



Universiteit
Leiden
The Netherlands

Multimodal image-guided interventions using oncological biomarkers

Stammes, M.A.

Citation

Stammes, M. A. (2018, May 22). *Multimodal image-guided interventions using oncological biomarkers*. Retrieved from <https://hdl.handle.net/1887/62351>

Version: Not Applicable (or Unknown)

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/62351>

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/62351> holds various files of this Leiden University dissertation.

Author: Stammes, M.A.

Title: Multimodal image-guided interventions using oncological biomarkers

Issue Date: 2018-05-22

**Multimodal image-guided interventions using
oncological biomarkers**

Marieke A. Stammes

Multimodal image-guided interventions using oncological biomarkers

© M.A. Stammes, 2018, Leiden, the Netherlands. All rights reserved. No parts of this thesis may be reproduced, distributed, stored in a retrieval system or transmitted in any forms or by any means without prior written permission of the author.

ISBN: 978-90-9030924-8

Lay-out by: M.A. Stammes

Printing by: ProefschriftMaken || www.proefschriftmaken.nl

Cover photo/artwork by: M.A. Stammes

The research described in this thesis was financially supported by the project grant H2020-MSCA-RISE grant number 644373 – PRISAR, the European Union Seventh Framework Programme FP7-PEOPLE-2013-IAPP grant number 612360 – BRAINPATH, the Center for Translational Molecular Medicine: 030-202 MUSIS, the European Research Council (ERC) through an ERC Advanced Grant grant number 323105-SURVive and a TI Pharma project number D4-603 - IMMUNOCOLOURS.

Financial support by the department of Radiology of the Leiden University Medical Center and iThera Medical GmbH for printing of this thesis was gratefully acknowledged.

**Multimodal image-guided interventions using
oncological biomarkers**

Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof.mr. C.J.J.M. Stolker,
volgens besluit van het College voor Promoties
te verdedigen op dinsdag 22 mei 2018
klokke 11.15 uur
door

Marieke Alice Stammes

geboren op 25 januari 1986
te Alkmaar

Promotor	Prof. dr. L.F. de Geus-Oei
Co-promotores	Dr. A.L. Vahrmeijer Dr. L.J. Cruz-Ricondo
Promotiecommissie	Prof. dr. C.A.M. Marijnen Prof. dr. F. Alves (Max Planck Institut & Universitätsmedizin Göttingen, Göttingen, DE) Prof. dr. M.A. van Buchem Prof. dr. ir. M. de Jong (Erasmus MC, Rotterdam) Prof. dr. A.C. Perkins (University of Nottingham, Nottingham, UK) Prof. dr. C.J.H. van de Velde

Patience is wisdom

Table of Contents

Chapter 1	General introduction and outline	9
-----------	----------------------------------	---

Part I – Image-guided Surgery

Chapter 2	Modalities for image- and molecular-guided cancer surgery	27
Chapter 3	Evaluation of EphA2 and EphB4 as targets for image-guided colorectal cancer surgery	57
Chapter 4	Fluorescence- and multispectral optoacoustic imaging for an optimised detection of deeply located tumors in an orthotopic mouse model of pancreatic carcinoma	73

Part II – Necrosis Imaging

Chapter 5	Necrosis avid near infrared fluorescent cyanines for imaging cell death and their use to monitor therapeutic efficacy in mouse tumor models	103
Chapter 6	Pre-clinical evaluation of a cyanine based SPECT probe for multimodal tumor necrosis imaging	133
Chapter 7	The necrosis-avid small molecule HQ4-DTPA as a multimodal imaging agent for monitoring radiation therapy-induced tumor cell death	159
Chapter 8	General discussion, summary, and future perspectives	183

Appendices

Nederlandse Samenvatting	203
List of Abbreviations	209
Curriculum Vitae	213
List of Publications & Conference Abstracts	215
Dankwoord	219