



Universiteit
Leiden
The Netherlands

Mapping and ablation of atrial tachyarrhythmias : from signal to substrate

Groot, N.M.S. de

Citation

Groot, N. M. S. de. (2006, September 14). *Mapping and ablation of atrial tachyarrhythmias : from signal to substrate*. Retrieved from <https://hdl.handle.net/1887/4915>

Version: Corrected Publisher's Version

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

Downloaded from: <https://hdl.handle.net/1887/4915>

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

Mapping and Ablation of Atrial TachyArrhythmias

From Signal to Substrate

Natasja MS de Groot

The research described in this thesis was performed at the department of cardiology and cardiothoracic surgery of the Leiden University Medical Center, Leiden and the department of physiology, Cardiovascular Research Institute Maastricht, Maastricht University, the Netherlands.

Financial contribution to the costs associated with the publication of this thesis from:

Biosense Webster/Johnson & Johnson Medical BV, St Jude Medical Nederland BV, Guidant Nederland BV, Boston Scientific Nederland, Merck, Sharp & Dome, Bard Electrophysiology, Philips Medical Systems, Siemens, Servier, Astellas Pharmas, Toshiba Medical Systems Nederland BV, Medtronic BV and Vitatron.

Copyright © Natasja M.S de Groot, 2006, Leiden, the Netherlands

No parts of this publication may be reproduced, stored or transmitted in any form or by any means without prior permission of the author.

Cover design by Natasja MS de Groot

Lay out by:
Buijten & Schipperheijn

Printed by:
Buijten & Schipperheijn, Amsterdam, the Netherlands

ISBN-10 90-9020960-3
ISBN-13 978-90-9020960-9

Mapping and Ablation of Atrial TachyArrhythmias

From Signal to Substrate

Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van de Rector Magnificus Dr. D.D. Breimer,
hoogleraar in de faculteit der Wiskunde en
Natuurwetenschappen en die der Geneeskunde,
volgens besluit van het College voor Promoties
te verdedigen op donderdag 14 september 2006
klokke 13.45 uur

door

Natasja Mireille Silvia de Groot

geboren te Heemstede
in 1972

Promotiecommissie

Promotores: Prof. Dr. M.J. Schalijs
Prof. Dr. M.A. Allesie, Universiteit van Maastricht

Referent: Prof. Dr. Ir. J. M. T. de Bakker, Academisch Medisch Centrum

Overige commissieleden: Prof. Dr. E. E. van der Wall
Prof. Dr. A. C. Gittenberger-de Groot
Prof. R. Dion
Dr. N.A. Blom
Dr. U. Schotten, Universiteit van Maastricht

Financial support by the Netherlands Heart Foundation for the publication of this thesis is gratefully acknowledged.

Als je doet wat je leuk vindt, hoef je nooit hard te werken

Mahatma Gandhi

dankzij mijn ouders

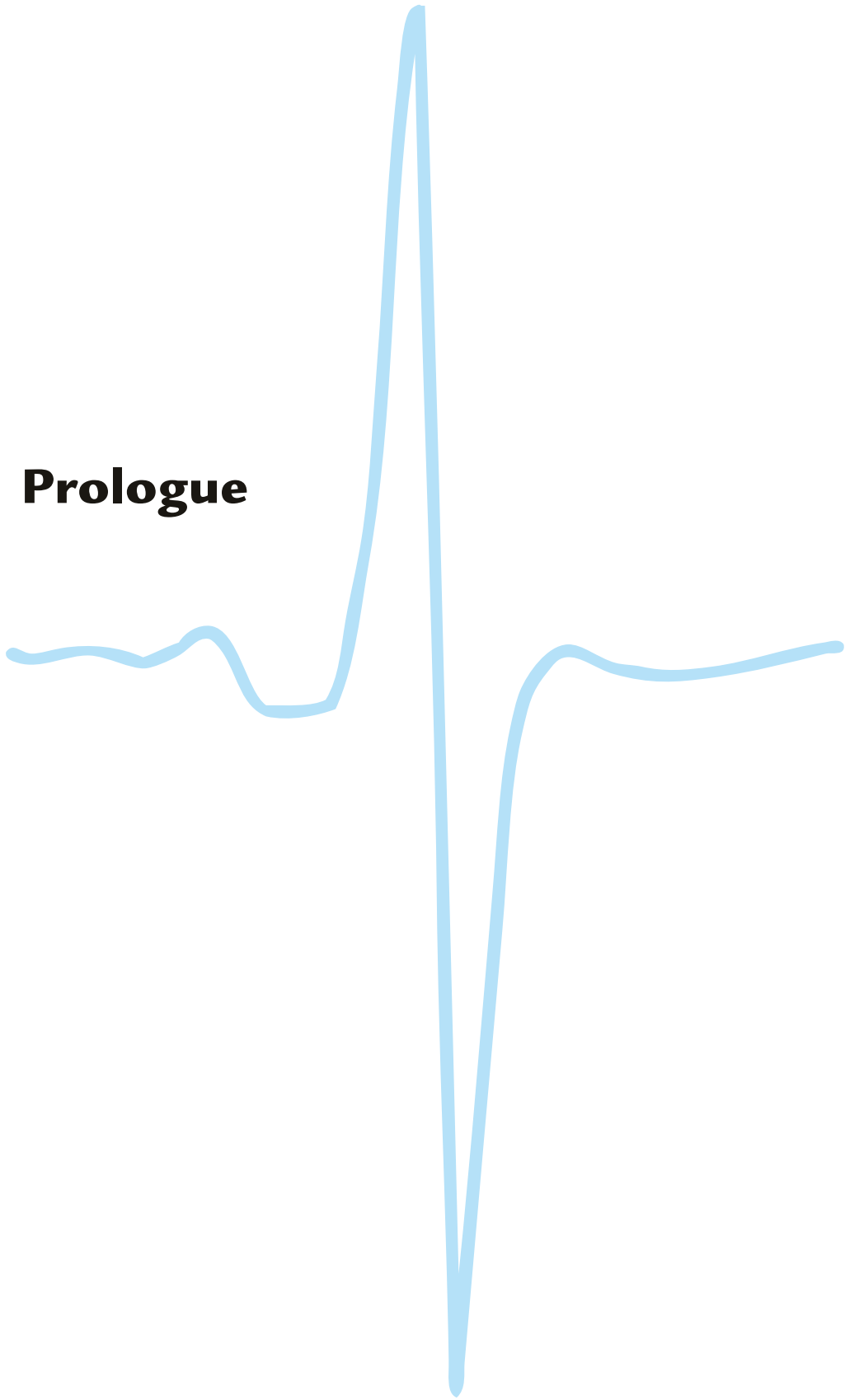


Table of Contents

<i>Prologue</i>	9
Chapter 1	
Mapping of atrial tachyarrhythmias	
Introduction and outline of this thesis	13
Chapter 2	
Analysis of temporal irregularity of atrial fibrillation cycle length	75
Chapter 3	
S wave predominance of epicardial electrograms during atrial fibrillation in humans: indirect evidence for a role of the thin subepicardial layer	101
Chapter 4	
Comparison of epicardial breakthrough of fibrillation waves between patients with acute and chronic atrial fibrillation	123
Chapter 5	
Conduction properties of fibrillation waves in the epicardial plane in patients with acute and chronic atrial fibrillation	149
Chapter 6	
Degree of fractionation of atrial fibrillation electrograms during acute and chronic AF	169
Chapter 7	
Epicardial high density mapping of bachmann's bundle in humans with chronic atrial fibrillation	195
Chapter 8	
Epicardial multi-site high density mapping as a new approach to identify the substrate of atrial fibrillation	211

Chapter 9	
Three-dimensional catheter positioning during radiofrequency catheter ablation in patients: first application of a real-time position management system	235
Chapter 10	
Three-dimensional distribution of bipolar atrial electrogram voltages in patients with congenital heart disease	255
Chapter 11	
Voltage and activation mapping: how the recording technique affects the outcome of catheter ablation procedures in patients with congenital heart disease	273
Chapter 12	
Ablation of macro-reentrant and focal atrial arrhythmias in patients with congenital heart defects after surgery: the role of circumscribed areas with heterogeneous conduction	293
Chapter 13	
Fractionated atrial potentials: markers of the origin of focal atrial tachycardia	315
Chapter 14	
Fusion of electroanatomical activation maps and multislice computed tomography to guide ablation of a focal atrial tachycardia in a Fontan patient	333
Chapter 15	
General discussion	343
<i>Epilogue</i>	369
<i>Summary and Conclusions</i>	373
<i>Samenvatting en Conclusies</i>	383
<i>List of Publications</i>	393
<i>Curriculum Vitae</i>	405

Prologue



Prologue

Atrial tachyarrhythmias are defined as supraventricular tachycardias that do not require the atrioventricular node or ventricular tissue for initiation and perpetuation.

It is expected that the number of patients presenting with atrial tachyarrhythmias will continue to rise in the next decades. This is mainly caused by ageing of our population as the incidence of atrial tachyarrhythmias is higher in older subjects. In addition, there is also a growing group of patients presenting with atrial tachyarrhythmias who have had corrective or palliative cardiac surgery for congenital heart defects. Refinement of surgical techniques has resulted in an improved life expectancy of this patient group. As the incidence of atrial tachyarrhythmias increases over time, late post-operative atrial tachyarrhythmias in subjects with congenital heart defects is nowadays becoming a more frequently encountered clinical problem. Another new growing patient population presenting with atrial tachyarrhythmias are endurance athletes as excessive sports activity is a risk factor for development of, for example, atrial fibrillation.

Atrial tachyarrhythmias can result in electrophysiological, structural and/or functional alterations of the myocardium (tachycardia-induced cardiomyopathy) and treatment is therefore essential. Pharmacological treatment of atrial tachyarrhythmias is often ineffective and limited by side effects. In the last decades, technological progress has resulted in development of (catheter based and surgical) ablation therapy. The introduction of ablative therapy has made it possible to treat atrial tachyarrhythmias curatively. In order to successfully eliminate atrial tachyarrhythmias by catheter ablation, correct diagnosis of the underlying mechanism of the arrhythmia is essential. The surface electrocardiogram is often not reliable and cardiac mapping is therefore compulsory to diagnose an atrial tachyarrhythmias for example as a focal atrial tachycardia, typical (counter) clockwise atrial flutter, atypical atrial flutter or an incisional atrial tachycardia. Data acquired by cardiac mapping also determines the mode of ablative therapy (e.g. focal application or construction of linear lesions). Yet, ablative therapy is not always successful which may be caused by insufficient understanding of the mechanism of the arrhythmia. Also, recurrences after ablation may be caused by progressive atrial myopathy or by incomplete ablative lesions.

Experimental and clinical mapping studies per se are essential in order to continue to increase our knowledge of atrial tachyarrhythmias and to provide a basis for development of innovative therapies or to improve existing treatment modalities.

