# METHODS IN MOLECULAR BIOLOGY™

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# In Vivo Cellular Imaging Using Fluorescent Proteins

## Methods and Protocols

Edited by

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Humana Press

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ISSN 1064-3745 ISSN 1940-6029 (electronic)
ISBN 978-1-61779-796-5 ISBN 978-1-61779-797-2 (eBook)
DOI 10.1007/978-1-61779-797-2
Springer New York Dordrecht Heidelberg London

Library of Congress Control Number: 2012936123



Printed on acid-free paper

Humana Press is part of Springer Science+Business Media (www.springer.com)

# Dedication

This volume is dedicated to Charlene M. Cooper who has devoted 16 years of way-beyond the call-of-duty to AntiCancer Inc. Without Charlene's devotion, superb administration, and thoughtfulness, this volume could not have been written.

# Preface

The discovery and genetic engineering of fluorescent proteins has revolutionized cell biology. What was previously invisible in the cell often can be made visible with the use of fluorescent proteins. This volume presents state-of-the-art research contributing to the revolution fluorescent proteins brought the visualization of biological processes in the live animal. This is the first volume in the new field of in vivo cell biology. The chapters in this volume are highlighted below.

Chapter 1 describes the use of the chick CAM model to visualize cancer cell migration and metastasis in a physiologically-relevant, but simple, in vivo setting using fluorescent proteins and other fluorescent probes.

Chapter 2 describes intravital fluorescent imaging of the real-time behavior of the individual cells of mammary tumors labeled with fluorescent proteins using multiphoton microscopy.

Chapter 3 describes the use of window chambers for cellular and subcellular imaging of cancer cells in mice.

Chapter 4 describes imaging of tumor–host interaction between pancreatic cancer cells and host-derived stroma and vasculature in which cancer cells and the host mice are color-coded with fluorescent proteins.

Chapter 5 describes stable transformation of cancer cells with fluorescent protein genes, using lentiviral vectors, which can be used for whole-body imaging on essentially any organ in mice.

Chapter 6 describes an in vivo imaging system consisting of mouse-implanted fluorescent protein-tagged metastatic cancer cell lines and a hand-held detection device for external, noninvasive and real-time monitoring of the therapeutic effects of drugs.

Chapter 7 describes three-dimensional imaging of tumors in mice expressing red fluorescent protein.

Chapter 8 describes real-time high-resolution imaging of angiogenesis and vascular response to anticancer and antiangiogenic therapy in live mice with orthotopic breast cancer labeled with fluorescent proteins.

Chapter 9 describes a tumor-specific, replication-competent, telomerase-dependent, GFP-expressing adenovirus to label tumors and metastasis with GFP in mice for detection and surgical navigation.

Chapter 10 describes a replication-competent, tumor-specific herpes simplex virus expressing GFP to label cancer cells in mice for visualization by endoscopy and in vivo microscopy.

Chapter 11 describes tumor-targeting GFP-expressing vaccinia viruses and bacteria to label tumors in mice for high-resolution imaging.

Chapter 12 describes genetic engineering of rats, rabbits, and pigs to express GFP which can be used for cell therapy and transplantation.

Chapter 13 describes the matching of exogenous fluorophores and endogenous fluorescent proteins in cancer cells to develop sensitive and specific cancer-targeting probes.

Chapter 14 describes embryo culture and fluorescent proteins to image developing vasculature and hemodynamics.

Chapter 15 describes new fluorescent proteins, with a wide range of spectral colors, including those that switch colors and kindle, isolated from coral reefs.

Chapter 16 describes how new improved far-red and infrared fluorescent proteins can be designed.

Chapter 17 describes imaging the effects of siRNA and microRNA in vivo.

Chapter 18 describes the use of different color fluorescent proteins to image the nuclear-cytoplasmic dynamics of cancer cells in vivo.

***San Diego, CA, USA*** ***Robert M. Hoffman***

# Contents

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