


生物策略表

類別	生物策略 (Strategy)	
生物策略 STRATEGY	蝙蝠的免疫系統幫助預防炎症反應 (Immune system of bats helps prevent inflammation response)	
生物系統 LIVING SYSTEM	蝙蝠 Chiroptera (Bats)	
功能類別 FUNCTIONS	#保護免受微生物危害 #Protect from microbes	
作用機制標題	蝙蝠的免疫系統演化以減緩對致病炎症的反應 (Bat's immune systems evolved to slow down the response to disease-causing inflammation)	
生物系統/作用機制示意圖		
作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)		
<p>介紹</p> <p>蝙蝠可以安全地藏有許多能殺死其他動物的病毒而不會生病。這是牠們的超能力嗎？牠們的免疫系統演化出一種方式，可以不對某些感染採取防禦措施。</p> <p>策略</p> <p>當潛在有害的外來物質進入動物的身體，例如病毒和細菌，動物的免疫系統會辨認它們。免疫系統也會清除正常過程中死亡的細胞並分解的細胞殘餘物 (remnant of cell)。稱作發炎體 (inflammasome) 的蛋白質可以偵測外來的入侵物，是免疫系統的重要組成。這會引發其它免疫細胞的生成，尋找並摧毀入侵物。</p> <p>但是免疫反應對動物本身並非沒有風險。當免疫細胞大量湧入以抵抗感染，它們會自然地引起炎症 (inflammation)—腫脹、發熱、發紅和疼痛。通常，細胞會快速清除有害物質而令炎症消退。但有時候，病毒加快動物的免疫系統。炎症會變得太過劇烈或持續過久，進而損壞周圍組織並引發疾病。</p> <p>科學家並沒有在蝙蝠中觀察到相同的發炎反應，最近的研究指出這些哺乳類的發炎性體有細微的差異，因此，並不會迅速引起大量免疫細胞湧入以抵抗病毒。這使得蝙蝠可以忍受大量不同種類的病毒，而不會遭受發炎性疾病例如狂犬病 (rabies)、伊波拉 (Ebola)、嚴重急性呼</p>		

吸道症候群 (SARS) 和新型冠狀病毒肺炎 (COVID-19)。這個機制十分重要，為蝙蝠會攝食許多攜帶病毒的昆蟲例如蚊子，同時這也讓蝙蝠變成疾病的儲存庫，這些疾病可能對人類致命。

一些科學家認為蝙蝠發展出此特性 (trait) 的可能原因是因為牠們會飛行。不同於其他哺乳類，飛行是需要消耗大量能量的行為，並且增加了細胞磨損和撕裂，這會釋出更多被分解的細胞碎片 (broken-down cellular bit)。免疫系統必須清除這種混亂。若蝙蝠沒有演化出這種能力來抑制其免疫反應，飛行便會造成牠們體內持續性的炎症。

變異的發炎體也可能導致蝙蝠壽命能長達40年的原因。隨著動物衰老，體內的細胞會更頻繁地分解，造成炎症和疾病。任何減緩炎症的過程都可以讓動物有機會更長壽。

潛力

透過了解蝙蝠如何忍耐病毒，科學家可以找到防止牠們傳播致命疾病給人類的方法，如新型冠狀病毒肺炎。另外藉由學習蝙蝠的免疫系統如何抑制炎症反應，他們可以探索對人類具有相同效果的療法和藥物，以減少體內炎症和衰老引起的其它疾病之影響。這些疾病包含心臟和循環系統疾病 (circulatory disease)、關節炎 (arthritis)、過敏和哮喘 (asthma)。

Introduction

Bats can safely harbor many viruses that kill other animals without getting sick. Their superpower? An immune system that has evolved a way not to mount a defense against some infections.

The Strategy

An animal's immune system recognizes potentially harmful foreign matter like viruses and bacteria when they enter the body. It also clears the remnants of cells that die and break down in the normal course of living. Proteins called inflammasomes that sense alien invaders are critical components of the immune system. These trigger the production of other immune cells that seek and destroy intruders.

But the immune response is not without risk to its owner. When immune cells flood in to fight infection, they naturally cause inflammation—swelling, heat, redness and pain. Normally, the cells get rid of the harmful matter quickly and the inflammation subsides. But sometimes, viruses can rev up an animal's immune system too much. The inflammation becomes too intense or lasts too long. Then it can damage surrounding tissue and cause disease.

But scientists don't see viruses triggering the same response in bats. Recent studies have shown that these mammals have a slight variation in their inflammasomes. As a result, they do not readily trigger floods of immune cells to fight viruses. And so bats can tolerate large amounts of many different kinds of viruses without suffering inflammatory diseases like rabies, Ebola, severe acute respiratory syndrome (SARS) and COVID-19. That's important because they eat loads of virus-carrying insects like mosquitoes. But it also makes bats a reservoir for diseases that can be lethal to people.

Some scientists think bats may have developed this trait because, unlike other mammals, they fly. It's a behavior that takes a lot of energy and increases wear and tear on cells that release more broken-down cellular bits. The immune system must clean this mess up. If bats had not evolved the ability to dampen their immune response, flying would cause constant inflammation in their bodies.

The altered inflammasome may also contribute to bats living so long—up to 40 years. As animals age, cells in their bodies break down more often, triggering inflammation and diseases. Any process that reduces inflammation gives those that have it better chances of living longer.

The Potential

By understanding how bats tolerate viruses, scientists can find ways to prevent them from transmitting deadly diseases like COVID-19 to people. And by learning how bats' immune systems dampen inflammation responses, they can explore therapies and drugs that could do the same in people to reduce the impacts of other diseases caused by inflammation and aging. These include heart and circulatory system diseases, arthritis, allergies and asthma.

文獻引用 (REFERENCES)

「蝙蝠身為唯一會飛行的哺乳類，牠們有無症狀地 (asymptotically) 成為給人類的方法備受科學界和公眾之間的大量關注。儘管蝙蝠有較高新陳代謝速度，牠們的壽命相較於體型來說非常長，我們在此提出一種機制，機制使蝙蝠對於三種不同人畜共患 (zoonotic) RNA 病毒的無效果 (sterile) 危險訊號和感染，作出抑制宿主炎症 (host inflammation) 的反應... 這涉及到長壽和無症狀病毒儲存庫狀態。」

“Bats, as the only flying mammals, have ‘emerged’ in both the scientific and general public arenas due to their ability to asymptotically host a large number of high-profile viruses. ... Bats also have an extraordinarily long lifespan relative to their body size, despite their elevated metabolic rates. ... Here, we report a mechanism by which bats dampen host inflammation in response to both ‘sterile’ danger signals and infections with three different zoonotic RNA viruses. ... with implications for longevity and asymptomatic viral reservoir status.”

參考文獻清單與連結 (REFERENCE LIST)

Ahn, M., D. E. Anderson, Q. Zhang, C. W. Tan, B. L. Lim, K. Luko, M. Wen, W. N. Chia, S. Mani, L. C. Wang, J. H. J. Ng, R. M. Sobota, C. A. Dutertre, F. Ginhoux, Z. L. Shi, A. T. Irving, and L. F. Wang. (2021). Dampened NLRP3-mediated inflammation in bats and implications for a special viral reservoir host. *Nature Microbiology* 4: 789-799.
(<https://www.nature.com/articles/s41564-019-0371-3>)

Xie, J., Y. Li, G. Goh, Y. Zhu, J. Cui, L. Wang, Z. Shi, P. Zhou. (2018). Dampened STING-dependent interferon activation in bats. *Cell Host & Microbe*. 23: 297-301.
(<https://doi.org/10.1016/j.chom.2018.01.006>)

Cross, R. (17 February, 2020). Could an NLRP3 inhibitor be the one drug to conquer common diseases? *Chemical & engineering news*. Retrieved from:
<https://cen.acs.org/pharmaceuticals/drug-discovery/Could-an-NLRP3-inhibitor-be-the-one-drug-to-conquer-common-diseases/98/i7>

Zimmer, K. (1 June, 2018). Why bats make such good viral hosts. *The Scientist*. Retrieved from:
<https://www.the-scientist.com/notebook/why-bats-make-such-good-viral-hosts-64251>

Rachel Ehrenberg. (19 June, 2020). The bat-virus détente. *Knowable Magazine*. Retrieved from:
https://knowablemagazine.org/article/health-disease/2020/why-do-bats-have-so-many-viruses?utm_campaign=newsletter-6-14-2020&utm_source=email&utm_medium=knowable-newsletter

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