

METHODS IN MOLECULAR BIOLOGY

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Reporter Gene Imaging

Methods and Protocols

Edited by

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Preface

Advances in the field of molecular imaging have provided biologists with tools to noninvasively follow fundamental biology processes with unprecedented ease and sensitivity. Non-invasive imaging techniques include radioactive, magnetic, and light-based methods to visualize cell movement, cell-cell communication, and gene expression.

The strength of reporter gene-based molecular imaging lies in the ability to track both the movement and function of cell populations in living subjects. Furthermore, the use of more than one imaging modality provides complementary information. This volume begins with a discussion of the advantages and limitations of combining fluorescent, bioluminescent, and radioisotopic reporter genes into one construct. This comprehensive review is followed by a method for creating a dual modality imaging reporter gene construct. Bioluminescent imaging using various luciferase genes is now a workhorse technique widely used in preclinical models of cancer and infectious disease. A detailed protocol for conducting a bioluminescent or fluorescent imaging experiment is followed by chapters that use light-based imaging to track immune system reconstitution, hypoxia, bacterial colonization, and macrophage localization and function. Widespread use of positron emission tomography (PET) imaging began with the advent of ^{18}F -FDG and is now a standard clinical diagnostic tool. Development of thymidine kinase (TK) as a PET reporter expanded the utility of this imaging modality to track specific cell populations and cellular functions in vivo. Protocols for detecting cancers using TK and responding immune cells using ^{18}F and ^{124}I -based tracers for TK and other nuclear reporters are described. Apoptosis is an important measure of cancer therapeutic efficacy. A comprehensive protocol for synthesis and use of an ^{18}F tracer for detection of caspase 3 as a readout for apoptosis is provided. Also included are protocols for emerging techniques such as the preclinical evaluation of PET radiotracers by Cerenkov imaging and the use of silver nanoparticles as cancer therapies.

Each chapter begins with an introduction to the topic, followed by a list of materials and detailed methods to conduct the procedure. Vendors are listed only where the equipment or reagent from a specific source is required.

This volume provides an introduction for the scientist who is new to the field of molecular imaging, as well as detailed methods for experts in other areas of molecular imaging.

Finally, I thank the colleagues who contributed their knowledge and expertise and John Walker for his advice and patience during the compilation of this volume.

Columbus, OH, USA

Purnima Dubey

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