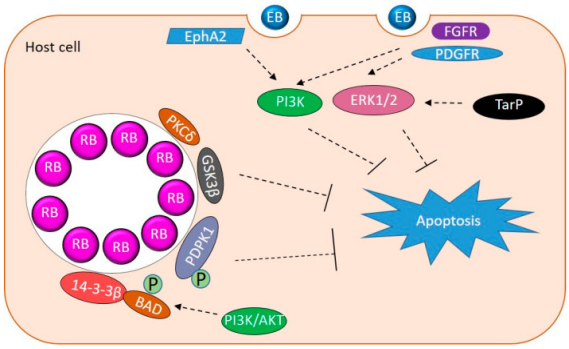
In 2020 Dr. Erika Lutter and Dr. Prakash Sah, made a discovery concerning the ever present pathogen Chlamydia, while most of the general audience will think of chlamydia as a pesky sexually transmitted infection the athogen itself actually does some very interesting things, which make it an incredicly interesting pathogen. It exists in two forms: the infectious body and the intercellular body. The intracellular bodies duplicate within the epithelium of the urogenital tract until the cells begin to burst releasing the infection. It remains more then just a simple infection as well though it can be treated and cured, it contains, "Ct has a number of **serovars** which cause different types of pathology; A–C are responsible for ocular infections (trachoma) and are a major cause of blindness particularly in the developing world; D–K cause the common sexually transmitted infection and L1 and L2 cause the severe pathology of lymphogranuloma venereum." (Lutter and Sah). The Focus however of the Study done by Lutter and Sah focused on the kinase hijacking of the host. As stated in the abstract of the paper at hand, "Being an obligate intracellular pathogen, *Chlamydia* relies on the host cell for its survival and development, subverting various host cell processes throughout the infection cycle. A key subset of host proteins utilized by *Chlamydia* include an assortment of host kinase signaling networks which are vital for many chlamydial processes including entry, nutrient acquisition, and suppression of host cell apoptosis." (Lutter and Sah).

Their stated reasoning from the abstract being that they have a significant impact on the economy and healthcare systems. "Chlamydiae species are obligate intracellular pathogens that represent a significant burden to healthcare and the economy. Human infections are caused by two species: *Chlamydia trachomatis* and *Chlamydia* (*Chlamydophila*) *pneumoniae*. *C. trachomatis* causes infections of ocular and genital tract epithelium" (Lutter and Sah). The bulk of the study done by Lutter and Sah focuses on *Chlamydia trachomatis,* as there are several strains and even a few zoonotic agents of chlamydiae. "Non-human infections are caused by various Chlamydiae strains including *Chlamydia muridarum, Chlamydia caviae* and *Chlamydia psittaci. C. muridarum* is a mouse adapted strain used as model for studying genital infections while *C. caviae* and *C. psittaci* are pathogens of veterinary importance, *C. psittaci* is a known zoonotic agent causing respiratory infections in humans and recently *C. caviae* is also emerging as a zoonotic agent" (Lutter and Sah).

The writer of this article made an attempt to reach out to Dr. Lutter she however was understandably busy, so this article hopes to give the best look into this research as possible. The first thing that truly must be discussed is the host exactly is Kinase and what is its function in the cell itself. "kinase, an enzyme that adds phosphate groups (PO43−) to other molecules. A large number of kinases exist—the human genome contains at least 500 kinase-encoding genes. Included among these enzymes' targets for phosphate group addition (phosphorylation) are proteins, lipids, and nucleic acids." (Kinase). Now with the knowledge of what kinase does, the

discussion can be opened on how this affects the survival and vitality of chlamydia.



This particular figure from the paper itself, helps give a crucial understanding of how the ability to hijack the host cells kinases. “Host kinases manipulated by Chlamydia to promote survival. Schematic contains a summary of host kinases manipulated by Chlamydia to inhibit apoptosis. EB binding and entry activate PI3K and ERK1/2 to promote survival. TarP activates Erk1/2. Sequestration of PKC, 14-3-3β, PDPK1, and GSK3β work via different mechanisms to prevent apoptosis.” (Lutter and Sah). By hijacking and manipulating the host kinases, the desired result “ensures that *Chlamydia*’s requirements are met without triggering host apoptosis.” (Lutter and Sah). Postponing apoptosis allows for the infection to further itself within the cell until the cell itself is ready to burst and release more bacteria.

Beyond messing with the kinases of the host cell, chlamydia as stated in the article is capable of damaging the host DNA. “*C. trachomatis* promotes host DNA damage by eliciting reactive oxygen species production while impairing the DNA damage responses (DDR). Even with impaired DDR, *C. trachomatis* keeps its host proliferating via ERK signaling (among other signaling pathways) creating an environment that may predispose the host cell to malignant transformation” (Lutter and Sah). PLacing the host at a higher disposition of developing tumors. As it has also been shown to reduce the levels of tumor suppressor protein p53 via PI3K/AKT signaling activation during infection to overcome DNA-damage-driven cytotoxic response.

The overall conclusions that were reached were that in the case of chlamydia, that the kinases are hijacked through the process of phosphorylation, the entire time that chlamydia resides in the cell, it is utilizing host kinase to optimize its survival in any and all cases. The study also suggests that perhaps, “Several chlamydial effectors likely interact with but may also be phosphorylated by host kinases during infection suggesting their activity may depend on host signaling pathways. Elucidating the role of chlamydial effector phosphorylation is an intriguing topic for future studies.” (Lutter and Sah). Overall the study itself helps bring further understanding to how chlamydia affects the cell, and uses its many molecular tools to its own advantage.

Sources:

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