A Multidisciplinary and Multicultural Adventure

From Materials Engineering to Cardiovascular Science

Vahid Serpooshan

As a young researcher in the field of cardiovascular bioengineering, I have received a multidisciplinary spectrum of academic training, from Materials Engineering to Cardiovascular Medicine. Along this diverse career path, I also took on an eventful personal life adventure, living in multiple countries with distinct cultures and languages.

My journey started at the prestigious Sharif University of Technology, the so-called MIT of the Middle East in Iran. I was introduced to the world of materials engineering and immersed myself in the characterization and synthesis of polymers and how microstructure–property relationship is defined during my Bachelor (BSc) and Masters (MSc) degrees training. Eager to learn more about nanoscale structures of polymers and composites, I joined the Institute of Nano Science and Technology at Sharif University to acquire additional expertise in nanomaterials.

My intensive training at Sharif encouraged me to further pursue how nanostructured polymers and composites can be engineered to harbor a variety of distinct properties. I became interested in exploring the specific use of these materials in biomedicine. With this in mind, I left Iran at the age of 27 years to start my PhD training in the field of biomaterials and tissue engineering at McGill University in Canada. This was a dramatic change for me in many ways—language, culture, people, and academic discipline. Fortunately, my PhD advisor, a young scientist who also immigrated to Canada, was able to provide the thoughtful mentorship that I needed. In addition, other fellows in the department, many of whom were also immigrants, played an enormously important role in facilitating my transition to the West.

My PhD research introduced me to tissue engineering of bone using stem cells and scaffolding biomaterials. I investigated how mechanical and structural properties of materials could influence the fate of stem cells and whether such engineering tool could be used to direct/promote bone formation. I also harnessed some of the skills that I learned in transport phenomena in Materials Engineering to develop a novel theoretical–experimental model to predict and measure hydraulic permeability of soft tissues and scaffolds.

During my PhD study, I learned that working in an interdisciplinary research area, although more exciting and stimulating, requires extra efforts. I often had to prepare for meetings, seminars, or classes with additional reading and preparation, to stay on par with fellows around me. I often had to search for the definition of keywords to understand basic concepts. I think these additional challenges had prepared me well for the physical, mental, and emotional challenges of becoming an academic scientist. By completing my PhD requirements in 3 years with significant research productivity and publication, I felt confident to further pursue a more exciting and challenging field—cardiovascular biology and medicine. I immigrated, once more, to the United States to start my post-doctoral training at Stanford University. I recall that the most striking change that I experienced with this transition was to enter an entirely new world of physicians/surgeons, medical students, and biomedical PhDs. I realized immediately that engineers tend to think and do research differently, and the key to success in this new environment is to find ways to synergize with others who are different and celebrate the differences. These experiences greatly enriched my understanding and appreciation of diversity, inclusivity, and equity, particularly in the academic environment.

During my 4 years of postdoctoral research at Stanford, I took on one of the most challenging goals in tissue engineering—to regenerate a damaged mammalian heart. Taking advantage of my diverse skill sets, I approached this problem from a different perspective—can we repair the injured adult heart with an embryonic heart-like biomaterial to support cardiomyocyte replication? To achieve this, we engineered a collagen-based cardiac patch pre-loaded with *FSTL1*, a novel signaling molecule, and demonstrated their ability to regenerate injured mouse and swine hearts (Wei K, Serpooshan V, et al *Nature* 2015; equal contribution).

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With these promising results, I succeeded in obtaining the National Institutes of Health Pathway to Independence Award (K99-R00) in 2016 on my first resubmission. The K grant application process was grueling, but it taught me how to recognize who my target audience is when writing a grant proposal and how to present my ideas and data in a way that are familiar to my reviewers. I think this is particularly important for trainees with an engineering background who are working in the biomedical research world. My own personal experience illustrates how innovative and potentially interesting engineering ideas may get lost in translation because of the differences in language and perspectives with biomedical researchers.

Currently, I am an Instructor in the Stanford University Cardiovascular Institute. My research has now taken on a new dimension that combines both tissue engineering and regenerative medicine. I am focused on applying a novel 3-dimensional bioprinting technology to create vascularized functional cardiac tissue. The 3-dimensional bioprinting lies at the crossroads of several fields of research, including materials science, biophysics, chemistry, mechanical and electrical engineering, and cell biology. For someone who is interested in pursuing a multidisciplinary research field like me, I cannot imagine a more ideal opportunity contribute my diverse background and skill sets to this exciting new research area.

As a young investigator with a multidisciplinary training experience, the 2 advices that I think would be beneficial for other trainees who wish to transition into the biomedical field from different backgrounds such as engineering are (1) make every effort to seek innovative ways to incorporate your previous skills into your new research and (2) think outside the box and be receptive to new ideas, so you can bring fresh perspectives to an existing problem.

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