Producing tears in a dish: Researchers develop first model of human conjunctiva

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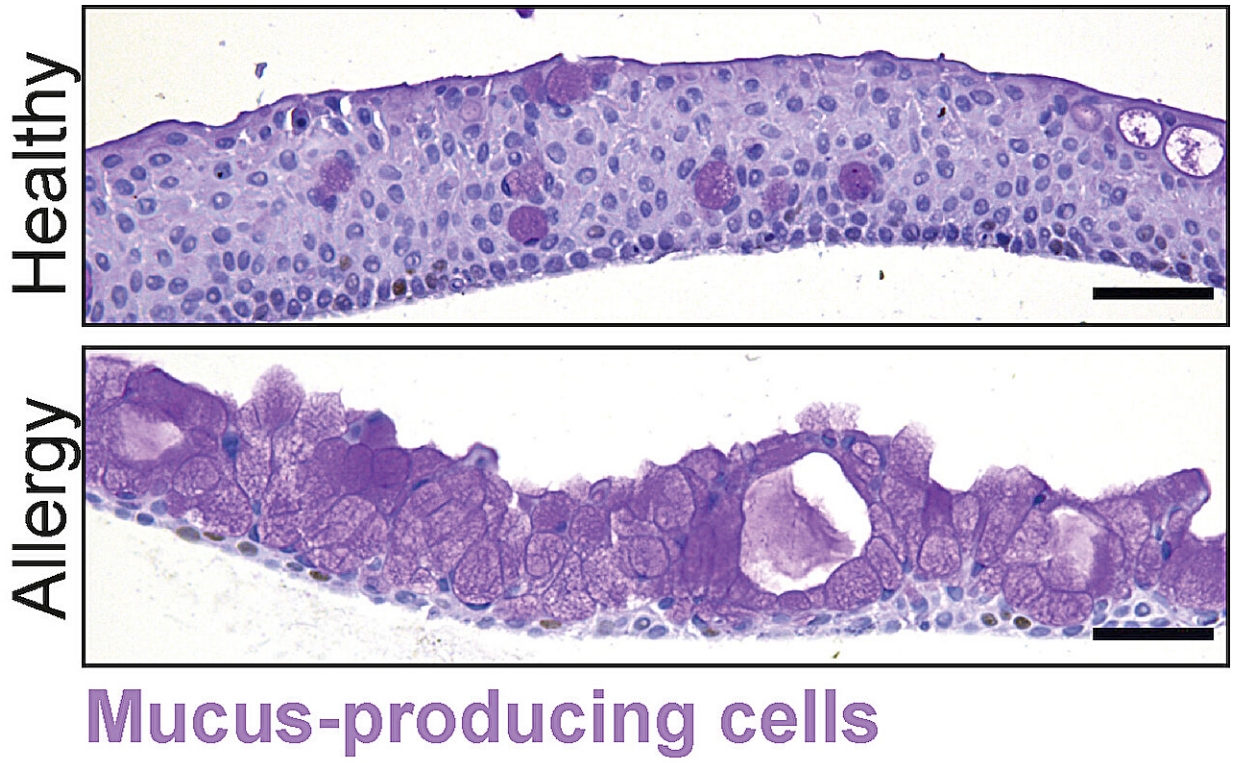


Under allergy-like conditions, the number of mucus-producing cells increases. Credit: Marie Bannier-Hélaouët, copyright: Hubrecht Institute.

The Organoid group at the Hubrecht Institute produced the first organoid model of the human conjunctiva. These organoids mimic the function of the actual human conjunctiva, a tissue involved in tear

production. Using their new model, the researchers discovered a new cell type in this tissue: tuft cells. The tuft cells become more abundant under allergy-like conditions and are therefore likely to play a role in allergies.

The organoid model can now be used to test drugs for several diseases affecting the conjunctiva. The study, "Human Conjunctiva Organoids to Study Ocular Surface Homeostasis and Disease," was published in *Cell Stem Cell* on 11 January 2024.

Our eyes produce tears to protect themselves from injuries and infections. The conjunctiva, a tissue that covers the white of the eye and the inside of the eyelids, is partially responsible for the production of these tears. It participates in tear production through the release of mucus. This mucus allows the tears to stick to the ocular surface and protects it from pathogens.

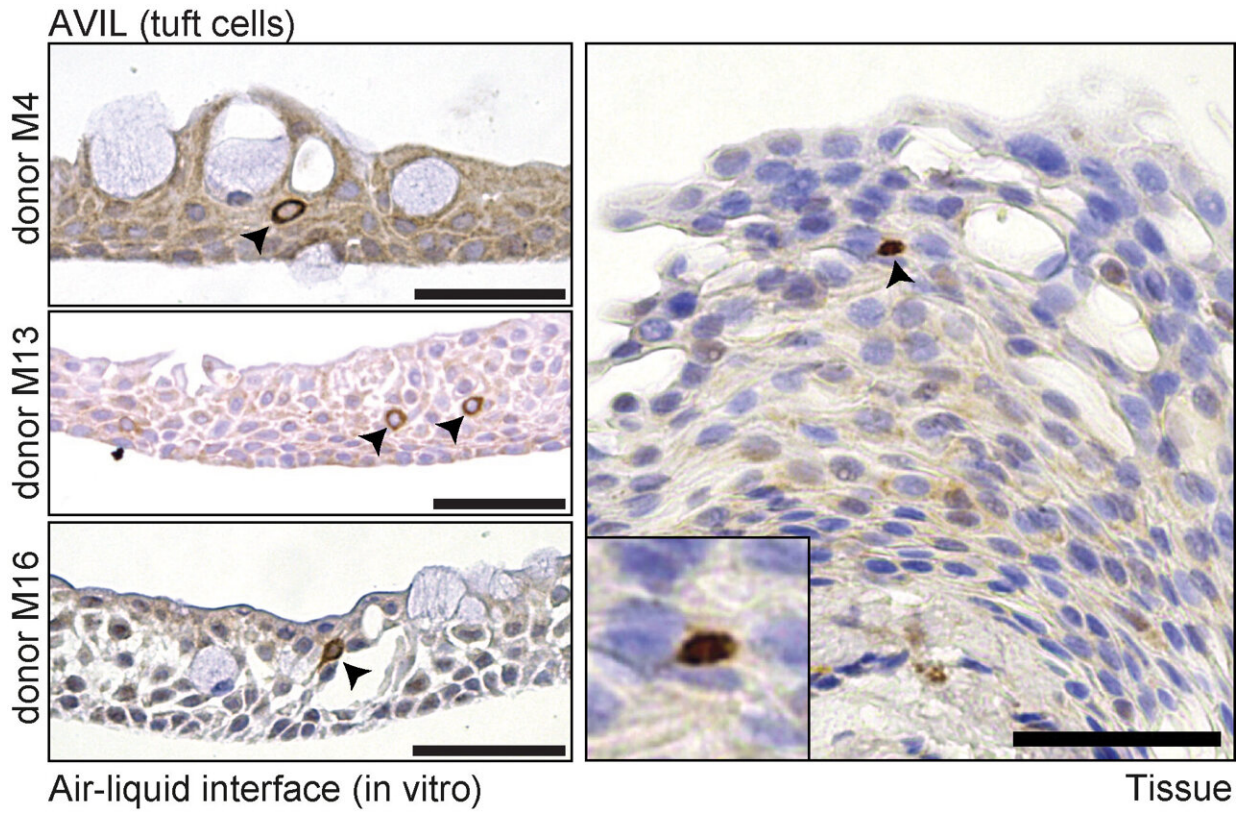
Several diseases and disorders affect the conjunctiva, such as dry eye disease, cancer, allergies and infections. In severe cases, dysfunction of this tissue can lead to blindness. Until now, there has not been a good model of the human conjunctiva, which limits research into its function in sickness and in health. Consequently, there are limited treatment options for diseases affecting the conjunctiva.

First model

To gain more insight into the composition and functioning of the conjunctiva, the Organoid group set out to develop the first human model of this type of tissue. They used cells from an actual human conjunctiva and grew them into 3D structures in a dish. These miniature structures are called organoids and function as real human conjunctiva.

"Once we had these functioning organoids, we wanted to know how the conjunctiva is involved in the production of tears," Marie Bannier-

Hélaouët, lead researcher in the project, explains. "We discovered that the conjunctiva makes antimicrobial components and therefore contributes to tear production in more ways than by simply making mucus."



Tuft cells are visualized with the special marker Advillin (AVIL). Credit: Marie Bannier-Hélaouët, copyright: Hubrecht Institute.

The researchers then altered the conditions in the dish with the miniature conjunctivae to mimic allergies. "The organoids started to produce completely different tears: there was more mucus but there were also more antimicrobial components," says Bannier-Hélaouët. Under these conditions, they also found a new cell type in the organoids: tuft cells.

Bannier-Hélaouët continues, "Similar cells have been discovered in other tissues, but not in the human conjunctiva." The tuft cells became more abundant under the allergy-like conditions, suggesting they play a role in the eye's reaction to allergies.

The newly developed organoid model opens the door for research into diseases affecting the conjunctiva. "We can use our model to test drugs for allergies or dry eye disease, for example," says Bannier-Hélaouët. In the long term, it may even be possible to make replacement conjunctivae for people with ocular burns, ocular cancers or maybe even genetic disorders.

"We are now running preclinical studies in rabbits to assess whether this approach is feasible and helpful," Bannier-Hélaouët concludes.

More information: Human Conjunctiva Organoids to Study Ocular Surface Homeostasis and Disease, *Cell Stem Cell* (2024). DOI: 10.1016/j.stem.2023.12.008. www.cell.com/cell-stem-cell/fu … 1934-5909(23)00438-1

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