

**The ECG**  
**A Two-Step Approach to Diagnosis**

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# The ECG

## A Two-Step Approach to Diagnosis

Foreword by Christopher Cannon

With 1154 Figures and 54 Tables



Springer

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I dedicate the book to my wife Ursula  
and to our children Gustav, Natacha, Sonja and Anatol



## Foreword

On this, the 100<sup>th</sup> anniversary of the electrocardiogram (ECG), it is a delight to welcome a new and comprehensive book on ECGs and arrhythmias. Professor Gertsch has compiled a wonderful book that covers all aspects of electrocardiography but with a very practical and clinically useful approach. In reading this book, I have been struck by its very straightforward layout and setup of each chapter, divided into sections for busy readers and advanced readers. This allows the reader to skim through the highlights of a particular section and, if he or she is more interested, can delve more deeply into that topic. The book has a very clear outline format so that one can follow the various issues on a topic. For example, in the ECG section, the various components of the ECG are divided into subsections and the various normal variants that can be seen are listed as subsections within each part of the chapter. The illustrations, figures, and tables in the book are very helpful. Within each chapter to explain vectors or mechanisms of arrhythmia are illustrations in color. Cataloged at the back of each chapter are example ECGs of all the topics discussed in each chapter.

This makes this book very useful for all levels of physicians and health-care professionals interested in ECGs, ranging from medical students who are first being exposed to electrocardiograms, to senior cardiologists who wish to find more detailed information about particular abnormalities. For all these reasons, I feel this book will be a welcome addition to the medical literature and should be very useful to cardiologists, electrophysiologists, internists, primary care physicians, nurses, medical residents, exercise physiologists and technicians, and all other health-care professionals caring for cardiac patients. Congratulations to Professor Gertsch on creating this important new book.

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## Preface

Twenty-five years ago a publisher invited me to write an ECG book. I refused because I had no time, having a 120 percent job. This was a good decision. In the decades which followed I have learned much more about the ECG and about teaching. And so I have eventually created this book at the end of my professional life, taking a 50 percent time out for three years.

Being involved in non-invasive and invasive cardiology, I had the constant opportunity to compare the ECG patterns with hard facts, such as echocardiographic and angiographic findings, to name only the most important ones. I became acquainted with the significance of arrhythmias during the implantation of many pacemakers and attending intensive care and emergency stations.

In this book I have tried to differentiate between basically important and frequent ECG patterns and arrhythmias on one hand, and less important and rarer – but interesting – findings on the other. This has been achieved by dividing most chapters into a section *At a Glance* and a section *The Full Picture*. Moreover, I have taken up many suggestions by my colleagues, thus providing an extensive presentation of the normal ECG and its (normal) variants, and a large chapter about exercise ECGs. Other ideas were cooked in my own kitchen, such as the chapters ‘Differential Diagnosis of Pathologic Q Waves’ and ‘Special Waves, Signs and Phenomena’, as well as a list of the etiologies of electrolyte imbalances, and of pericarditis. With clinical data and the inclusion of about 50 case reports (also called ‘short stories’), the clinical significance of ‘the ECG’ is highlighted and the reading experience thus enhanced.

The book is intended for cardiologists, internists and general practitioners, for the specialist team in intensive care units and for especially gifted and interested students.

Marc Gertsch

## Introduction by Bernhard Meier

A single author book in any field of cardiology has become an exquisite rarity. It takes a super specialist to comprehensively review the large topic of electrocardiography in a fashion appropriate to cardiologists, internists, general practitioners, and medical students. Marc Gertsch meets that requirement as only few can. He is a professor of cardiology at the University of Bern, Switzerland, and he has devoted his professional life largely to the dwindling art of ECG interpretation. Keeping up a regular practise of clinical and invasive cardiology alongside has enabled him to correlate ECGs and real life at all times. At the dusk of his career he has sat down to convey his profound knowledge of electrocardiography to all those in the medical profession who use this key tool of the trade. Only few medical professionals have no interface whatsoever with electrocardiography. To all others who deal with the electrocardiograms occasionally or regularly, this book offers a unique opportunity to catch-up, to keep abreast, or even to excel in this domain.

The book is unique in its style as it is unique in its depth of practical information on carefully selected sub-headings of the topic. The illustrations remain faithful to the saying that a picture is worth a thousand words. Yet, wherever needed, text and tables are interspersed and the clinical, physiological or etiological background of depicted electrocardiographic changes are elucidated, for example in a comprehensive list of etiologies of electrolyte imbalances.

The examples of electrocardiograms are carefully selected out of a gargantuan gamut of real life ECGs accumulated in a large tertiary center over years. They are crisply reproduced, succinctly explained, and very often rendered absolutely fascinating by the added history of the patient concerned.

The witty two-layer structure of the book allows the matter-of-fact reader to take home whatever is needed (and a little more) in virtually no time, while the wizard finds tasty tidbits, passion, and joy in digging into the deeper level.

This book is the next best thing to hovering over real ECGs, fresh from the machine, together with a master of the art such as the author Marc Gertsch.

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- Professor Christopher Paul Cannon (Brigham and Women’s Hospital, Boston, USA) for writing the foreword.

August 2, 2003. Marc Gertsch



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# Abbreviations

The following abbreviations are used regularly throughout the text.

AAI pacing	Atrial inhibited atrial pacing
ACE	Angiotensin-converting enzyme
acPE	Acute pulmonary embolism
AF	Atrial fibrillation
AJT	Automatic junctional tachycardia
AMI	Acute myocardial infarction
AP or acP	Action potential
APB	Atrial premature beat
ÅQRS <sub>F</sub>	Mean QRS axis in the frontal plane
ASD	Atrial septal defect
AV	Atrioventricular
AVNRT	Atrioventricular nodal reentrant tachycardia
BVH	Biventricular hypertrophy
CABG	Aortocoronary bypass grafting
CAD	Coronary artery disease
CHD	Coronary heart disease
CK = CPK	Creatine kinase
CK-MB	Myocardial-bound creatine kinase
COPD	Chronic obstructive pulmonary disease
Coro	Coronary angiogram/coronary angiography. (In most cases 'Coro' also includes left ventricular angiography/-gram)
CPK	Creatine phosphokinase
CPR	Cardiopulmonary resuscitation
CT	Computerized tomography
CX	Circumflexa (circumflex branch of the left coronary artery)
DC	Direct current
DD	Differential diagnosis
DDD	Double chamber double inhibited (pacing)
ECG	Electrocardiogram
Echo	Echocardiogram/echocardiography (in most cases color Doppler is integrated)
EF	Ejection fraction (in most cases of the left ventricle)
EPI/EPG	Electrophysiologic investigation/study
HOCM	Hypertrophic obstructive cardiomyopathy

Htx	Xeno-transplantation of the heart
ICD	Implantable cardioverter defibrillator
INR	International normalized ratio (for oral anticoagulation)
LA	Left atrium/left atrial
LAD	Left anterior descending coronary artery = left anterior descending branch of the LCA
LAD	Left axis deviation ( $\angle QRS_F < -30^\circ$ )
LAFB	Left anterior fascicular block (= left anterior 'hemiblock')
LBBB	(Complete) left bundle branch block
LCA	Left coronary artery
LPFB	Left posterior fascicular block (= left posterior 'hemiblock')
LV	Left ventricle/left ventricular
LVH	Left ventricular hypertrophy
MET	Metabolic equivalents
MET	Maximal exercise test
MI	Myocardial infarction
MRI	magnetic resonance imaging
NSAID	Nonsteroidal anti-inflammatory agent
PA	Pulmonary artery
PE	Pulmonary embolism
PET	Positron emission tomography
PJRT	Permanent junctional reciprocating tachycardia
PTCA	Percutaneous coronary transluminal angioplasty
RA	Right atrium/right atrial
RBBB	(Complete) right bundle branch block
RCA	Right coronary artery
RV	Right ventricle/right ventricular
RVD	Right ventricular dysplasia
RVOT	Right ventricular outflow tract
SA	Sinoatrial
SACT	Sinoatrial conduction time
SN	Sinus node
SNRT	Sinus node recovery time
SPECT	Single proton emission computed tomography
SR	Sinus rhythm
SVPB	Supraventricular premature beat
SVT	Supraventricular tachycardia
SVTab	Supraventricular tachycardia with aberration
VPB	Ventricular premature beat
VSD	Ventricular septal defect
VT	Ventricular tachycardia
VVI	One-chamber ventricular (pacemaker)
VVI(R)	Ventricular inhibited ventricular pacing with rate responsiveness
WPW syndrome	Wolff-Parkinson-White syndrome