# Transcript

Paul:

Hello, my name is Paul Klenerman. I'm a professor at Oxford and I'm the host of this podcast on immunology called To Immunity and Beyond. So this is just to say that what we're putting forward with the podcast is a scientific discussion, and it's really just for information. And it isn't in any way medical advice. So if it's medical advice you're after, please go and talk to your doctor or some other medical professional. Meanwhile, enjoy the podcast.

Well, hello and welcome to another edition of To Immunity and Beyond. And today I've got Ghada Alsaleh with me and we're going to talk about her really interesting work in the Space Innovation Lab, which I think people will have heard exists, but probably don't really know what's happening in there. But first up, Ghada, as I've asked everybody on the podcast so far: how did you get into the science, and just maybe describe to people your story to get to this point.

Ghada

Thank you. Also first of all, I would like really to thank you, to have me here. So I trained as a pharmacist, so I was always fascinated with the drug and drug discovery. But I didn't really find myself to sell drug or stay in a pharmacy. I was more oriented to research and then I decided to do my PhD. I did it in University of Strasbourg, in France, and then I was more focused in understanding and knowing more about immunology and rheumatic disease. And by the end of my study, I start to be more curious about ageing, which I find is a very new topic and it might be involved in different disease, and from there I moved to the UK to do my postdoc in Katja Simon lab where I wanted to study also the effect of ageing in our immune response. And recently, or three years ago now, the time passed so fast, I became a new investigator, new principal investigator at the Botnar Institute. And my research again, focus on studying the process of ageing and its impact on our immune response and also musculoskeletal disorder. And as you mentioned, I'm the founder and also the leader of the first Space Innovation Lab in the UK.

Paul

Great. Thanks. So well maybe just explain how you got to set up the Space Innovation Lab. That sounds like, you know, quite a big leap.

Ghada

Yeah, actually it's a good point. It's a part of curiosity and also networking. As I mentioned, I'm interested in ageing and also, as many people, I was fascinated with space and what astronauts do, and we all maybe noticed that the astronauts have or suffer from different disorder and their immune system in their muscles and their joint. And at some point, I said to myself, well, this is a bit strange. It's really similar to our age-related disease, but no one ever discussed it as – is this the true process, is it the same things that happen on Earth? And there was actually kind of curiosity. And then I start to reach out to a few people who work in space and also reach to people from NASA. And I ask them, can I get some sample from astronauts, how we can get this, actually, how we could be able to study. And it was a very complicated to get this of course, and I also asked if you can get some mouse tissue. And of course, work with the International Space Station is very complicated, but this actually puts me in connection with people who wanted actually to do this Space Innovation Lab, which is a very new project. It's also a new company. It's not totally new company but it's called Space Application Service, so you can imagine like FedEx or like DHL that you would like to send sample from one place to another, but actually this company which allowed you to put your sample into the International Space Station. And of course there was other company behind that and also the company then later on worked with James Green, who was the former chief scientist of NASA, and this start for a new company and then. They were very interested in my ageing research. And here we start and we built this.

Paul

Great. So is there a system that NASA ran to follow up the health of the astronauts as they came back from space? And if so, is there a kind of, a few simple stories that have emerged from that?

Ghada

Yes, definitely. They have their own system and they have also a lot of scientists work with astronaut before and after. And they also have different device to measure, you know, their health and also we work with Tara Ruttler, who is also was the chief arbiter of NASA. And her role was the health of actually the astronaut. And she had a lot of IP. Where the astronaut need to sleep, when they exercise, but in the beginning they never do exercise. Now we do ask them to exercise. We do need to tell them when to eat, when to sleep, because you know they don't have a day and night. So everything is a bit different and disorder, but NASA have a lot actually recorded about that and it's not only NASA, you know, you have also the Japanese, you have the Chinese, you have the Russian, the Arabian Space Innovation Lab. So each of these parts or organisations, they also take care of their astronaut, and there is a lot of data. But there is a limitation and of course a process as any other process to have access to this data.

Paul

And what do you think the big picture though is for somebody who spent a decent amount of time in space? What are the physiological and especially immunological changes that you might expect to see?

Ghada

This is a very good question and this is why I really wanted to work in ageing because it's not clear. I mean, even if you go to some of the research that has been done in the International Space Station, you never have the answer for that. So we have observation. So when I ask them, OK, there's a change in their immune system, but what is it exactly in terms of immunologist, what is it, is it CD4? Is it TH1? I mean, what kind of observation we have with, I didn't really manage to get this answer. And it's the same for other cells. And this is why I said OK, we need to do it. We need to look, you know, in in our biological way, not only looking at astronaut or get some blood from them. But I have to mention there are few big studies happening now, like the twin study where you have astronauts who have been like twin astronaut. One of them stays on Earth and the other one has spent a while at International Space Station and they get of course a lot of data. I mean a lot of samples from them, including blood, serum, urine and have been doing huge omic to identify the difference. Inflammation was one of these. That's really clear and the change. Mitochondria was one of the things that I found it very, very interesting also to follow.

Paul

Great. That's amazing that you could find enough twins that you could send one of them off to space, but I guess quite a lot of people have been into space by now in, in on all the iterations of the space station. And as you mentioned, different countries. So that's amazing. So actually, how does this sort of really interface with your background then in in rheumatology and as you mentioned inflammation. What are the specific things that you want to get out of it?

Ghada

I mean, in terms of rheumatology, I'm most likely focused on osteoarthritis, which is one of the age-related diseases. But mainly I do really believe that if we understand better how we aged and this process of ageing, we might be able to identify a biomarker or maybe a new gene target that could help, or even manage the treatment in a better way. So the idea of this project is to first of all to answer one question: Is the ageing or the change that we see in the astronaut, is it really a true ageing process, similar to what we identify here on Earth, with all this hallmark of ageing? Or there's one hallmark of ageing? And if yes, then that means it's really a very important platform. That would help us use it as an accelerating ageing model. You can also imagine with me that this is very important because the process of ageing happens for a long period and you need several years, while in two weeks or one month in space you manage to see disorder. So it might be aggressive or accelerated, so maybe there are some targets that we never managed to identify in Earth because it was so slow and for a long period. While you can maybe detect this change easily in space. This is one of the point. If it's really a true accelerated ageing model, we have a few drugs that now we use them as anti-ageing drug and we have also new drug that we are testing in our lab to use them for the treatment of osteoarthritis. So our next step would be to test this drug in the International Space Station because one of the things I forget to mention in the beginning, is that these astronauts and with all this disorders that they have on the International Space Station, when they go back to Earth, they reverse it. So whatever the mechanism, we are able to reverse that and this will give us hope that we might actually be able to understand why we age and how can we slow that. Can we manage to treat different age-related disease.

Paul

OK, that sounds really good. And I got a couple of questions. So one of which is like well, how? I mean, so obviously it's very different to be up in space and so forth, but it's not obvious to me why that would suddenly trigger mitochondrial changes or other changes that link to ageing. So maybe start with that one.

Ghada

Of course, we don't know. There are a lot of things happening in space, but you have the microgravity, so might be the microgravity, might be the radiation. I would think the radiation would play really very important role because we know here that radiation could lead to the end damage and the end damage of course lead to all the other processes. But to answer this question exactly or to be sure if it's the microgravity or the radiation or any other factor, once we have the results, we can mimic the microgravity in Earth and you can also mimic the radiation in earth so we could later on try to identify what is the true mechanism. But again, I'm not really curious to know why or what of these may be more important. If we manage to say it is the same mechanism and I can use it to identify, you know, biomarker or even to validate a drug, whatever the reason is, you know it's still more important.

Paul

OK. So tell me about the experiments you're doing. So some of it you're measuring basically bio samples from people who've been up and down to the space station, basically on other missions. Correct me if I'm wrong. But other things are more experimental where you're sending tissues up into space. So maybe describe an experiment if you can.

Ghada

Yeah. I mean in in term of sample from the astronaut, it's really hard to get them, but we are in collaboration with other people who might be able to provide this, but most likely in bioinformatic base because my experiment is focused more on osteoarthritis in the first time, so I'm focused on chondrocyte and also synovial tissue. And this is very hard to get them from an astronaut. You can't send a doctor and make a biopsy, right, in the International Space Station. And if they, if you wait until they are in earth, then you can start the process, I mean change the process. So I think one of the first challenge we start with: can we take human tissue from synovial tissue and how much time we could keep them alive to be able to send them to the space, cause one of the limitation in space is that you can't send samples and bring them anytime. You have a very limitation and it's a very long process and you can imagine that you don't have temperature all the time, so we had to actually measure all this parameter. So what we do, we do take synovial tissue from a patient. We make from this synovial tissue an organoid and this take us really more a year and a half to develop an organoid because we really wanted to make the whole synovial. So we now managed to have the different subset, different fibroblasts, different macrophages, different immune cells. So if you take a human tissue and our organoid you won’t really distinguish between them. So this organoid, we did a lot of tests to be able to see how much time they will be alive and available. And this was our first sample that we set and we managed to give them a few, I mean at least very well conditioned for one month and now we would be able even to extend this more.

Paul

So have your organoids been circling the earth, they've already gone up there. Is that right?

Ghada

Yes. I mean, they fly in December and we are sending another sample now in April.

Paul

Right, so then they'll come back down and then you can take them into the lab and, uh, start to do your analytics of various kinds. Fantastic. So I appreciate it's early days, so and there's lots to do. So perhaps give us a sense of the kind of the duration of the project and also the size of the lab and who's involved and what are their roles?

Ghada

Yeah, I think one of the main things I have to mention is about the Space Innovation Lab and the new technology. So you know if you want to work in space it costs a lot of money and also a lot of time because you need to choose the astronaut, you need to train them and you need to tell them what they need to do when they are in the International Space Station. If you are a biologist you need a biologist or someone knows how to deal with the cells, right? And this long time ago take a lot of time. So this lab actually allowed me to work from my place, from my office, and manage the samples while they are in the International Space Station, I don't need the help of the astronaut. We don't need them to be involved. We are happy to talk to them or chat, which is of course not always easy, but mainly any astronaut in the International Space Station could take this small box that we developed and put it in the platform. That's it. And from my office we could see the sample. We could have a photo. We could measure. I mean, this small box is having a very small computer and you could decide what parameter you want it to have. So you could design it for your experiment.

Paul

So you're not going to be heading yourself or lab members, if somebody signed up to your lab, they don't get into space then, is that off the cards?

Ghada

Yeah, they don't go actually to the International Space Station, but they go to the Kennedy Space Centre in the US to do the experiments. If they want it, they will look soon for a volunteer, for those who would like to fly.

Paul

OK, great. So tell me a little bit more about how the process goes, who's in the lab with you, how long does the thing get funded for, to develop a really good understanding of what's going on?

Ghada

So the project, we have the funds until 2026. We would be able to send for the moment two mission, which we are doing so far. I have two PhD students who work in this project and one postdoc. In term of time, we hope that by the end of this year we will definitely have the first result if everything goes well. In terms of timing of the experiment, you need around one week to two weeks to make the organoid, and then one month in the first time to send them to the International Space Station. So you can imagine they need to go into a rocket or SpaceX or other mission. They're going to go to the International Space Station. One astronaut will take the box and put it in the platform. We're going to monitor it as we want for a month, and then they’re going to come back with another, you know, docking system.

Paul

That's good. OK. So just to finish, what what's the sort of longer term view of this, so you're just getting going. So there's obviously lots of increasing activity, people want to send missions to Mars, manned missions to Mars and so forth. Are you involved in any of that, or how does it work for you, now you're in the space club?

Ghada

I think it's a very good point. I always I try also when I discuss with the people, with NASA or even ISA before we go to Mars, we need to answer this question and this difference between biological ageing and chronological ageing. So. People most of the time, you know, as in many movies like Interstellar where he goes up and then he came back very young, right? I mean he has the same age of his daughter. This is the chronological ageing, but the truth that we don't know in terms of biology that he might have the same age or even more, so before we go to Mars, we should really answer this question. What happens to human beings if we went to space because it seems to be accelerating ageing. You know, we are not ageing in the same way as we are on Earth. So this is a good question. I don't have collaboration directly with that, but we do have a lot of people interested. So we think this might come. We never know, if Elon Musk is interested, he might come.

Paul

Well, I'm sure he's listening to the podcast, so you might be hearing from him soon. Thanks very much for coming in and talking today, Ghada, and I think there'll be lots of interest in your amazing work. And when the samples have returned to Earth and you figured out what's happened, we'll perhaps hear from you again. Thank you very much.

Ghada

Yeah. Thank you very much. And again, this laboratory, we are very collaborative people. So if anyone would like to do any science, we are very happy to collaborate with them and see how we could achieve that. Thank you again for having me Paul.