Xenopus laevis as a Model for the Functional Analysis of Genes Involved in Embryogenesis and Postembryonic Organ Regeneration

Takashi Hasebe and Atsuko Ishizuya-Oka
Department of Biology, Nippon Medical School

The overexpression study is one of the most useful methods for investigating the function of a gene of interest, and this can be easily achieved by using the frog system. Either plasmid DNA digested by meganuclease or synthetic mRNA is injected into Xenopus laevis fertilized eggs to generate transgenic tadpoles or tadpoles transiently overexpressing certain gene(s), respectively (Fig. 1).
The expression of injected mRNA brings about various effects on embryogenesis according to its function (Fig. 2). In addition, frog metamorphosis serves as a good model for studying organ regeneration because the organs after metamorphosis bear many similarities to their mammalian counterparts. We established a gene transfer system (Fig. 1) and showed the function of genes involved in regeneration of the *Xenopus* intestine (Fig. 3). This system, combined with the use of transgenic frogs, has shed light on the molecular mechanisms of organ regeneration conserved across the animal species.

**Fig. 1**  
Strategy for the functional analysis of genes involved in embryogenesis and postembryonic organ regeneration.

**Fig. 2**  
Transient overexpression of GFP and matrix metalloproteinase (MMP)-14 injected into eggs. Overexpression of MMP-14 (right) but not GFP (left) causes severe developmental defects.

**Fig. 3**  
Intestines transfected with plasmids expressing both a thyroid hormone-responsive basic leucine zipper-containing transcription factor (TH/hZip) and GFP. Overexpression of the transgene causes an increase in number of proliferating cells positive for proliferating cell nuclear antigen (arrows) in the epithelium (e) but not in connective tissue (ct). Scale bar, 20 μm.