What can blood tell us about hair loss caused by alopecia areata?

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What is the problem?

Figure 1 Children with alopecia areata taking part in Alopecia UK charity event.

2% of the population develop a specific type of hair loss called alopecia areata. The disease is caused by cells of our immune system, which usually protect us from bacteria and viruses, mistakenly attacking the structures in our skin that grow hair, called hair follicles. The damage to the hair follicles results in circular patches of hair loss on the scalp. For some people, the hair will regrow, but in severe cases the disease can worsen to affect the entire scalp and/or body (Figure 1).

Treatments available for alopecia areata are usually ineffective for people that have severe hair loss and those affected may develop anxiety and depression, which can significantly impact their quality of life. We want to understand how and why cells of the immune system attack hair follicles so that we can target them with new therapies.

What are we interested in?

We know that people with alopecia areata have specific immune system cells, called CD8 T cells, that attack hair follicles leading to hair loss. Directly targeting these cells would not be a feasible option to prevent hair loss because they are vital in protecting us against virus infections.

Cells of our immune system do not work in isolation and require help from other cells and molecules of the immune system to carry out their activity. We want to identify what cells and molecules may be contributing to the harmful immune response in alopecia areata by analysing blood and skin from people with alopecia areata. Understanding this may lead to new strategies that could be used to treat the condition.

What did we do?

We set up a research clinic at the Queen Elizabeth University Hospital in Glasgow and collected blood from people with alopecia areata and healthy controls (people without alopecia areata). We isolated immune system cells from the blood (Figure 2) and identified the different types of cells that were present in blood using a technique called flow cytometry (Figure 3). We also measured the amount of specific proteins, called cytokines, that tell us about the types of immune responses that are taking place in the blood.

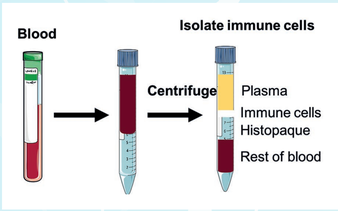

Figure 2 Immune system cells were separated from blood. Blood was layered on top of a liquid called histopaque that allows you to separate the different components of blood when spun (centrifuged) at high speed. After 20 minutes of spinning, 4 layers are formed: plasma, immune system cells, histopaque and red bloods cells. The immune system cell layer can be carefully removed to perform the steps described in figure 3.

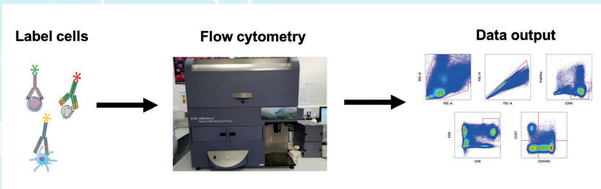

Figure 3 Immune system cells were labelled with different antibodies attached to different fluorescent colours. The antibodies only bind to the specific proteins we are interested in looking at, which identify different types of cells of the immune system. The immune system cells were run through a flow cytometer, which uses a laser to detect the different colours present on individual cells. We then use a computer to visualise this information to determine what specific cells are present in a patient's blood.

What did we find?

We found that people with alopecia areata have a higher percentage of a specific immune system cell in their blood, called CCR6+ CD4 T cells (Figure 4). This is a type of T cell that helps drive CD8 T cell responses, which are normally involved in protecting us against infections. Interestingly, these cells contribute to other diseases caused by misdirected immune responses, such as inflammatory bowel disease and psoriasis.

We also found that the amount of specific cytokines, released from CCR6+ CD4 T cells, are increased in blood from people with alopecia areata (Figure 5). Surprisingly, we also detected increases in cytokines associated with other cells that are normally associated with allergic diseases, such as asthma.

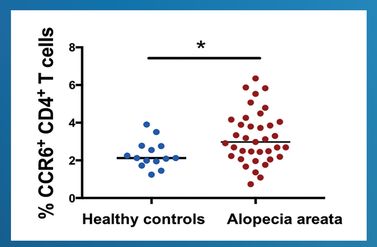

Figure 4 CCR6+ CD4 T cells are increased in the blood of people with alopecia areata.

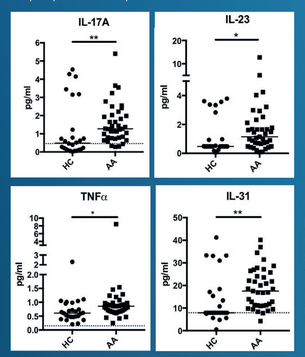

Figure 5 Inflammatory cytokines (IL17A, IL-23, TNFa, IL-31) are increased in blood of people with alopecia areata.

What does this mean?

Our findings indicate that CCR6+ CD4 T cells and a number of cytokines are altered in the blood of alopecia areata patients. We are currently analysing skin samples from patients to try to understand how these cells and cytokines are involved in causing and sustaining hair loss. To do this, we slice the skin into very thin pieces and label immune cells in the same way as we did for flow cytometry. We then use a microscope to visualise what cells are interacting with the hair follicles. We hope that our results will lead to the development of new treatments for alopecia.

Who am I?

I am a 3rd year PhD student at the Institute of Infection, Immunity and Inflammation at the University of Glasgow. Before starting my PhD, I completed an undergraduate degree in Immunology and Pharmacology at the University of Strathclyde and a Masters degree in Stratified Medicine at the University of Glasgow. I am interested in understanding how the immune system works so that we can manipulate these mechanisms to treat disease.

Kym started her PhD project entitled *"Investigating the immunopathogenesis of alopecia areata, and the link to intestinal inflammation"* in 2016 and while principally based at the University of Glasgow, supervised by Professor Simon Milling, she is also working closely with AstraZeneca R&D Mölndal.