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Intestinal Stem Cells

Methods and Protocols

Edited by

Paloma Ordóñez-Morán

Division of Cancer and Stem Cells, School of Medicine, Biodiscovery Institute, Centre for Cancer Sciences, University of Nottingham, Nottingham, UK

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Editor
Paloma Ordóñez-Morán
Division of Cancer and Stem Cells
School of Medicine
Biodiscovery Institute
Centre for Cancer Sciences
University of Nottingham
Nottingham, UK

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Preface

The intestinal epithelium is one of the most rapidly renewing types of tissue in the body, where intestinal stem cells are responsible for fueling the turnover of the tissue. A precise balance between self-renewal and differentiation of stem cells is essential to maintain homeostasis. Loss of this balance tends to lead to uncontrolled cell growth or prematuration and thus results in tumors, cancers, or tissue defects. During recent years, many researchers have undertaken great efforts to understand how the intestine replaces and repairs itself through the identification of the different intestinal stem cell populations and by defining its role in the continual renewal of the epithelial layer.

The goal of this book is to englobe the most up-to-date methods of the intestinal stem cell field. We provide here step-by-step guidance to a variety of techniques for studying intestinal stem cells properties. We aim to provide comprehensive and easy-to-follow protocols that are designed to be helpful to both seasoned researchers and newcomers to the field. The protocols included in this volume are separated into four different parts. Part I (Chapters 1–7) describes in vitro techniques to study different aspects of the intestinal stem cell functions by innovative imaging and functional assays. We have put particular emphasis on approaches to study the metabolism and niche of intestinal stem cells. Part II (Chapters 8 and 9) outlines the power of the single-cell transcriptional profiling method. In these recent years, the knowledge of intestinal stem cell heterogeneity has quickly advanced thanks to the development of this emerging technology. Part III (Chapters 10–17) presents protocols for the isolation of intestinal crypts to generate and establish 3D organoids to study stem cells. Functional analysis of stem cells and their environment can currently be performed by using innovative in vitro 3D technology that allows long-term culture and maintains basic crypt-villus physiology. This method allows a level of accessibility and tractability that is impossible to achieve in vivo and reduces animal experimentation. Furthermore, we also present protocols that use these 3D organoids as a tool to study intestinal stem cell properties. Finally, Part IV (Chapters 18–23) describes different animal models of gastrointestinal cancer and also presents examples of the use of in vivo state-of-the-art methods for studying intestinal tumor-initiating cells or cancer stem cells.

I would like to thank all of the contributors for sharing their expertise and for carefully guiding readers through all the details of their respective techniques. I am very grateful to the series editor, Dr. John Walker, for his help during the editing process.

Nottingham, UK *Paloma Ordóñez-Morán*

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Contributors

Judith Agudo • *Department of Cancer Immunology and Virology, Dana-Farber Cancer Institute, Boston, MA, USA; Department of Immunology, Harvard Medical School, Boston, MA, USA*

Steven J. Altschuler • *Department of Pharmaceutical Chemistry, University of California, San Francisco, San Francisco, CA, USA*

Jumpei Asano • *Department of Biodefense Research, Medical Research Institute, Tokyo Medical and Dental University (TMDU), Tokyo, Japan; Seirei Women's Junior College, Akita, Japan*

Durga Attili • *Department of Cell and Developmental Biology, University of Michigan, Ann Arbor, MI, USA*

Kevin Barber • *Eli and Edythe Broad Center of Regeneration Medicine and Stem Cell Research, University of California, San Francisco, San Francisco, CA, USA; Department of Biochemistry and Biophysics, University of California, San Francisco, San Francisco, CA, USA*

Jake M. Bieber • *Department of Pharmaceutical Chemistry, University of California, San Francisco, San Francisco, CA, USA; Graduate Program in Bioengineering, University of California, Berkeley, Berkeley, CA, USA*

Costanza Borrelli • *Institute of Molecular Life Sciences, University of Zurich, Zurich, Switzerland; Institute of Molecular Cancer Research, University of Zurich, Zurich, Switzerland*

Erin C. Bush • *Department of Systems Biology, Columbia University Irving Medical Center, New York, NY, USA; Department of Biochemistry & Molecular Biophysics, Columbia University Irving Medical Center, New York, NY, USA*

Ruben I. Calderon • *Division of Digestive and Liver Diseases, Department of Medicine, Columbia Center for Human Development, Columbia Stem Cell Initiative, Columbia University Irving Medical Center, New York, NY, USA; Department of Genetics and Development, Columbia University Irving Medical Center, New York, NY, USA*

Juan Antonio Cámara • *Preclinical Imaging Platform, Vall d'Hebron Institute of Research (VHIR), Barcelona, Spain*

Claudia Capdevila • *Division of Digestive and Liver Diseases, Department of Medicine, Columbia Center for Human Development, Columbia Stem Cell Initiative, Columbia University Irving Medical Center, New York, NY, USA; Department of Genetics and Development, Columbia University Irving Medical Center, New York, NY, USA*

Ina W. Chen • *Department of Pharmaceutical Chemistry, University of California, San Francisco, San Francisco, CA, USA*

Chia-Wei Cheng • *The David H. Koch Institute for Integrative Cancer Research at MIT, Cambridge, MA, USA; Department of Biology, MIT, Cambridge, MA, USA*

Irene Chicote • *Stem Cells and Cancer Laboratory, Vall d'Hebron Institute of Oncology (VHIO), Barcelona, Spain*

Hans Clevers • *Hubrecht Institute, Royal Netherlands Academy of Arts and Sciences (KNAW), Utrecht, The Netherlands; Oncode Institute, Utrecht, The Netherlands; University Medical Center Utrecht, Cancer Genomics Netherlands, Utrecht, The Netherlands; Princess Maxima Center for Pediatric Oncology, Utrecht, The Netherlands*

Justin A. Colacino • *Department of Environmental Health Sciences, University of Michigan School of Public Health, Ann Arbor, MI, USA; Department of Nutritional Sciences, University of Michigan School of Public Health, Ann Arbor, MI, USA; Center for Computational Medicine and Bioinformatics, University of Michigan, Ann Arbor, MI, USA*

Caroline Dafflon • *Disease Area Oncology, Novartis Institutes for BioMedical Research, Basel, Switzerland*

Michael K. Dame • *Division of Gastroenterology, Department of Internal Medicine, University of Michigan Medical School, Ann Arbor, MI, USA*

Pierre Dessen • *Swiss Institute for Experimental Cancer Research, École Polytechnique Fédé rale de Lausanne (EPFL), Lausanne, Switzerland*

Ruslan I. Dmitriev • *School of Biochemistry and Cell Biology, University College Cork, Cork, Ireland*

Faranak Fattahi • *Eli and Edythe Broad Center of Regeneration Medicine and Stem Cell Research, University of California, San Francisco, San Francisco, CA, USA; Department of Biochemistry and Biophysics, University of California, San Francisco, San Francisco, CA, USA*

Jared M. Fischer • *Cancer Early Detection Advanced Research Center, Knight Cancer Institute, Oregon Health & Science University, Portland, OR, USA; Department of Molecular and Medical Genetics, Oregon Health & Science University, Portland, OR, USA*

Masayuki Fujii • *Department of Organoid Medicine, Keio University School of Medicine, Tokyo, Japan*

Hartmut Geiger • *Division of Experimental Hematology, Cancer Biology & Stem Cell Biology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA*

David L. Hacker • *Protein Production and Structure Core Facility (PPSCF), School of Life Sciences, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland*

Jonathan M. Harnoss • *Cancer Immunology, Genentech, Inc., South San Francisco, CA, USA*

Michael A. Helmrath • *Department of Pediatric General and Thoracic Surgery, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA; Department of Pediatrics, University of Cincinnati, Cincinnati, OH, USA*

Sha Huang • *Division of Gastroenterology, Department of Internal Medicine, University of Michigan Medical School, Ann Arbor, MI, USA; Department of Cell and Developmental Biology, University of Michigan, Ann Arbor, MI, USA*

Joerg Huelsken • *Swiss Institute for Experimental Cancer Research, École Polytechnique Fé dérale de Lausanne (EPFL), Lausanne, Switzerland*

Masamichi Imajo • *Institute for Chemical Reaction Design and Discovery (WPI-ICReDD), Hokkaido University, Sapporo, Japan*

Nicholas Jinks • *Cancer Genetics & Stem Cell Group, BioDiscovery Institute, Division of Cancer and Stem Cells, School of Medicine, University of Nottingham, Nottingham, UK*

Hossein Kashfi • *Cancer Genetics & Stem Cell Group, BioDiscovery Institute, Division of Cancer and Stem Cells, School of Medicine, University of Nottingham, Nottingham, UK*

Taryn E. Kawashima • *Cancer Early Detection Advanced Research Center, Knight Cancer Institute, Oregon Health & Science University, Portland, OR, USA*

Ophir D. Klein • *Department of Pediatrics, University of California, San Francisco, San Francisco, CA, USA; Program in Craniofacial Biology and Department of Orofacial Sciences, University of California, San Francisco, San Francisco, CA, USA; Department of Pediatrics and Institute for Human Genetics, University of California, San Francisco, San Francisco, CA, USA; Klein Lab, UCSF, San Francisco, CA, USA*

Noelyn Kljavin • *Molecular Oncology, Genentech, Inc., South San Francisco, CA, USA*

Kevin G. Leong • *Discovery Biology, Exelixis Inc., Alameda, CA, USA; Discover Oncology, Genentech, Inc., South San Francisco, CA, USA*

Maxime M. Mahe • *Department of Pediatric General and Thoracic Surgery, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA; Department of Pediatrics, University of Cincinnati, Cincinnati, OH, USA; Université de Nantes, INSERM, TENS, The Enteric Nervous System in Gut and Brain Diseases, IMAD, Nantes, France*

Elise C. Manalo • *Cancer Early Detection Advanced Research Center, Knight Cancer Institute, Oregon Health & Science University, Portland, OR, USA*

Maria M. Mihaylova • *Department of Biological Chemistry and Pharmacology, The Ohio State University, Columbus, OH, USA; The Ohio State University Comprehensive Cancer Center, Columbus, OH, USA*

Shizuka Miura • *Division of Organogenesis and Regeneration, Medical Institute of Bioregulation, Kyushu University, Fukuoka, Japan*

Tomohiro Mizutani • *Hubrecht Institute, Royal Netherlands Academy of Arts and Sciences (KNAW), Utrecht, The Netherlands; Oncode Institute, Utrecht, The Netherlands*

Andreas E. Moor • *Institute of Molecular Cancer Research, University of Zurich, Zurich, Switzerland*

Kodandaramireddy Nalapareddy • *Division of Experimental Hematology, Cancer Biology & Stem Cell Biology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA*

Abdolrahman S. Nateri • *Cancer Genetics & Stem Cell Group, BioDiscovery Institute, Division of Cancer and Stem Cells, School of Medicine, University of Nottingham, Nottingham, UK*

Theresa N. Nguyen • *Cancer Early Detection Advanced Research Center, Knight Cancer Institute, Oregon Health & Science University, Portland, OR, USA*

Maxim Norkin • *Swiss Institute for Experimental Cancer Research, École Polytechnique Fédé rale de Lausanne, Lausanne, Switzerland*

Toshiaki Ohteki • *Department of Biodefense Research, Medical Research Institute, Tokyo Medical and Dental University (TMDU), Tokyo, Japan*

Irina A. Okkelman • *School of Biochemistry and Cell Biology, University College Cork, Cork, Ireland*

Paloma Ordóñez-Morán • *Division of Cancer and Stem Cells, School of Medicine, Biodiscovery Institute, Centre for Cancer Sciences, University of Nottingham, Nottingham, UK*

Héctor G. Palmer • *Stem Cells and Cancer Laboratory, Vall d'Hebron Institute of Oncology (VHIO), Barcelona, Spain*

Dmitri B. Papkovsky • *School of Biochemistry and Cell Biology, University College Cork, Cork, Ireland*

Holly M. Poling • *Department of Pediatric General and Thoracic Surgery, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA*

Jens Puschhof • *Hubrecht Institute, Royal Netherlands Academy of Arts and Sciences (KNAW), Utrecht, The Netherlands; Oncode Institute, Utrecht, The Netherlands*

Chathruckan Rajendra • *Department of Pediatrics, University of California, San Francisco, San Francisco, CA, USA; Program in Craniofacial Biology and Department of Orofacial Sciences, University of California, San Francisco, San Francisco, CA, USA*

Laura E. Sanman • *Department of Pharmaceutical Chemistry, University of California, San Francisco, San Francisco, CA, USA*

Albert Santamaría-Martínez • *Tumor Ecology Lab, Department of Oncology, Microbiology and Immunology, Faculty of Science and Medicine, University of Fribourg, Fribourg, Switzerland*

Taku Sato • *Department of Biodefense Research, Medical Research Institute, Tokyo Medical and Dental University (TMDU), Tokyo, Japan*

Toshiro Sato • *Department of Organoid Medicine, Keio University School of Medicine, Tokyo, Japan; Department of Gastroenterology, Keio University School of Medicine, Tokyo, Japan*

Frederic J. de Sauvage • *Molecular Oncology, Genentech, Inc., South San Francisco, CA, USA*

Ryan Scott • *Research Biology, Genentech, Inc., South San Francisco, CA, USA*

Kismet Sheldon-Collins • *Columbia Center for Human Development, Columbia Stem Cell Initiative, Division of Digestive & Liver Diseases, Department of Medicine, Columbia University Irving Medical Center, New York, NY, USA; Department of Genetics & Development, Columbia University Irving Medical Center, New York, NY, USA*

Stephen E. Sherman • *Department of Cancer Immunology and Virology, Dana-Farber Cancer Institute, Boston, MA, USA*

Peter A. Sims • *Department of Systems Biology, Columbia University Irving Medical Center, New York, NY, USA; Department of Biochemistry & Molecular Biophysics, Columbia University Irving Medical Center, New York, NY, USA*

Catherine Sohn • *Research Biology, Genentech, Inc., South San Francisco, CA, USA*

Felipe De Sousa e Melo • *Discovery Oncology, Genentech, Inc., South San Francisco, CA, USA*

Jason R. Spence • *Division of Gastroenterology, Department of Internal Medicine, University of Michigan Medical School, Ann Arbor, MI, USA; Department of Cell and Developmental Biology, University of Michigan, Ann Arbor, MI, USA; Department of Biomedical Engineering, College of Engineering, University of Michigan, Ann Arbor, MI, USA; Center for Organogenesis, University of Michigan Medical School, Ann Arbor, MI, USA*

Tianhong Su • *Division of Digestive and Liver Diseases, Department of Medicine, Columbia Center for Human Development, Columbia Stem Cell Initiative, New York, NY, USA; Department of Genetics and Development, Columbia University Irving Medical Center, New York, NY, USA*

Shinya Sugimoto • *Department of Organoid Medicine, Keio University School of Medicine, Tokyo, Japan; Department of Gastroenterology, Keio University School of Medicine, Tokyo, Japan*

Nambirajan Sundaram • *Department of Pediatric General and Thoracic Surgery, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA*

Atsushi Suzuki • *Division of Organogenesis and Regeneration, Medical Institute of Bioregulation, Kyushu University, Fukuoka, Japan*

Curtis A. Thorne • *Department of Cellular and Molecular Medicine, University of Arizona Cancer Center, University of Arizona, Tucson, AZ, USA*

Maria Trifas • *Division of Digestive and Liver Diseases, Department of Medicine, Columbia Center for Human Development, Columbia Stem Cell Initiative, New York, NY, USA; Department of Genetics and Development, Columbia University Irving Medical Center, New York, NY, USA*

Simon Vales • *Department of Pediatric General and Thoracic Surgery, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA*

Tomas Wald • *Program in Craniofacial Biology and Department of Orofacial Sciences, University of California, San Francisco, San Francisco, CA, USA*

Lani F. Wu • *Department of Pharmaceutical Chemistry, University of California, San Francisco, San Francisco, CA, USA*

Kelley S. Yan • *Division of Digestive and Liver Diseases, Department of Medicine, Columbia Center for Human Development, Columbia Stem Cell Initiative, Columbia University Irving Medical Center, New York, NY, USA; Department of Genetics and Development, Columbia University Irving Medical Center, New York, NY, USA*

Omer H. Yilmaz • *The David H. Koch Institute for Integrative Cancer Research at MIT, Cambridge, MA, USA; Department of Biology, MIT, Cambridge, MA, USA; Broad Institute of Harvard and MIT, Cambridge, MA, USA; Department of Pathology, Massachusetts General Hospital and Harvard Medical School, Cambridge, MA, USA*