Faculty of Health Sciences

2020 Australian Government Research Training Program Scholarships

Strategic Project Profile

PROJECT TITLE: Designing a healthy cell-based transplantable pancreas using bio-nanotechnology, bio-printing and advanced bile acid-biomaterials

FIELD OF RESEARCH CODE: 1115

PROJECT SYNOPSIS: The supervisory team consists of 1) Dr Al-Salami, a leading expert in bio-nanotechnology, and bile acid-based biomaterials, and in 2014 was the first in the world to pioneer a new concept that incorporation of humans gut-produced bile components into pharmaceutical gels using nanotechnology, will form little houses that have the potential to grow miniature organs, specifically, the pancreas, 2) Prof Lowe, a leading expert in chemical synthesis of complex materials which are used for drug and tissue delivery, and has won multiple world-class prestigious awards over the last 30 years, and 3) Dr Doyle, a leading expert with national and international funding in tissue bio-printing and synthesis of bio-artificial transplantable blood vessels. Dr Al-Salami and the team have strong collaboration with academic and industrial research labs in the European Union and thus, PhD students can be offered to spend some time in these European labs.

Currently, insulin is being prescribed for all Type 1 diabetic patients, 35% Type 2 diabetic patients and the majority of gestational diabetic (pregnant) women. Despite strict adherence to injecting insulin, more than 50% of diabetic patients suffer from insulin side effects, and over or under dosing, which result in significant complications and

inflammation contributing to the metabolic syndrome of diabetes and poor quality of life (life expectancy of diabetic patients is 10 years less than the rest of us).

Accordingly, the project aims to revolutionize current diabetes treatment through using bio-nanotechnology and bio-printing to achieve two major milestones: 1) designing drug nanoparticles to rejuvenate pancreatic tissues so when pancreatic tissues are harvested from humans or animals they are better prepared for transplantation (process known as pre-conditioning of pancreatic islets), and 2) designing new bile acid-based chemically stable devices for engineering tissues to form a healthy functional pancreas ready for transplantation and treating diabetes. The pancreas will be transplanted into diabetic patients with the aim to supplement or even replace the need for insulin injections. The pancreatic tissue which will be loaded into the transplantable devices will be harvested from animals or human cadavers. The project has three main chapters: 1) Design and characterization of pharmaceutical formulations consisting of chemically stable bile acid-based nano-biomaterials and drug nanoparticles, 2) Biological testing of the biomaterials after bio-encapsulation and bio-printing of healthy, living and functional tissues/cells harvested from pancreas of animals and human cadavers, and 3) Surgical transplantation of the devices (containing the functional pancreatic tissues) into animal models of diabetes to test the effectiveness of the transplanted devices in treating diabetes, and treating the diabetes-associated metabolic syndrome with a focus on the inflammatory and the bile acid profiles.

WHAT MINIMAL ATTRIBUTES AND SKILLS EXPECTED BY THE CANDIDATE BE COMPETITIVE:

In addition to being interested in medically-based nanotechnological research, the student needs to have one or more of the following research attributes:

1) Honours or/and
2) Masters or/and
3) Significant research experience (> 1 year, lab based)

Students are advised to contact the Project Lead listed below prior to submission of their scholarship application to discuss their suitability to be involved in this strategic project.

PROJECT LEAD CONTACT

NAME: **Hani Al-Salami, Faculty of Health Sciences**

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CO-SUPERVISOR

NAME: **Andrew Lowe, Faculty of Health Sciences**

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CO-SUPERVISOR

NAME: **Barry Doyle, Faculty of Health Sciences**