

Dr Sandra Lee heads the Immunobiology Group

A passionate and inspired scientist, Dr Sandra Lee has led the Immunobiology Group since its formation in 2013. Sandra holds several complementary positions, including Senior Research Fellow at the University of Sydney, Treasurer of the Australian Atherosclerosis Society and membership of the education committee of the Australian Vascular Biology Society. She also holds key roles at the Heart Research Association as PhD Student Coordinator and representative of the Institutional Biosafety Committee (IBC).

The Immunobiology Group is a tightly knit group composed of one post-doctoral researcher, three PhD students, one research assistant, an honours student and a Marcus Blackmore Fellow, Dr Stacey Robinson from the HRA UK. Sandra enthuses about her team at the HRA, "We have a group of high quality scientists who work well together," Sandra explained. "We are supported by great leaders and we maintain close collaborative links with the universities and hospitals."

Sandra finds her work both challenging and immensely rewarding. "I love coming up with new ideas, implementing them and seeing what results we get," said Sandra. "It thrills me to develop students over time, seeing their progress and growth, and of course I love the exchange of ideas when meeting other scientists at conferences."

The group's overarching purpose is to investigate the role of HDL, often referred to as the "good cholesterol" and inflammatory proteins such as chemokines, on key vascular biological processes. These processes include atherosclerosis - the fatty plaque formation responsible for angina and heart attacks, restenosis – the narrowing of the arteries that can occur after stenting, and angiogenesis – the growth of new blood vessels.

A major focus of the group is finding novel ways to hinder inflammatory diseases using chemokine inhibitors. Chemokines are small inflammatory proteins that play a key role in the immune response to injury or infection. They direct the migration of inflammatory cells to sites of vascular injury and play a critical role in the development of inflammatory diseases such as atherosclerosis.

"We are currently looking at unique chemokine inhibitors that can specifically inhibit certain classes of chemokines. We are exploring them as potential therapies to prevent atherosclerosis, cancer and restenosis," Sandra explained.

The team have been investigating the effects of the chemokine inhibitor '35K' on angiogenesis. Early findings suggest that 35K has striking inhibitory effects on the angiogenesis associated with inflammatory conditions, but not in low oxygen conditions where angiogenesis is preserved. This means that 35K inhibits detrimental angiogenesis, which promotes atherosclerosis and cancer, but has no effect on good forms of angiogenesis.

"While new vessel formation after a heart attack will improve long term survival and prognosis, current angiogenesis inhibitors impede angiogenesis across the board, good and bad. Our findings could lead to drugs with significant advantages over current anti-angiogenic therapies," said Sandra.

In an exciting development, the group have a paper under review with the European Heart Journal, controversially suggesting that the protective functions of HDL may be dramatically reduced in advanced atherosclerosis. In epidemiological studies, higher levels of HDL have been strongly associated with a reduced risk of atherosclerosis. Likewise, animal studies have shown the consistent benefit of HDL on early atherosclerosis.

“Despite strong epidemiological and experimental evidence of effect, this has not translated into successful therapy for humans with established disease in large scale clinical trials,” explained Sandra. “Our studies demonstrate that raising HDL is much more effective at reducing early-stage atherosclerosis than late-stage disease, indicating that the timing of HDL-raising is a critical factor in its protective effects,” Sandra said.

The group have also received much acclaim for their work on the role of HDL in wound healing. The group is exploring the topical application of HDL, where the HDL is applied directly to the wound, and its effect on healing capacity. “Wound repair in diabetic patients is severely impaired and can lead to intractable wounds and even amputation,” explained Sandra. Impressively, the group have shown that in diabetic patients, HDL can return the impaired angiogenesis to non-diabetic levels, having enormous implications for diabetic wound care.

Another important line of research looks at how HDL might be used to aid recovery and improve outcomes after stent implantation, an operation to place a metal scaffold into a diseased artery to restore blood flow. The group have made the important discovery that HDL bound onto stainless steel, the material used in stents, can prevent blood clotting and smooth muscle cell proliferation, important contributors to restenosis and stent failure. Furthermore, they have identified that infusions of HDL reduce the re-growth of cells following stent implantation.

Sandra began her science career at Adelaide University, gaining her Bachelor of Science with First Class Honours in the Department of Physiology. Sandra enjoyed her laboratory experience investigating antioxidants so much that she revised her ambition of becoming a dietitian and instead decided to embark on a research career.

Sandra remained at Adelaide University to complete her PhD, studying the ways in which antioxidants regulate cholesterol metabolism. It was during this time that she crossed paths with an inspirational scientist and postgraduate coordinator, Professor Caroline Macmillan. “Caroline was a fantastic influence at the time, she was the person who made me think of seriously pursuing a career in science,” said Sandra.

Sandra spent several years as a post-doctoral scientist at Oxford University in the Department of Cardiovascular Medicine and the Wellcome Trust Centre for Human Genetics. She worked alongside Professor David Greaves and interventional cardiologist and researcher, Professor Keith Channon, examining the importance of chemokines on the development of atherosclerosis.

Returning to Sydney in 2007, Sandra began working as a senior post-doctoral researcher in the Lipid Group at the HRA with Professors Kerry-Anne Rye and Philip Barter. She studied the role of chemokines in the protective effects of HDL in atherosclerosis. Sandra swiftly won a highly sought-after National Heart Foundation Career Development Fellowship to continue her work.

Sandra describes herself as the product of two very driven and competitive parents. Her mother was a talented teacher, while her father was Director of the Water Laboratories of South Australia, and more recently the former Chief Scientist of South Australia. Sandra and her rheumatologist brother were inspired by their parents' love of learning and science.

A keen rower, Sandra has rowed for Australia. Combining science with intensive rowing training has influenced her work, "It has helped make me more disciplined, able to perform under pressure and push through pain barriers to achieve my best." Sandra also coaches rowing, which she attributes to developing her leadership skills. "Managing an unruly mob of rowers at 4am has taught me a lot about leadership," she said. "I'm not a morning person, but once I'm out on the water I'm happy."