Institute of DNA Medicine
Project Laboratory for Kidney Regeneration

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General Summary

Many efforts has been made to apply regenerative medicine to clinical renal diseases, and some renal diseases in which the renal structure is maintained might be treated by infusing stem cells isolated from the bone marrow or the adult kidney. However, such a cell-therapy — based strategy cannot be applied to chronic renal diseases in which the renal structure, including scaffolding, has been completely disrupted. Therefore, the aim of research for absolute kidney regeneration should be to develop a way to rebuild an entire functional kidney de novo as a substitute for dialysis. However, because of the anatomical complexity of the kidney and the need for residential cells to communicate with one another to fulfill renal functions, the kidney has been considered the most difficult organ to regenerate. We are investigating the potential for reconstructing an organized and functional kidney structure, using the developing xenoembryo as an organ factory.

Research Activities

Establishment of an erythropoietin-producing organoid from human mesenchymal stem cells

Differentiation of autologous stem cells into functional transplantable tissues for organ regeneration is a promising regenerative therapeutic approach for cancer, diabetes, and many other human diseases. Yet to be established, however, is differentiation into tissue capable of producing erythropoietin, which has a critical function in anemia. Here we report a novel erythropoietin-producing organ-like structure (organoid) derived from human mesenchymal stem cells (hMSCs). Using our previously established relay culture system, an hMSC-derived, human erythropoietin-competent organoid was established in rat omentum. The organoid-derived levels of human erythropoietin increased in response to anemia induced by rapid blood withdrawal. In addition, when native (rat) erythropoietin production was suppressed, the presence of an organoid enhanced recovery from anemia. Together these results confirmed the generation of a stem-cell — derived organoid that can produce erythropoietin and is sensitive to physiological regulation.

Publications

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