Reflections on my Summer 2023 Research Project

Julia Anandarajah

I spent this summer working on myself, becoming more confident, resilient, and experienced. This was thanks to my 6-week Laidlaw research project. I crossed my fingers, hoped for the best, and jumped out of my comfort zone into a small lab on the third floor of TBSI, full of expensive equipment, strange chemicals, and new people. Little did I know that this lab would become both a haven, allowing me to grow and learn, and a place of frustration and disappointment, demanding resilience.

COPD, chronic obstructive pulmonary disease is one that affects the alveoli of the lungs (the tiny air sacs that oversee oxygen and carbon dioxide exchange). Its causes include smoking and air pollution. It leads to severe inflammation in the lungs, shortness of breath, cough etc. It is terminal and there is currently no cure.

The outer layer of the alveoli is made up of two types of epithelial tissue: type I and type II. Inside the alveoli, we find white blood cells called alveolar macrophages (AM's). Together, cells of the epithelial tissue and AM's work as an air purification system. Hence, for smokers, these cells are always working hard, clearing the lungs of harmful chemicals from cigarettes.

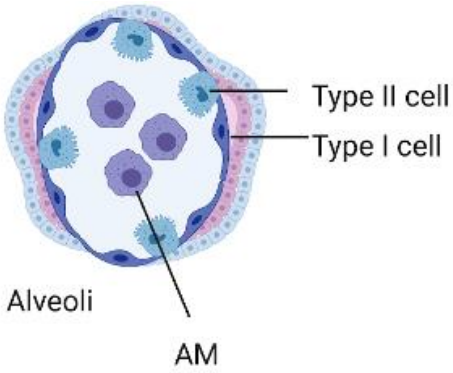

Fig.1 depicts an alveolus and its associated cells.

This consistent exposure to cigarette smoke causes smokers' cells to release chemicals called cytokines, which in turn trigger a series of responses in the body such as an increase in AM's or inflammation. Continuing inflammation may damage the lungs, causing limited air flow and other COPD symptoms.

The goal of my project was to understand how AMs react in a COPD patient's lungs and the effect they have on type II cells. By furthering our understanding of this relationship, we can find ways to manipulate it and determine a treatment for COPD.

To carry out my investigation, I grew AMs in a specialised media and treated them with chemicals such as cigarette smoke extract (to mimic the conditions of someone suffering from COPD). I expected these cells to react to their treatments by releasing cytokines into their media. After 24 hours, this media, which contained the secreted cytokines (known as a secretome), was placed on healthy type II cells. 24 hours were given to allow the type II cells to respond. They were then analysed to determine how:

1. Treated (dysfunctional) AM's,
2. Type II cells that were exposed to media of dysfunctional AM's,

responded to their treatment.

Analysis included:

1. Extraction of RNA (genetic material) from cells.
2. Converting the RNA to single stranded DNA (a version we can carry out experiments on).
3. Carrying out RT-qPCR tests on the ssDNA (to determine what chemicals the cells released and in what quantities).

This process took 5 days (3 days for treatment, 2 days for analysis), meaning time management was vital in order to repeat the experiment several times and produce reliable results within 6 weeks.

The data I have collected, though limited (for reasons I will describe later), reveals a close relationship between AM's and type II cells. The graphs below measure the change in production of specific cytokines based on the treatments. The AM test groups were an untreated control (CTRL), cigarette smoke extract (CSE) treatment, and ferric ammonium citrate (FAC) treatment - an iron compound that causes the cells to mimic the conditions of COPD.

We can see similarities in the reaction of AMs to their treatments and of type II cells to the secretome of those treated AM's. Essentially, this tells us that the chemicals released by AM's treated with cigarette smoke incited healthy, untreated type II cells to react in the same way as if they were exposed to the smoke themselves. This correlation is clearly observed in Fig. 2 showing the increase in cytokine produced by CSE treated cells (Fig. 2b) and by the type II cells treated with this secretome (Fig.2b). The AM used in this experiment are fetal liver derived alveolar macrophages (FLAMs).

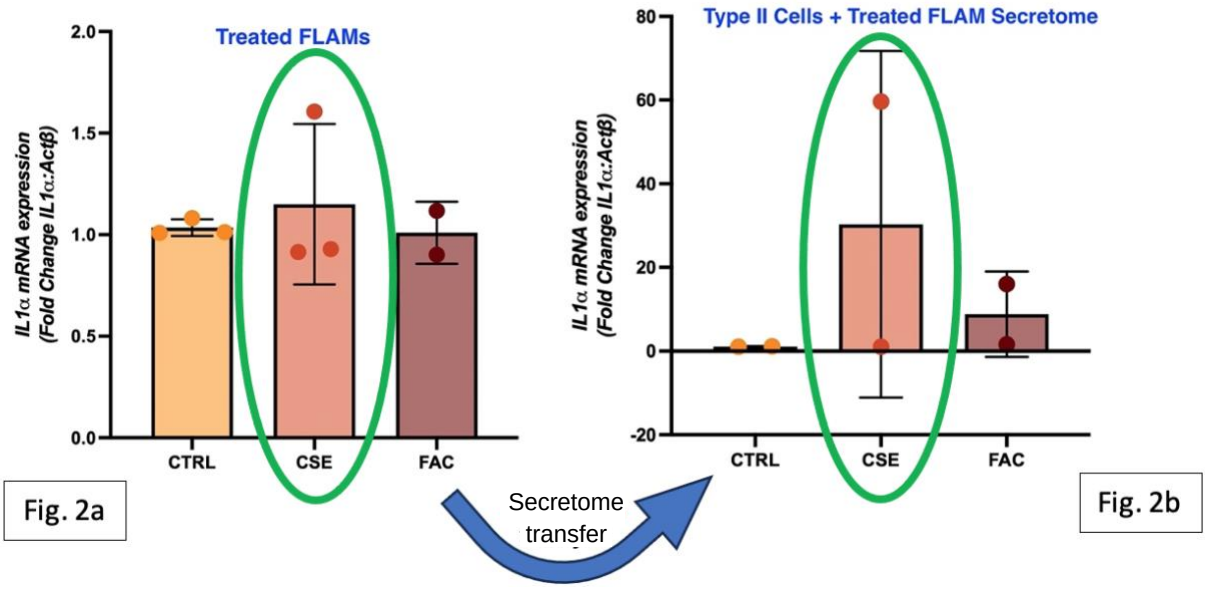

Fig. 2a

Fig. 2b

These preliminary results tell us that these Type II cells are responsive to messages from FLAMs. These results suggest that treating one cell type could be sufficient, indirectly affecting both cell types.

When writing my Laidlaw application, aside from project goals, I have also set several personal goals, as mentioned in my personal development plan (PDP). I hoped to gain research and life experience, improve my communication skills, confidence, and assertiveness. I wanted to meet people in my field, improve my critical thinking and reflective practice.

To achieve these personal goals, I planned to create a reflective journal, describing each week of my project, to improve my reflective practice and keep track of the strengths and skills I was developing. This journal was a safe, private place to share my thoughts and release any frustration.

Within the first week of the project, it dawned on me that research seldom goes to plan. I quickly encountered several challenges that tested me in several ways. The first was adjusting to my new setting. As a second-year student in a research lab full of successful postgraduates, I felt vulnerable and intimidated. It was difficult to approach members of the lab and ask for help, a skill that was vital.

The solution to this problem was patience. Gradually, I became more comfortable and confident. I got to know people in the lab making it easier to ask them questions. With time, I became comfortable with working in the lab, collecting and analysing results. I progressed from a scared, and quiet second year student, to a confident, more experienced researcher.

Next was accepting that mistakes are bound to happen. As my experiment required 5 days, if something went wrong on the second day, the experiment could not continue. During the first two weeks, I made mistakes that resulted in my cells dying and progress being lost.

It was one thing to run into trouble with an experiment due to an obvious mistake that could be rectified. However, after a few weeks, I began collecting inconsistent results for no obvious reason. No matter how many times I re-read the manual or repeated the experiment, I would either get in-accurate or undetermined results. These instances left me feeling frustrated and confused. This challenge combined with the aforementioned feelings of intimidation and inferiority left me doubting my capabilities and future as a researcher.

This was where my communication skills were needed, and my resilience was further tested. To determine the cause of the inaccurate results, I had to approach members of the lab, discuss the problem, and listen to their advice. Though it felt like an interrogation at the beginning, as my communication skills and confidence improved, these discussions became an opportunity to learn from more experienced researchers, allowing me to find the root of the problem and rectify it.

As the end approached, I had settled into a routine and felt excited to go to the lab every morning. This is when the final challenge decided to strike. To produce sound results, experiments need to be repeated three times. As my initial experiments produced

inconsistent results, the project was delayed by 2 weeks, creating a time constraint. It was now vital to effectively plan and manage the time that remained. I began feeling stressed and anxious and as we know, working under pressure is rarely effective or productive. I rushed and made silly, unnecessary mistakes, further delaying the project, and increasing my stress. I found this period frustrating, discouraging and tiring. I was dedicated and enthusiastic, but my results did not show this.

Although the toughest challenge, it was the most valuable, teaching me a lot about myself and my work ethic. I realised, with the help of my strength's profile, that I am a perfectionist. I can easily get caught up in the details rather than appreciating the whole picture. Furthermore, I am very self-aware. Though a positive quality, it can also be draining and cause me to overthink. Luckily, I attended my coaching session around this period and realised I need to work alongside these qualities to succeed.

Hence, for the final week of my project, I introduced a new mindset that would reduce the amount of pressure I was putting on myself. Rather than rushing to complete my experiments in that week, I altered my goals and expectations. I prioritized the quality of the experiments, allocating enough time to analyse results, and discuss them with lab members. This made the final week of my project the most productive, enjoyable, and educational. This was only possible because of the lessons I learned along the way.

Though challenging, intense, and occasionally stressful, the 6 weeks I spent in the lab have been unbelievably valuable, teaching me so much more than biology. As a researcher, I learned how important it is to be resilient and patient. I saw how much passion and enthusiasm is required to work in this field.

As a future leader, I had the opportunity to observe several different leadership styles at work. The most striking leader was my supervisor. Though constantly busy, writing research proposals, doing administrative work, and bringing up her two young children, she always made time for her employees. She met with each lab member individually and held a group meeting weekly. At meetings, a member of the lab would present their work and discuss it with their colleagues in a safe space. My supervisor managed to pass on her work ethic and

passion to her team members, a leadership skill I greatly admire and value. I felt she gave the members of her team enough supervision to keep them feeling supported and motivated but enough independence to be inquisitive and grow as researchers.

Another leadership style that struck me was that of a principal investigator in our lab. Though the members of his team were still very hardworking and passionate about their work, they felt overlooked by their leader. When a group member ran into difficulty during an experiment, they were scared to approach this supervisor in fear of being scolded. On the rare occasion that he visited the lab or arranged to meet with his students, there was a nervous atmosphere in the lab. I believe that as a leader, it is important to adapt your leadership style to your group and their requirements. In this case, I feel the PI's leadership style did not match the needs of his group, who in my opinion, needed to be appreciated, supported, and inspired.

At the beginning of this 6-week experience, my goals were to gain research experience, improve my communication skills, resilience, confidence, and assertiveness. I wanted to meet new people in my field and improve my reflective practice and critical thinking. By keeping a reflective journal, I kept track of the challenges I encountered, how I felt during them and how I overcame them. Though I was not very consistent with these reflections, I can clearly see how much more resilient I have become and as the weeks went by, the reflections became easier to write due to an improvement in my reflective practice. Working in a lab full of busy PhD students forced me to be assertive and confident in order to ask for help and guidance, which in turn improved my communication skills. Working independently with a specific set of goals in mind demanded forward thinking and planning. Finally, I met so many new people that welcomed me into their lab and gave me a safe space to learn and grow. I will be forever grateful to them for that and for this experience. It helped me realise that research is my passion.