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Skin infections can increase allergic inflammation in the lungs

Association between bacterial infections and allergic asthma discovered in study

A temporary bacterial infection of the skin can cause long-lasting changes in the immune system and increase allergic inflammation. This is the result of a study led by CeMM and the Medical University of Vienna, recently published in the prestigious journal *Science Immunology* (DOI:10.1126/sciimmunol.adp6231). The findings uncover a previously unknown connection between the skin, bone marrow and lungs, offering new prospects for the development of treatment strategies for allergic diseases such as asthma.

Using a mouse model, the research team examined how a localized bacterial skin infection can influence the immune system. Staphylococcus aureus (S. aureus) is a common and widespread bacterium that can act as both a harmless skin inhabitant and a pathogen. The scientists observed that in response to S. aureus skin infection, not only the expected immune cells—neutrophilic granulocytes—known for their role in fighting bacteria, migrated to the inflamed area. They also detected eosinophils, a special type of white blood cell that plays an important role in allergic diseases. Remarkably, the skin infection caused long-term changes in bone marrow stem cells from which eosinophils develop. "Our extensive analyses showed that the eosinophils from infected mice exhibited a long-lasting pro-inflammatory signature. This immune imprinting persisted long after the skin infection had resolved," reports first author and CeMM PhD Student Mariem Radhouani.

Increased reaction to house dust mite allergens

To investigate the effects of this immunological reprogramming, the researchers exposed the previously infected mice to house dust mite allergens—the most common triggers of allergic asthma. "The results were astounding, but very clear: after contact with the allergens, animals with a previous skin infection developed more severe allergic inflammation in the lungs. They showed an increased number of eosinophils in the lung tissue, increased production of allergy-promoting antibodies and reduced lung function," explains study leader Philipp Starkl (MedUni Vienna's Department of Medicine I) the new findings. The researchers also demonstrated that this enhanced immune response was mediated by the eosinophils originating from the altered bone marrow. Transplantation of eosinophils from previously

infected mice to healthy animals was enough to cause increased allergic lung inflammation in the recipient mice.

The research team could identify two messenger substances that are crucial for this reprograming of eosinophils: interleukin-33 (IL-33) and C5a, an important component of the complement system. As such, IL-33 promotes the proliferation of eosinophils in the bone marrow, while C5a directs the altered immune cells into the lungs. "Targeting these signalling pathways could represent a new treatment strategy for allergic diseases such as asthma or prevent their development," the authors conclude, noting that further research is already underway to validate and expand upon these findings.

Pictures attached
Photo: The authors of the study Philipp Starkl and Mariem Radhouani © Wolfgang Däuble/CeMM

The Study "Eosinophil innate immune memory after bacterial infection promotes allergic lung inflammation" was published in *Science Immunology* on 4 April 2025. DOI: 10.1126/sciimmunol.adp6231
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The **CeMM Research Center for Molecular Medicine of the Austrian Academy of Sciences** is an international, independent and interdisciplinary research institution for molecular medicine under the scientific direction of Giulio Superti-Furga. CeMM is oriented towards medical needs and integrates basic research and clinical expertise to develop innovative diagnostic and therapeutic approaches for precision medicine. Research focuses on cancer, inflammation, metabolic and immune disorders, rare diseases and aging. The Institute's research building is located on the campus of the Medical University and the Vienna General Hospital.
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The **Medical University of Vienna (MedUni Vienna)** is one of the longest-established medical education and research facilities in Europe. With almost 8,600 students, it is currently the largest medical training centre in the German-speaking countries. With more than 6,500 employees, 30 departments and two clinical institutes, twelve medical theory centres and numerous highly specialised laboratories, it is one of Europe's leading research establishments in the biomedical sector. MedUni Vienna also has a medical history museum, the Josephinum.

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