

CRC CRC Press
Taylor & Francis Group

WITH VITALSOURCE®
EBOOK

SECOND EDITION

Manual of Hypertension

of the European Society of Hypertension

EDITED BY

Giuseppe Mancia • Guido Grassi • Josep Redon



ESH European
Society of
Hypertension

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

© 2014 by Taylor & Francis Group, LLC
CRC Press is an imprint of Taylor & Francis Group, an Informa business

No claim to original U.S. Government works
Version Date: 20140317

International Standard Book Number-13: 978-1-84184-998-0 (eBook - PDF)

This book contains information obtained from authentic and highly regarded sources. While all reasonable efforts have been made to publish reliable data and information, neither the author[s] nor the publisher can accept any legal responsibility or liability for any errors or omissions that may be made. The publishers wish to make clear that any views or opinions expressed in this book by individual editors, authors or contributors are personal to them and do not necessarily reflect the views/opinions of the publishers. The information or guidance contained in this book is intended for use by medical, scientific or health-care professionals and is provided strictly as a supplement to the medical or other professional's own judgement, their knowledge of the patient's medical history, relevant manufacturer's instructions and the appropriate best practice guidelines. Because of the rapid advances in medical science, any information or advice on dosages, procedures or diagnoses should be independently verified. The reader is strongly urged to consult the relevant national drug formulary and the drug companies' printed instructions, and their websites, before administering any of the drugs recommended in this book. This book does not indicate whether a particular treatment is appropriate or suitable for a particular individual. Ultimately it is the sole responsibility of the medical professional to make his or her own professional judgements, so as to advise and treat patients appropriately. The authors and publishers have also attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

Except as permitted under U.S. Copyright Law, no part of this book may be reprinted, reproduced, transmitted, or utilized in any form by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information storage or retrieval system, without written permission from the publishers.

For permission to photocopy or use material electronically from this work, please access www.copyright.com (<http://www.copyright.com/>) or contact the Copyright Clearance Center, Inc. (CCC), 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400. CCC is a not-for-profit organization that provides licenses and registration for a variety of users. For organizations that have been granted a photocopy license by the CCC, a separate system of payment has been arranged.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

Visit the Taylor & Francis Web site at
<http://www.taylorandfrancis.com>

and the CRC Press Web site at
<http://www.crcpress.com>

Its predictive value was similar to that of R-R variability on spectral analysis. On which day after acute myocardial infarction heart rate has the greatest predictive power for mortality is not well known. According to the results of a study in a population of patients admitted to three hospitals in Italy, the predictive power of heart rate after admission increased progressively during the first week after admission to peak at the end of the week (35).

High heart rate has been found to be associated with cardiovascular mortality in patients with stable angina also (36). In an analysis of the Coronary Artery Surgery Study (CASS) performed in patients with chronic coronary artery disease divided into quintiles of resting heart rate, Diaz et al. found a close association of heart rate with mortality irrespective of age, gender, or previous cardiovascular disease (37). The relationship between heart rate and cardiovascular outcomes was investigated also in the placebo arm of the morbidity-mortality Evaluation of the If inhibitor ivabradine in patients with coronary disease and left ventricular dysfunction (BEAUTIFUL) trial, a large cohort of patients with stable coronary artery disease and left ventricular dysfunction (38). Patients with heart rates of 70 bpm or greater had an increased risk for cardiovascular death, admission to hospital for heart failure, admission to hospital for myocardial infarction, and coronary revascularization

between 60 and 70 bpm (18%), 71–90 bpm (20%), and >90 bpm (35%). High resting heart rate was an independent risk factor for mortality both in patients with and without beta-blocker treatment, indicating that beta-blocker use was not the explanation for the heart rate–mortality relationship. In the Danish Investigations and Arrhythmia ON Dofetilide (DIAMOND) study, the long-term prognostic importance of resting heart rate was investigated in patients hospitalized with left ventricular dysfunction in connection with either heart failure or myocardial infarction (44). During 10 years of follow-up, 72% of patients with myocardial infarction and 89% of those with heart failure died. In multivariable-adjusted models, baseline heart rate was associated with an increase in mortality in both patients with myocardial infarction and heart failure. In this study, the importance of resting heart rate on short-term prognosis was stronger in the myocardial infarction patients than in the heart failure patients ($P < 0.0001$ for interaction).

FOLLOW-UP HEART RATE IN CLINICAL STUDIES

In most epidemiologic studies, the association with cardiovascular outcomes or mortality was investigated only

26. Carnethon MR, Yan L, Greenland P, et al. Resting heart rate in middle age and diabetes development in older age. *Diabetes Care* 2008; 31:335–9.
27. Hillis GS, Woodward M, Rodgers A, et al. Resting heart rate and the risk of death and cardiovascular complications in patients with type 2 diabetes mellitus. *Diabetologia* 2012; 55:1283–90.
28. Hillis GS, Hata J, Woodward M, et al. Resting heart rate and the risk of microvascular complications in patients with type 2 diabetes mellitus. *J Am Heart Assoc* 2012; 1:e002832.
29. Thayer JF, Yamamoto SS, Brosschot JF. The relationship of autonomic imbalance, heart rate variability and cardiovascular disease risk factors. *Int J Cardiol* 2010; 141:122–31.
30. Honda T, Kanazawa H, Koga H, et al. Heart rate on admission is an independent risk factor for poor cardiac function and in-hospital death after acute myocardial infarction. *J Cardiol* 2010; 56:197–203.
31. Parodi G, Bellandi B, Valenti R, et al. Heart rate as an independent prognostic risk factor in patients with acute myocardial infarction undergoing primary percutaneous coronary intervention. *Atherosclerosis* 2010; 211:255–9.
32. Lee KL, Woodlief LH, Topol J, et al. Predictors of 30-day mortality in the era of reperfusion for acute myocardial infarction. Results from an international trial of 41,021 patients. *Circulation* 1995; 91:1659–68.
33. Zuanetti G, Mantini L, Hernandez-Bernal F, et al. Relevance of heart rate as a prognostic factor in patients with acute myocardial infarction: insights from the GISSI-2 study. *Eur Heart J* 1998; 19 (Suppl. F):F19–26.
34. Copie X, Hnatova K, Staunton A, et al. Predictive power of increased heart rate versus depressed left ventricular ejection fraction and heart rate variability for risk stratification after myocardial infarction. Results of a two-year follow-up study. *J Am Coll Cardiol* 1996; 27:270–6.
35. Berton G, Cordiano R, Palmieri R, et al. Heart rate during myocardial infarction: relationship with one-year global mortality in men and women. *Can J Cardiol* 2002; 18:495–502.
36. Palatini P. Heart rate: a strong predictor of mortality in subjects with coronary artery disease. *Eur Heart J* 2005; 26:943–5.
48. Mancia G, Parati G, Pomidossi G, et al. Alerting reaction and rise in blood pressure during measurement by physician and nurse. *Hypertension* 1987; 9:209–15.
49. Palatini P, Winnicki M, Santonastaso M, et al. Reproducibility of heart rate measured in the clinic and with 24-hour intermittent recorders. *Am J Hypertens* 2000; 13:92–8.
50. Hansen TW, Thijs L, Boggia J, et al. Prognostic value of ambulatory heart rate revisited in 6928 subjects from 6 populations. *Hypertension* 2008; 52:229–35.
51. Hozawa A, Inoue R, Ohkubo T, et al. Predictive value of ambulatory heart rate in the Japanese general population: the Ohasama study. *J Hypertens* 2008; 26:1571–6.
52. Ben-Dov IZ, Kark JD, Ben-Ishay D, et al. Blunted heart rate dip during sleep and all-cause mortality. *Arch Intern Med* 2007; 167:2116–21.
53. Palatini P, Reboldi G, Beilin LJ, et al. Predictive value of night-time heart rate for cardiovascular events in hypertension. The ABP-International study. *Int J Cardiol* 2013 [Epub ahead of print].
54. Sega R, Facchetti R, Bombelli M, et al. Prognostic value of ambulatory and home blood pressures compared with office blood pressure in the general population: follow-up results from the Pressioni Arteriose Monitorate e Loro Associazioni (PAMELA) study. *Circulation* 2005; 111:1777–83.
55. Hozawa A, Ohkubo T, Kikuya M, et al. Prognostic value of home heart rate for cardiovascular mortality in the general population: the Ohasama study. *Am J Hypertens* 2004; 17:1005–10.
56. Kannel WB, Brand N, Skinner JJ Jr, et al. The relation of adiposity to blood pressure and development of hypertension. *Ann Intern Med* 1967; 67:48–59.
57. Reed D, McGee D, Yano K. Biological and social correlates of blood pressure among Japanese men in Hawaii. *Hypertension* 1982; 4:406–14.
58. Shigetoh Y, Adachi H, Yamagishi S, et al. Higher heart rate may predispose to obesity and diabetes mellitus: 20-year prospective study in a general population. *Am J Hypertens* 2009; 22:151–5.
59. Nagaya T, Yoshida H, Takahashi H, et al. Resting heart rate and blood pressure, independent of each other, proportionally raise the