Tracing the patterns of blood vessels as key to sustaining vital functions

Blood vessels deliver oxygen and nutrition to all parts of our body and carry away waste materials. They play an extremely important role in maintaining our biological functions. Even during the embryonic stage, the cardiovascular system begins to work. During embryogenesis, the blood vessel network has high plasticity, and as the shape of the body changes, so too does the shape of this network shift from moment to moment. The finished network of blood vessels is unpredictable, however, and reaches a fundamental pattern common to all people, about ignoring the peripheral vessels. In other words, networks of vessels is able to shift in position and shape as humans develop, yet eventually will develop into a highly reproducible pattern showing very little variation from person to person. There is where my fascination lies, as a biologist; the phenomena surrounding formation of blood vessels. In order to establish how the blood vessel network is formed through the action of vascular endothelial cells, and how the vessels are able to adapt to the changing shape of the embryo, I developed an animal model that would allow me to observe vascular endothelial differentiation in embryos.

In my current work, I do not only look at blood vessels, but at the surrounding tissue too. Endothelial cells cultured outside of the body are not able to produce thick blood vessels in vitro unlike in the animal body. So, instead, they work with the surrounding tissue to create a functional vessel. By observing and understanding how the cells interact with surrounding tissue, I hope to be able to discover something regarding the mechanisms by which blood vessel networks are formed at the earliest developmental stages.

If you want to understand the behavior of cells and the mechanisms behind that behavior, you have to be determined enough to spend hours peering down the lens of a microscope. In that instant, I feel as if you watch cells moving around inside a living body—this is surely the most satisfying reward for any developmental biologist.

Enriching the life sciences by deepening our understanding of cell division mechanisms

A single cell divides, then divides again, and resultant cells go on to make up all of the tissues and organs in the human body. We know that a sophisticated regulatory mechanism, comprising proteins, is closely involved in this cell division. But there is still so much we do not know. Dr. Satoru Mochida concentrates on research design to deepen our understanding of how phosphorylation, which alongside other processes such as multification and acetylation, affects the proteins required for cell division to occur, is regulated.

"Genetic information can be activated or inactivated according to the behavior of proteins," explains Dr. Mochida. "For example, the skin undertakes an iterative cycle of cell division, constantly replacing itself, but this does not occur in brain cells. Something needs to decide whether a cell is to divide or not, and one of the mechanisms for regulating cell division is phosphorylation." It has already been demonstrated how phosphorylation, which occurs when phosphates attach to a protein, and the opposite action (= dephosphorylation) can work to switch the cell division on and off. "The phosphorylation of proteins is a chemical reaction prerequisite for almost all vital phenomena. It does not just regulate cell division, either. If we understand the general and essential principle behind it works, I think there is potential to make contributions to a wide range of research fields in the life sciences."

References
- Mochida et al., 2010. Science, 320 (5875): 1870-1873. Gwaxad phosphatase as an inhibitor of IRAK that is essential for innate immunity.

Profile

Satoru Mochida
Profile
Graduated from the Faculty of Science, Kyushu University. Completed a Doctoral degree in the Graduate School of Science, Kyushu University. Held a research fellowship at Osaka Institute of Science and Technology Promotion Corporation (now). Took a postdoctoral position at Cancer Research UK in the United Kingdom. Joined Kumamoto University in August 2010. Took up the concurrent role of a research fellow in December 2011 in the Precursory Research for Embryonic Sciences and Technology (PRESTO) program run by the Japan Science and Technology Agency (JST).

Associate Professor

Ko Ishitara
Profile
Graduated from the Faculty of Science, Kyushu University. Went on to graduate study at the Graduate School of Science, Kyushu University and The Graduate University for Advanced Studies. After graduate study, Dr. Ishitara worked with Dr. Young Seok Cho at the Max Planck Institute for Molecular Genetics, Berlin and joined Young Seok Cho at the Institute of Molecular Embryology and Genetics as a researcher. In 2012, he became an Assistant Professor and part of the ‘Next Track’ at the Priority Organization for Innovation and Excellence. Took up his current position in 2012.

References