Western Faculty Profile: Dr. David Hess

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To begin, can you tell me about your educational background and what led you to research?

I did my Ph.D. in Pharmacology at the University of Western Ontario looking at adverse drug reactions. As an undergrad, I wasn't sure if I wanted to go to medical school, teacher's college, or work in industry. Pharmacology gives you the option of pursuing a job in pharmaceutical industry if academia isn't to your liking. My interests in going to graduate school originate from a bone marrow transplant I had when I was fifteen years old. This is a treatment for aplastic anemia, a disease where no blood cells are produced because bone marrow stem cells stop regenerating. Since then, my interests have been directed at medicine, research, and stem cell biology.

However, it wasn't until I did my first post-doc fellowship with Mickie Bhatia at Robarts Research Institute, that I decided to become a stem cell researcher. There, we transplanted bone marrow cells into mouse models to treat diabetes. At this time, I realized that I wanted to pursue academia. Since all my training was done at one institution (it's important for academic scientists to experience various training environments), I did a second post-doc at Washington University in St. Louis with Jan Nolte, applying the principles from mouse models to human stem cells.

What, specifically, do you research?

I research stem cell transplantation. Initially, my focus was on hematopoietic stem cells, but now we're also looking at using bone marrow and umbilical cord stem cells to treat diseases such as diabetes and vascular diseases. One benefit of using post-natal adult stem cells is that there is no clinical evidence that cancer is a problem. Tumour formation is problematic for embryonic human stem cells, but animal models and clinical trials show that cancer isn't an issue in adult stem cells.

Through my post-doc training, we focused on bone marrow stem cells and inducing regeneration of beta-islets in mouse models. In St. Louis, we did xenotransplantation – application to human stem cells. We used aldehyde dehydrogenase (ALDH), which is highly expressed in stem cells, as a marker to find rare stem cells in human samples to use in animal models. This is a pre-clinical proof of concept to get FDA approval for critical limb ischemia treatments in type II diabetes. In our current clinical trial, we're using autologous bone marrow cells from the patient, using ALDH, then purifying the stem cells, and injecting them back into people who are at risk of losing their limbs. The stem cells will secrete factors to stimulate angiogenesis, blood vessel formation, that is deficient in these patients. The same methodology can be applied in type I diabetes, where the stem cells secrete factors that will cause the regeneration of beta cells in the recipient; the stem cells themselves do not turn into beta cells. For cellular applications, human bone marrow or umbilical cord blood are great sources of stem cells for the critical limb ischemia and type I diabetes treatments. In essence, our focus is to find new opportunities to treat diseases using stem cells.

What do you find rewarding about your work?

I really like the fact that my work is close to the clinical side because I want to impact patients. Some of my research has gone into clinical trials and that is by far the most rewarding thing about my job. As well, I really enjoy teaching. Throughout my years as a researcher, I've learned to communicate and to lecture strongly. My job is mostly research, but I do a bit of extra teaching just because I like it. In addition, the success of my lab trainees is very rewarding. When my students win awards, go on to medical school, get a post-doc or a job, it means that I did a good job training them and that they are prepared to be leaders. So, the impact of my research and teaching, are the most rewarding parts.

Are there any challenges associated with doing research?

There is a lot of rejection mostly from reviewers and from grant committees, so you must not take things personally. Prepare yourself for not getting a grant the first time around, learn from the failures, then do what reviewers suggest and resubmit. If you have some establishment, there's always industrial money and patrons that are interested in what you're doing.

From my personal research, whether the cells come from the same person (autologous) or another person (allogeneic) is important. There are no immunity issues for autologous transplantations, but for allogeneic, immunosuppressants have to be used and the cells need to be compared using human leukocyte antigen phenotyping. The hardest part is stopping autoimmunity; we can induce beta cell regeneration and the secretion of immunomodulatory factors that dampen the autoimmunity, but treatments still need to withstand the persistent autoimmunity.

You have really interesting research studies, how do you come up with the next research question?

Basically, doing the actual research leads to the next step. You need to select the correct research question as a follow-up, apply for grants, and try to get those high impact publications. Another way is by collaborating with colleagues; it's a lot harder for independent researchers that do this by themselves in conjunction with applying for grants. The quality of the research questions and the results essentially determine how much funding will be awarded in the future. Researchers must be able to compete at the top 15th percentile to get top grants, and this occurs by publishing in high impact journals consistently, which is a measure of productivity.

For students, I would suggest getting immersed in research. It takes time for researchers to train and guide you to a point when you can come up with good research questions yourself. A great way to start is by volunteering or working in a lab during the summer. Start by emailing scientists in areas that you are interested in, otherwise the research will be very difficult to conduct. The goal is getting trained under the most established scientist in your area of interest because these people have extensive experience and knowledge.

When recruiting potential undergraduate/graduate students, what qualities do you look for?

I look for individuals with motivation, but most importantly determination and perseverance. One of the questions I ask potential students is "what difficulties have you had in your life, and how did you overcome them?" Doing a Ph.D. and a post-doc, that's approximately 10 years before you become an independent researcher. There are lots of opportunities to leave and do something else, and many students do that, but perseverance will push students to become the next scientific leaders in universities, drug companies etc.

Do you have any advice you would give to undergraduate students who are considering a career in research?

First of all, you just need to go and do research. You don't need to know what you want to do, but don't be afraid to commit to something long term. Most importantly, don't be in a rush! The time and effort you will put in will be worth it, since you are learning so much more and increasing your skills. Many people start as master's students because it's a two-year program, but then transfer to Ph.D. There are opportunities to get scholarships, become a TA, and in a post-doc, you're basically paid to do what you do. There are opportunities to work as you are training. If you work hard, apply yourself, and be energetic, you will get through all these steps and not go into debt.

For people with not as much research experience: still apply to grad school and tell them that you are interested, willing to put in the time and effort, and want to research. Professors can tell when people are looking just for a booster to med school or other professional applications, but we are looking for people who sincerely want to do research.

To Learn more on Dr. Hess's lab and research, please visit his website:

<http://www.robarts.ca/david-hess>