Science and Technology Group
Annual Report FY2020

Ai Kiyomitsu
Science and Technology Associate

1 Introduction

After fertilization, one cell embryos undergo repeated cell division to create functional tissues during development in multi-cellular organisms. Although this process is very complicated and mysterious, each division can be classified into two types, symmetric or asymmetric division. Symmetric division produces identical daughter cells for clonal expansion, while asymmetric division increases cell type diversity for differentiation. The balance of symmetric and asymmetric division must be critical for proper development. Early studies in *C. elegans* embryos established a key conceptual framework of asymmetric division, but how symmetric division is actively regulated remains unclear, especially in early embryos.

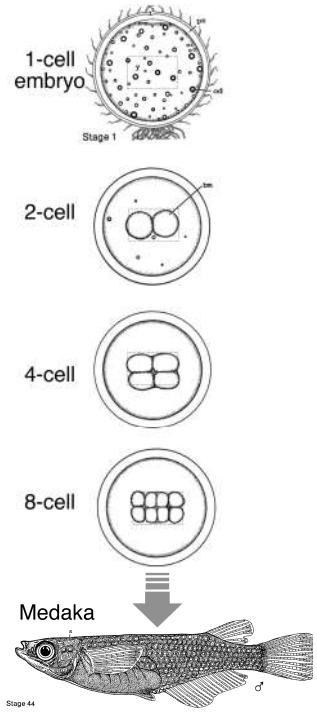

Figure 1. Drawings of embryonic division in Medaka *Oryzias latipes.* (Adopted from Iwamatsu, *Mech Dev.* 2004)

In contrast to *C. elegans*, vertebrate embryos generally show symmetric division in the first several divisions. In Medaka *Oryzias latipes*, one-cell embryos divide symmetrically at least in the first 2 divisions, and generate beautiful symmetrical cellular patterning until the 16-cell stage (Figure 1). During this process, the bipolar spindle must be properly assembled and positioned within a cell since the spindle specifies a cell cleavage site perpendicularly in the middle of the spindle between separating chromosomes during anaphase. However, in contrast to the smaller somatic cells, mechanisms of spindle positioning remain largely unclear in larger vertebrate embryonic cells. Understanding the mechanisms in Medaka embryos must provide useful insights for a better understanding of early embryonic divisions in vertebrates, including human.

2 Activities and Findings

Since April 2020, I set up several lab equipment in cooperation with Kiyomitsu Unit, including water-circulation systems, microinjection systems, stereo-microscopes and a spinning-disc confocal microscope system. I established protocols for Medaka breeding and CRISPR/Cas9-based genome editing. Importantly, I succeeded in establishing a knock-in Medaka strain and visualizing a key microtubule associated protein in Medaka embryos.

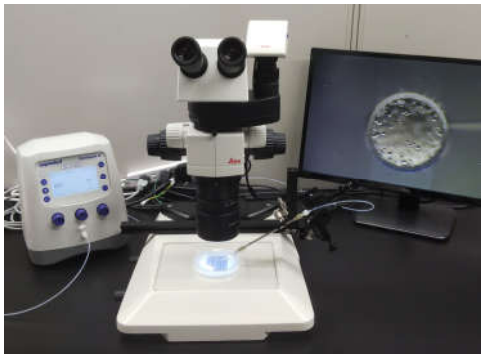

Figure 2. A microinjection system to establish transgenic Medaka strains.

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3 Collaborations

Kiyomitsu Unit, OIST
Prof. Minoru Tanaka and Dr. Toshiya Nishimura, Nagoya University
Dr. Satoshi Ansai, Tohoku University

4 Publications and other output

<Presentation>
Ai Kiyomitsu, *How Medaka early embryos generate beautiful cellular patterning for proper development?* OIST STG forum, 12 March 2021.