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.

Professor
Takumi Era
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Profile
Graduated with a Bachelor’s 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 a clinical physician at the Second Department of Internal Medicine, Kumamoto University School of Medicine, before going on to take up a research assistant role at the Research Institute for Microbial Disease at Osaka University.
Field a prolific position as the head of the Hagedorn Laboratory in the Molecular Medicine Center for Developing Biology as a researcher. Worked on pioneering research in the field of regenerative medicine, Internal Medicine, Kumamoto University Hospital.
In 2020 appointed as a professor of the Graduate School of Medical Sciences, Kumamoto University.

References

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 stem 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. To this end, he began to pursue this curiously, 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 immune and organs partially involves the same molecular regulatory mechanisms as in the carcinogenesis. With development, however, the cells differentiate on an orderly progression, while cancer cells proliferate chaotically. "My research attempts to answer a number of questions, namely what are the differences in the mechanisms between developing orderly and disorderly proliferation, and how are abnormal cells, which go on to cause cancer, able to develop? If the processes in the normal stages of cell development were revealed, it would 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 endothelial stem cells. The potential scope of his research has been expanded greatly by the discovery of iPS cells.

"In order to elucidate the mechanisms of pathological events, 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 reprogrammed 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 fibroblasts from the human skin, and today it has even become possible to generate iPS cells directly from peripheral blood cells. "iPS cells can be used to study their great potential, which Dr. Era seeks to harness in order overcome the present obstacle 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 disease, 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 conventional and research institutions.

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 just once 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 fosters 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 not always smooth sailing. “It is a challenge that is most important in research, and should build up your experience and your ability to think creatively.”

Application of basic research findings to the development of new therapies

Characterization of disease-derived iPS cells

Application of iPS cells to research on intractable diseases