Making Change: Engineering the Future of Medicine

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Monday, January 13, 2020
Reception 3:30-4:00 p.m. | PAA A110
Lecture 4:00-5:00 p.m. | PAA A110

Abstract
With personal trainers and tailored suits, why don't we have personalized medicine? Working at the interface of chemistry, biology, and engineering, we are designing strategies with the individual in mind. But before we get to the patient, we're investigating models of disease to determine how we can better understand disease progression and how we can stop and reverse that disease instead of merely treating its symptoms.

I will share three stories that are promising in cancer, blindness and stroke. In each story, I will highlight both the underlying innovation and the opportunities that lay ahead.

In cancer, most patients are treated similarly, with a series of drugs as the disease progresses. We wondered whether we could find a way to make this personal – take a biopsy of the person's cancer and figure out which drugs would be best suited to that individual. With this goal in mind, we first had to find a way to grow the cancer cells in the laboratory. To do this, we synthesized a water-swollen polymer, a hydrogel (think jello), in which to grow cancer cells in the laboratory. Now we can grow cancer cells in the laboratory in an environment that mimics the way they grow in us. In terms of screening, we can investigate drugs for their effects on both cell viability and cell invasion. This is particularly important in highly invasive diseases.

In blindness due to age-related macular degeneration, the cells at the back of the eye, the photoreceptors and the retinal pigmented epithelium, die. In order to stop and reverse blindness,

these cells need to be replaced, yet finding a source of these cells is in itself difficult. In collaboration with Prof Derek van der Kooy's lab, we derived photoreceptors for transplantation, but found that conventional strategies of transplanting these cells resulted in significant cell death. We designed an injectable hydrogel in which to transplant the cells and observed significantly greater survival and some functional repair.

The holy grail of regenerative medicine is stimulation of the stem cells that are already resident in us. Until the early 1990s, we didn't think that our brains had the capacity to regenerate. We now know that we all have stem cells in our brains. The challenge is to figure out how to stimulate them to promote repair. In collaboration with Prof Cindi Morshead's lab, we designed a patch (or a drug-infused band-aid) that could be applied directly on the brain in a model of stroke. With the release of two proteins, we demonstrated that these resident stem cells could be stimulated to promote tissue and functional repair.

These three stories underline the opportunity of collaborative, multi-disciplinary research at the intersection of chemistry, biology and engineering applied to solving problems in medicine. It is exciting to think what we will discover as this research continues to unfold.

Bio

Professor Molly Shoichet holds the Tier 1 Canada Research Chair in Tissue Engineering at the University of Toronto. She served as Ontario's first Chief Scientist in 2018 where she worked to enhance the c ulture of science. Dr. Shoichet has published over 675 papers, patents and abstracts and has given over 400 lectures worldwide. She currently leads a laboratory of 25 and has graduated 190 researchers. Her research is focused on drug and cell delivery strategies in the central nervous system (brain, spinal cord, retina) and 3D hydrogel culture systems to model cancer. Dr. Shoichet co-founded four spin-off companies, is actively engaged in translational research and science outreach. Dr. Shoichet is the recipient of many prestigious distinctions and the only person to be inducted into all three of Canada's National Academies of Science, Engineering and Health Sciences. Professor Shoichet is a Fellow of the Royal Society (UK) and Foreign Member of the US National Academy of Engineering. She is an Officer of the Order of Canada and holds the Order of Ontario. Dr. Shoichet is a University Professor – the highest distinction of the University of Toronto, which is held by less than 2% of the faculty. Dr. Shoichet was the L'Oreal-UNESCO For Women in Science Laureate for North America in 2015 and won the Killam Prize in Engineering in 2017. Dr. Shoichet received her SB from the Massachusetts Institute of Technology (1987) and her PhD from the University of Massachusetts, Amherst in Polymer Science and Engineering (1992).

Acknowledgements: We are grateful for funding from the Natural Sciences and Engineering Research Council of Canada, the Canadian Institutes of Health Research, the Canada Research Chairs program, the Canada First Research Excellence Fund via Medicine by Design, Green Eggs and LAM and the McEwen Centre for Regenerative Medicine.

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