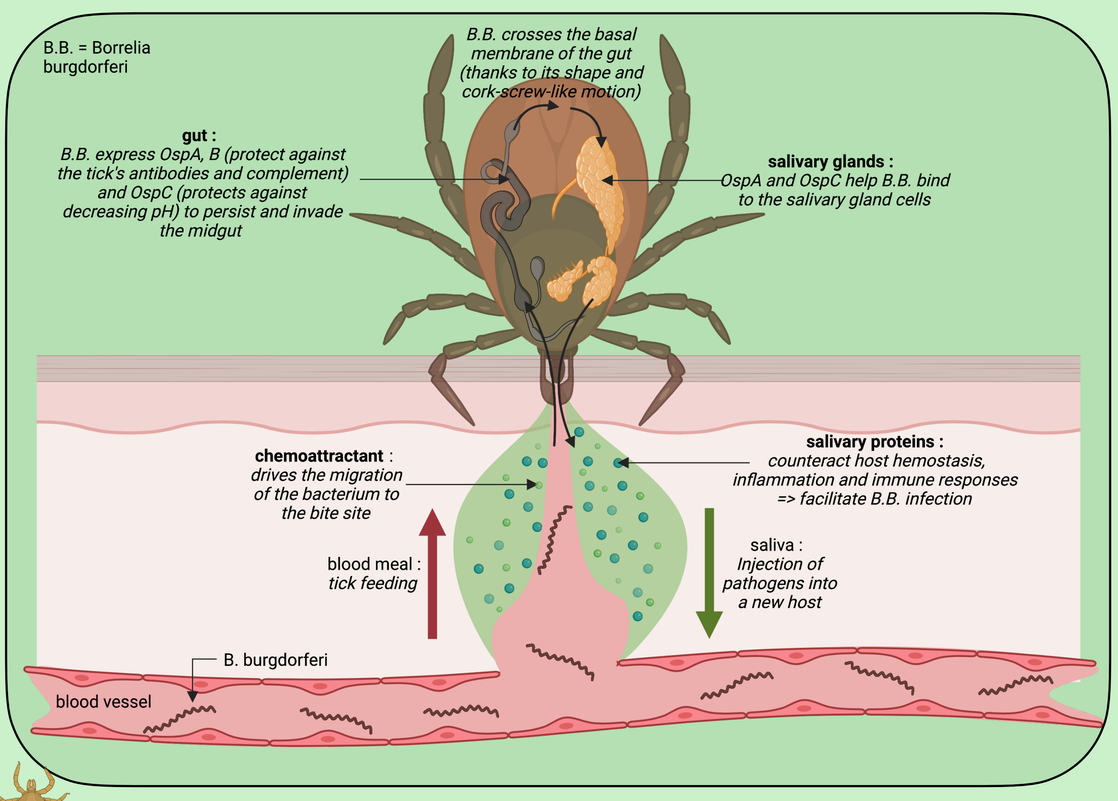
Evasion of innate and adaptive immunity, persistent colonization of diverse tissues including joints, nervous system, heart and skin.

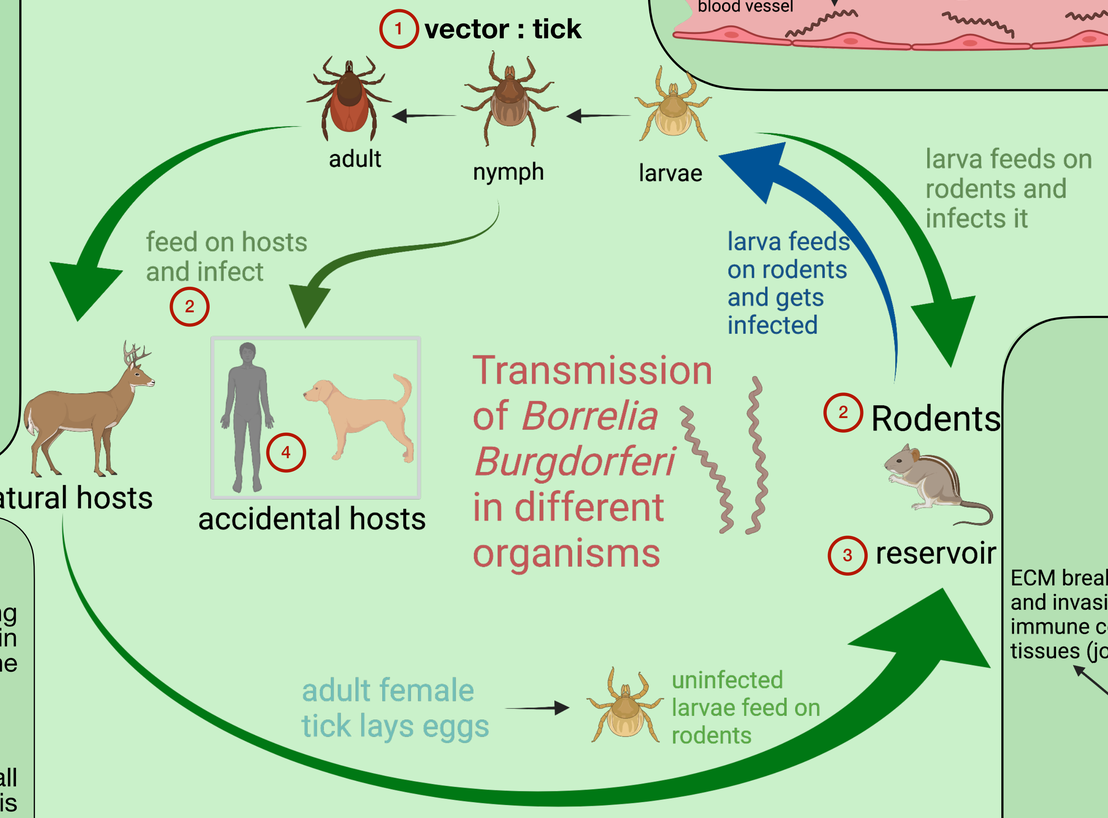
Systemic inflammatory response : arthritis, peripheral neuropathy, encephalopathy, carditis, acrodermatitis

1 B. Burgdorferi in the vector and infection

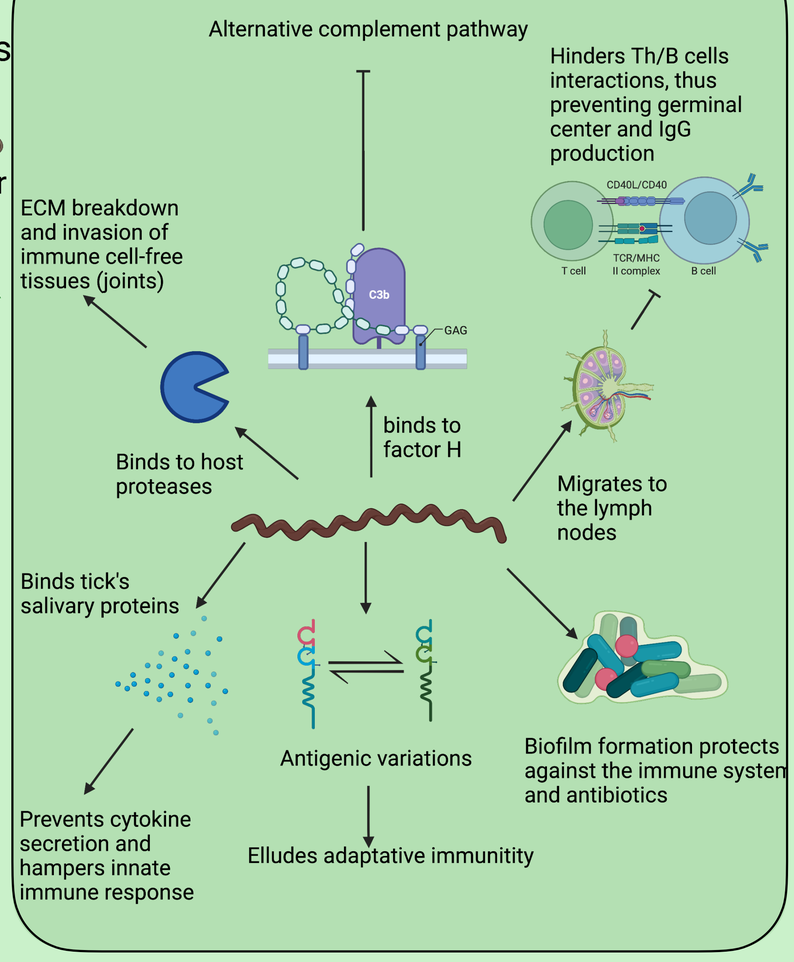
4 Inflammatory response and symptoms in Humans

As opposed to most of the natural hosts, infection of humans can result in lyme disease as a consequence of the human immunopathological response to B. Burgdorferi





2 Immune invasion in the mammalian host



Vaccines :

Gene sequence variations, between and within species, coding for surface proteins required for infectivity or persistence within vertebrate hosts (such as OspC, OspA and VlsE) complicates the design of effective vaccines.

<u>Potential solutions :</u>

- design multivalent recombinant protein vaccine to target all known serotypes of a specific protein of B.Burgdorferi . This is already investigated by the current phase 2 vaccine candidate (from valneva and pfizer) which targets 6 different OspA.
- design vaccine to induce an inflammatory response tick's salivary proteins in order to repel the tick before inoculation of B.Burgdorferi into skin

Antibiotics :

- Antibiotics currently used against Lyme disease are efficient at clearing the bacteria mainly during the early dissemination phase
- However, antibiotics are less efficient when the bacteria have moved in the connective and neurological tissues and form biofilm communities
- Within the biofilm, bacteria are physically joined together producing a matrix, characterized by the presence of an extracellular polymeric substance (EPS) which are mainly composed of polysaccharides, proteins, and DNA conferring resistance to antibiotic penetration.

3 Immunocompetent reservoir animals are essential to maintain persistent infection.

- For the disease to be maintained, spirochetes must be hosted by a sufficiently large number of reservoir mammals. This is necessary for larvae ticks, produced by dissemination, to attach and get infected, reinitiating the life cycle of the bacterium.
- Infection in reservoir must allow the spirochete to resist long enough in the reservoir's organism for it to infect a naive tick.
- For the case of Lyme disease: the white-footed mouse does not respond with an inflammatory response, contrary to humans and other non-reservoir hosts. Therefore, it does not induce tissue damage. Other mice strains may present similar manifestations of infections seen in humans. This solidifies the challenge of defining a reservoir host.

Conclusion

In order to complete its life cycle into different host organisms, Borrelia Burgdorferi has acquired an exceptionally complex capability of adapting to the constraints imposed by these various environments. All of this is steered by the expression of precise genes, which enables the bacterium to migrate and to scavenge host's proteins to protect itself from the immune system. Moreover, its peculiar shape enables it to outspeed the immune cells and to "dig" holes thanks to its corkscrew-like motion, into hardly accessible tissues. As the infection triggers lots of unspecific symptoms, it is paramount to improve prevention, screening and therapeutic methods in order to treat the bacterium before it becomes disseminated and hardly treatable.