

LYME DISEASE



WHAT IS LYME DISEASE?

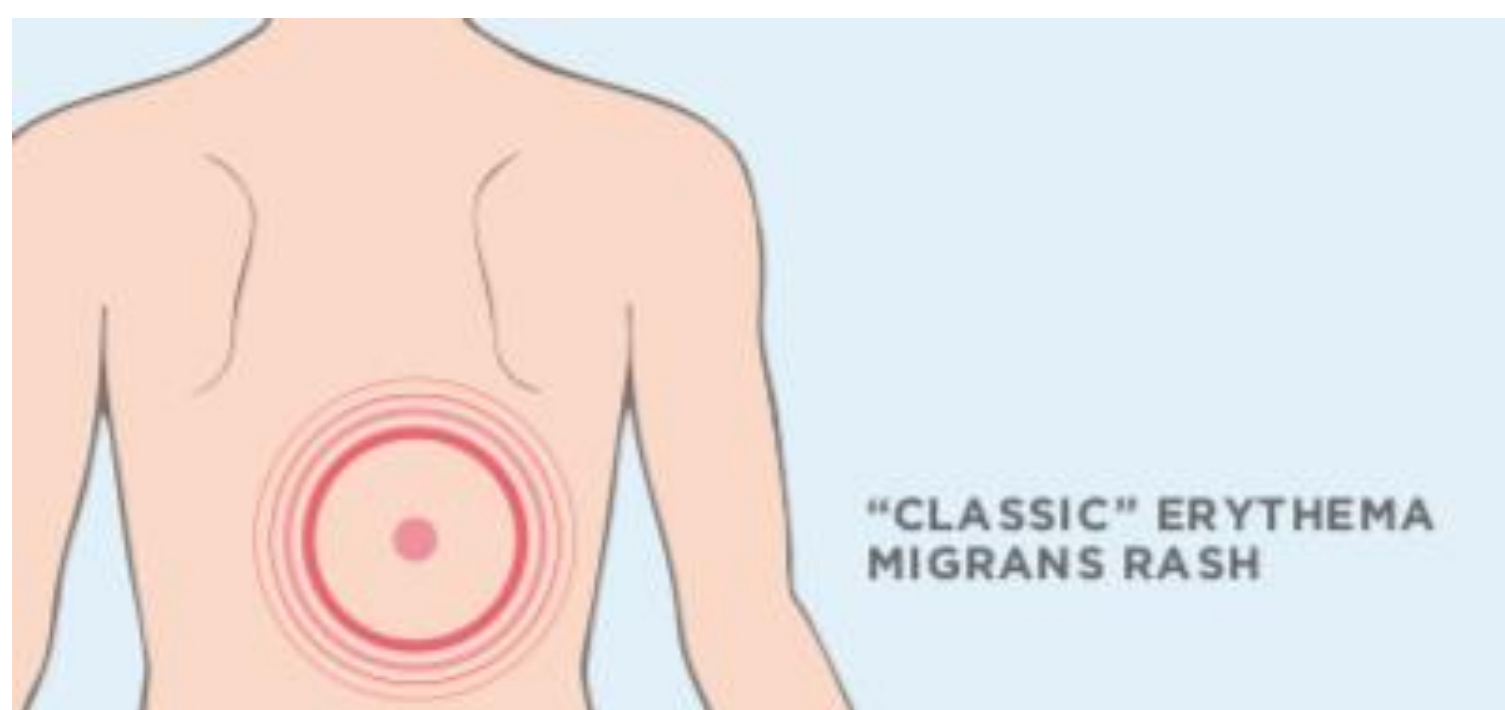
Lyme disease is the fastest growing and most common tick-borne illness in the Northern Hemisphere [1]. It is caused by *Borrelia* bacteria transmitted to humans by infected *Ixodes* ticks [2]. In most cases, the tick must be attached to the human body for 36 to 48 hours before the bacteria can be transmitted [1].



SYMPTOMS, DIAGNOSIS & TREATMENT

Early symptoms of Lyme disease (including a gradually expanding red circular rash called *Erythema migrans* or more unspecific symptoms like fatigue, fever, headache, mild stiff neck, arthralgia or myalgia [3,1]) are often overlooked or misinterpreted [4]. Approximately 80% of cases are characterized by the development of an acute *Erythema migrans* rash at the site of the tick bite, however, in approximately 20% of cases the *Erythema migrans* is absent [1].

If diagnosed early, Lyme disease can be successfully treated with antibiotics [1]. However, 5-10% of all patients do not respond well to antibiotics and experience ongoing debilitating symptoms [2]. Left untreated, the disease can spread and cause more serious complications affecting the joints (arthritis), the heart or the nervous system [2].



PREVENTION

Today, preventing Lyme disease means preventing tick bites [5], but personal protective measures are underutilized [6] and pest management efforts have only had limited success in controlling ticks and the associated diseases [7]. Currently there is no Lyme disease vaccine available to protect humans from this devastating illness and the medical need for vaccination against Lyme is steadily increasing as the disease footprint widens [8].

FACTS & FIGURES

300,000

Americans are diagnosed with Lyme disease each year [1].

96%

Of Lyme cases reported in the U.S. were concentrated in 14 states [1].

\$712M - \$1.3B

Each year, the U.S. healthcare system spends \$712M - \$1.3B on Lyme disease [9].

\$3,000

Each year, the U.S. healthcare system spends \$3,000 per Lyme disease patient [9].

VALNEVA'S VACCINE CANDIDATE - VLA15

VLA15 is currently the only clinical-stage Lyme vaccine program. The candidate is a multivalent vaccine against the six most common species of the *Borreliosis spirochete* that cause Lyme disease in North America and Europe. VLA15 is a new construct based on the well-established principle of fighting Lyme transmission by targeting OspA proteins, one of the outer surface proteins expressed by the bacteria that causes Lyme disease. Part of the company's development process is to undertake extensive studies to demonstrate the safety of VLA15 [10].

The VLA15 program was granted Fast Track designation by the FDA in July 2017 [11] and in December 2018, Valneva successfully completed Phase 1 development for VLA15 [12].

VLA15 is currently being tested in a Phase 2 clinical study in both the U.S. and Europe. Valneva completed Phase 2 patient enrollment in 819 people at the end of September 2019. The overall objective for Phase 2 is to determine the optimal dosage level and schedule for use in Phase 3 pivotal field efficacy studies, based on immunogenicity and safety data [13].

The complete Phase 2 study is expected to be approximately two years in duration with first data expected mid-2020.

References:

- Lyme Disease. (2019, December 16). Retrieved from <https://www.cdc.gov/lyme/index.html>
- Stanek, G., Wormser, G. P., Gray, J., & Strle, F. (2012). Lyme borreliosis. *The Lancet*, 379(9814), 461-473. doi: 10.1016/S0140-6736(11)60103-7
- Shapiro, E. D. (2014). *Borrelia burgdorferi* (Lyme Disease). *Pediatrics in Review*, 35(12), 500-509. doi: 10.1542/pir.35-12-500
- Aucott, J., Morrison, C., Munoz, B., Rowe, P. C., Schwarzwalder, A., & West, S. K. (2009). Diagnostic challenges of early Lyme disease: Lessons from a community case series. *BMC Infectious Diseases*, 9(1). doi: 10.1186/1471-2334-9-79
- LYME DISEASE: What you need to know. (2008). Retrieved from <https://www.cdc.gov/lyme/resources/brochure/lymediseasebrochure.pdf>
- Methods to Prevent Tick Bites and Lyme Disease. Ogden, Lindsay, Schofield. *Cl in Lab Med*. 2015 Dec;35(4):883-99. doi: 10.1016/j.cll.2015.07.003. Epub 2015 Aug 28.
- Integrated Pest Management in Controlling Ticks and Tick-Associated Diseases. Stafford, Williams, Molaei. *Journal of Integrated Pest Management*, (2017) 8(1) : 28; 1-7 doi: 10.1093/jipm/pmx018.
- New Scientist, Lyme disease is set to explode and we still don't have a vaccine; March 29, 2017, <https://www.newscientist.com/article/mg23431195-800-lymedisease-is-set-to-explode-and-you-cant-protect-yourself>
- Adrion, E. R., Aucott, J., Lemke, K. W., & Weiner, J. P. (2015). Health Care Costs, Utilization and Patterns of Care following Lyme Disease. *Plos One*, 10(2). doi: 10.1371/journal.pone.0116767
- Lyme Disease - VLA15. (n.d.). Retrieved from <https://valneva.com/research-development/lyme-disease/>
- Valneva press release: https://valneva.com/wp-content/uploads/2019/06/2017_07_24_VLA_Lyme_FDA_Fast_track_PR_EN.pdf
- Valneva press release: https://valneva.com/wp-content/uploads/2019/06/2018_03_19_VLA15_Phase_I_Results_PR_ENG.pdf
- Valneva Austria GmbH (2019). Immunogenicity and Safety Study of a Vaccine Against Lyme Borreliosis, in Healthy Adults Aged 18 to 65 Years. Randomized, Controlled, Observer-blind Phase 2 Study. (Clinicaltrials.gov Identifier NCT03769194). Retrieved from <https://clinicaltrials.gov/ct2/show/NCT03769194>