Division of Stem Cell Research
Cell Modulation

Through the comprehensive analysis of the initial stage of cell differentiation We aim to elucidate basic mechanisms and apply that knowledge To the development of next-generation research on intractable disease

In order to effectively elucidate the mechanisms by which abnormalities occur in cells, we must first clarify what happens in the initial stages of stem cell differentiation. In his research, Dr. Takumi Era uses embryonic stem (ES) and induced pluripotent stem (iPS) cells to examine the basic mechanisms of embryogenesis, with a view to establishing next-generation therapies.

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Profile

Graduated with a Bachelor1s degree from the Kumamoto University School of Medicine, before going on to complete a doctoral degree at the Graduate School of Medicine at the same university.
Worked as an attending physician at the Second Department of Internal Medicine, Kumamoto University School of Medicine, then went on to take up a research assistant role at the Research Institute for Microbial Diseases at Osaka University.
Held a post-doc position at the Howard Hughes Medical Institute, University of California, Los Angeles, then joined the RIKEN Center for Developmental Biology as a researcher. Worked as an attending physician in the Division of Hematology, Department of Internal Medicine, Kumamoto University Hospital.
In 2008, Dr. Era became a professor at the Institute of Molecular Embryology and Genetics, Kumamoto University.

References

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Understanding the normal to examine the abnormal

The transplantation of hematopoietic stem cells has been established as the treatment for hematological malignancies. Despite this, there are many problems in stem cell therapies because of the difficulties in cell preparation. This has led to increasing interest in the potential output of research that makes use of pluripotent cells (ES and iPS cells), which have the capacity to differentiate into a number of different types of cell.

When Dr. Era was working as a hematologist, he became interested in the question of how blood cells become cancerous, leading to leukemia. He then chose to pursue this curiosity, taking up a path of stem cell research. “Blood cells can be generated from embryonic stem cells (ES cells), a type of pluripotent cell, under a proper condition. My belief is that, in order to understand how abnormal cells are generated, we must first focus on the initial stages of stem cell differentiation. So I started to study the mechanisms of ES cell differentiation into blood cells.”

The development of the tissues and organs partially involves the same molecular mechanisms as seen in the carcinogenesis. With development, however, the cells proliferate in an orderly manner, while cancer cells proliferate chaotically. “My research attempts to answer a number of questions, such as what are the differences in the mechanisms between driving orderly and disorderly proliferation, and how are abnormal cells, which go on to cause disease, able to develop? If the processes in the initial stages can be clarified, then it may well be possible to develop methods of cellular regeneration, which in turn may have useful applications in the treatment of cancer and other diseases,” says Dr. Era.

Disease-derived iPS cells speed up the pace of research

In his research thus far, Dr. Era has succeeded in inducing ES cells to differentiate into mesenchymal stem cells and endoderm stem cells. The potential scope of his research has also been expanded greatly by the discovery of iPS cells.

“In order to elucidate the mechanisms of pathological events in diseases, we must have access to the cells of patients with the disease in question. The number of patients with intractable diseases, however, is very few, so researchers who want to study certain diseases have hardly access to the cells of relevant patients,” explains Dr. Era. “What is more, for neurological diseases there were certain challenges in extracting the cells required for research.” The emergence of iPS cells, however, has solved many of these problems. iPS cells, artificially engineered pluripotent stem cells, are generated from already differentiated somatic cells such as skin and blood cells by recovering pluripotency (meaning they can differentiate into a number of different cell types). Cells derived from the patient are used to generate iPS cells, and these cells can then be induced to differentiate into different types of cell again. By studying this process, it is possible both to understand the mechanisms that cause disease to occur and to make discoveries that may lead to the development of new therapies. “iPS cells are usually generated from somatic cells such as fibroblastic cells in the human skin, and today it has even become possible to generate iPS cells from peripheral blood cells.” iPS cells contain within them great potential, which Dr. Era seeks to harness in order overcome the present obstacles preventing further research into intractable diseases and the establishment of new therapies. “This has really widened the scope of research for scientists. If we can get more people working on unlocking the secrets of intractable diseases, then I think we will see real advancements in medicine”.

The Rare Disease Bank

In 2009, the Rare Disease Bank was set up as part of a project funded by the Japanese Ministry of Health, Labour and Welfare on rare and intractable diseases. The role of the bank is to collect and store biological specimens, such as patient blood, cells, and DNA. By targeting 130 rare diseases, collection is conducted by a dedicated research team, which works with medical institutions to collect and store biological specimens and medical data from patients. These resources are available to universities and research institutes.

Dr. Era is involved in the project as a member of the research unit tasked with developing methods for the efficient provision of biological specimens. “The establishment of this sort of bank is of great significance for research that focuses on intractable diseases. I hope that it will help us relieve patients with intractable diseases, even if it is just one at a time.”

At the same time, Dr. Era notes the importance of failure in research. “If you are able to accept that some of your research will fail, that frees your mind to discover things that you might otherwise never even have considered. Of course, knowledge is extremely important, but as a researcher you also need to have experienced failure. Anyone thinking of choosing a career in research should be aware that it is willingness to take on a challenge that is most important in research, and should build up your experience and your ability to think creatively.”