

The President's Lecture

In October 2004, the International Council created a new distinguished lecture, named The President's Lecture, which is a highlight of ISHR World Congresses and Section meetings.

The President's Lecture is held at each World Congress of the ISHR and, in non-Congress years, at the annual meeting of one of the 3 largest ISHR Sections on a rotating basis. This lecture is intended to be a high profile event and is scheduled as a keynote plenary lecture. The International Council selects the speaker. **The topic of the lecture is in the field of molecular biology, genetics, genomics or proteomics, but the content should be chosen to be of broad interest to the cardiovascular community.** The speaker is reimbursed for travel expenses, and receives a plaque and a \$1,000 honorarium. A photograph and biosketch of the speaker is published in *Heart News and Views*, and is posted in the ISHR website.

The President's Lecture enhances the content of the ISHR scientific meetings by providing a high-quality presentation in a topical area that is not covered by other distinguished lecture awards, and reflects the continuing growth of the ISHR as a professional Society.

This award is funded by a generous donation from **Roberto Bolli, MD**, Winner of the ISHR 2004 Research Achievement Award, who declined to collect the monetary prize associated with the Award and requested that it be used for this purpose.



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ISHR

International Society for Heart Research

The President's Lecture 2014



Honored Speaker

**Keiichi Fukuda,
M.D., Ph.D.**

“Regenerative Medicine of
the Heart using iPS cells”

Keiichi Fukuda, M.D., Ph.D.

2014 Honored Speaker
Miami, FL, USA

Dr. Keiichi Fukuda is professor and chief of the Department of Cardiology at Keio University School of Medicine in Tokyo, Japan. Dr. Fukuda is one of the pioneers in the field of cardiac regeneration and has been at its cutting edge for the past 20 years. His laboratory has made several contributions to our understanding of both the fundamental biology of stem cells and how to regenerate cardiomyocytes and transplant them into the heart *in vivo*.

It is now widely accepted that stem cells exist in many tissues, and can differentiate into various type of cells. Dr. Fukuda first reported that bone marrow mesenchymal stem cells can be induced to differentiate into cardiomyocytes *in vitro*, and that these regenerated cardiomyocytes can be transplanted into the heart *in vivo*. He also reported that neural crest stem cells exist in the heart and bone marrow and can differentiate into cardiomyocytes, smooth muscle cells, neurons and glial cells *in vitro*, and can regenerate cardiomyocytes after myocardial infarction *in vivo*.

After the development of human ES and iPS, Dr Fukuda changed his research direction and tried to regenerate human cardiomyocytes from these stem cells for clinical use. He first developed a method to generate iPS cells from peripheral circulating T lymphocytes using Sendai virus containing Yamanaka factors, which makes it possible to obtain iPS cells from 0.1 ml of peripheral blood and

from T cells that were once frozen or left at room temperature overnight. He then found that several factors such as noggin and Wnt were expressed in the future heart-forming area of the embryo, and that application of these factors to ES and iPS cells can induce cardiomyocytes. Moreover, he found that the G-CSF/G-CSF receptor is an autocrine growth factor for fetal cardiomyocytes, and that its administration to fetal or regenerated cardiomyocytes can expand their cell number.

Dr Fukuda also developed two novel methods to purify cardiomyocytes from ES or iPS-derivatives. The first method allows cardiomyocytes to be highly purified by FACS using mitochondria-specific dye. Cardiomyocytes contain a large number of mitochondria, and administration of mitochondria-specific dyes, such as Mitotracker Red or TMRM, allows separation of the cardiomyocytes by fluorescence. The second method allows you to purify cardiomyocytes by exploiting the differences in the metabolic energy pathways between cardiomyocytes and ES and iPS cells. These stem cells mainly utilize the glycolysis pathway for ATP synthesis and DNA/amino acid production; the end-product, pyruvate, is changed to lactate and is discarded from these cells. In contrast, cardiomyocytes mainly use the TCA cycle for ATP synthesis, and utilize lactate, which is oxidized to pyruvate, as an energy source. By using specific culture medium, in which glucose is depleted and lactate is supplemented, you can purify the cardiomyocytes. These purified cardiomyocytes do not contain undifferentiated cells and do not form teratoma after transplantation.

Dr Fukuda also investigates disease models of iPS cells from patients with long QT syndrome, Brugada syndrome, hypertrophic cardiomyopathy, and other hereditary heart diseases. Dr Fukuda's lab currently does the translational research for

transplantation of iPS cell-derived regenerated cardiomyocytes into patients with severe congestive heart failure.

Training is also an important part of Dr. Fukuda's activities. Dr. Fukuda has served as mentor to 40 Ph.D. and M.D./Ph.D. students and numerous postdocs who have gone on to independent positions in academia. These trainees have come from both domestic academia and from foreign countries.

Dr. Fukuda has also devoted time to the larger cardiovascular society. He has served as president of the Japanese Pulmonary Hypertension Society and the Japanese Section of the ISHR. He is currently secretary general of the Japanese College of Cardiology, and on the board of directors of the Japanese Circulation Society and Japanese Society of Regenerative Medicine. He is an Associate Editor of the *JMCC*, and a Consulting Editor of *Circulation Research*.

Previous Award Winners.....

Richard N. Kitsis, M.D.: San Diego, CA 2013

Steven Houser, PhD: Fukuoka, Japan 2012

Sian Harding, PhD: Haifa, Israel 2011

Issei Komuro, MD, PhD: Kyoto, Japan 2010

R. John Solaro, PhD: Baltimore, MD 2009

Gerd Hasenfuss, MD: Yokohama, Japan 2008

Jeffrey Robbins, PhD: Bologna, Italy 2007

Mark Sussman, PhD: Toronto, ON 2006