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Original research

Long-term survival benefit of ramipril in patients with acute myocardial infarction complicated by heart failure

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ABSTRACT

Aims ACE inhibition reduces mortality and morbidity in patients with heart failure after acute myocardial infarction (AMI). However, there are limited randomised data about the long-term survival benefits of ACE inhibition in this population.

Methods In 1993, the Acute Infarction Ramipril Efficacy (AIRE) study randomly allocated patients with AMI and clinical heart failure to ramipril or placebo. The duration of masked trial therapy in the UK cohort (603 patients, mean age=64.7 years, 455 male patients) was 12.4 and 13.4 months for ramipril (n=302) and placebo (n=301), respectively. We estimated life expectancy and extensions of life (difference in median survival times) according to duration of follow-up (range 0–29.6 years).

Results By 9 April 2019, death from all causes occurred in 266 (88.4%) patients in placebo arm and 275 (91.1%) patients in ramipril arm. The extension of life between ramipril and placebo groups was 14.5 months (95% CI 13.2 to 15.8). Ramipril increased life expectancy more for patients with than without diabetes (life expectancy difference 32.1 vs 5.0 months), previous AMI (20.1 vs 4.9 months), previous heart failure (19.5 vs 4.9 months), hypertension (16.6 vs 8.3 months), angina (16.2 vs 5.0 months) and age >65 years (11.3 vs 5.7 months). Given potential treatment switching, the true absolute treatment effect could be underestimated by 28%.

Conclusion For patients with clinically defined heart failure following AMI, ramipril results in a sustained survival benefit, and is associated with an extension of life of up to 14.5 months for, on average, 13 months treatment duration.

INTRODUCTION

Survival following acute myocardial infarction (AMI) remains a key objective for healthcare professionals and governments throughout the globe. Despite major advances in the emergency treatment and secondary prevention of AMI, a substantial proportion of patients with AMI develop heart failure,¹ which in turn is associated with high morbidity, mortality and healthcare expenditure.^{2–4}

Moreover, therapeutic inhibition of ACE has become an established strategy in the care of patients with AMI and heart failure.⁵ ACE inhibition reduces death and disease in patients with left ventricular systolic dysfunction, and coronary artery disease.^{6–8} In the Acute Infarction Ramipril

Efficacy (AIRE) study, ACE inhibition at an average follow-up time of 15 months after randomisation significantly reduced all-cause mortality, and continued to confer a survival benefit at 3 years following study closure in the AIRE Extension (AIREX) study.^{9–12} Further placebo-controlled survival studies testing the efficacy of ACE inhibition in patients with AMI and clinical heart failure are unlikely because withholding a treatment of accepted clinical value would be unethical. Therefore, in the AIRE survival (AIRE-S) study, we aimed to assess the long-term (29.6 years after randomisation) magnitude of impact on length of survival observed after treatment with ramipril (target dose 5 mg twice daily) when compared with placebo.

METHODS

Patients and design

The rationale, design, organisation, outcome definitions and results of the AIRE study have been published previously.^{10–12} This was an independent, multinational, multicentre, double-blind, randomised, placebo-controlled, parallel-group investigation into the potential benefits from treatment with the lipophilic ACE inhibitor ramipril (target dose 10 mg/day) following AMI complicated by clinical evidence of heart failure. When the trial was conducted, in 1993, all patients had an ECG and cardiac enzyme confirmation of AMI, and also evidence of transient or persisting heart failure as judged by the attending physician (chest X-ray evidence of left ventricular failure, or auscultatory evidence of pulmonary oedema, or a third heart sound in the presence of persistent tachycardia), usually sufficient to justify diuretic or vasodilator therapy. Patients were excluded if they had evidence of clinical instability, contraindications to the use of ACE inhibitor therapy, heart failure of primary valvular or congenital origin or overt heart failure deemed to require treatment with an open-label ACE inhibitor. After applying these entry criteria to consecutive patients admitted to the UK centres (30 centres), 44% of patients approached declined to give their consent to take part in the study. All 603 of the remaining patients were then randomised by telephone to receive masked treatment with either ramipril (titrated over 4 days to 5 mg twice daily) or a matching placebo. Treatment was started between 2 and 9 days after the onset of AMI. Patients initially received either 1.25 or 2.5 mg ramipril or

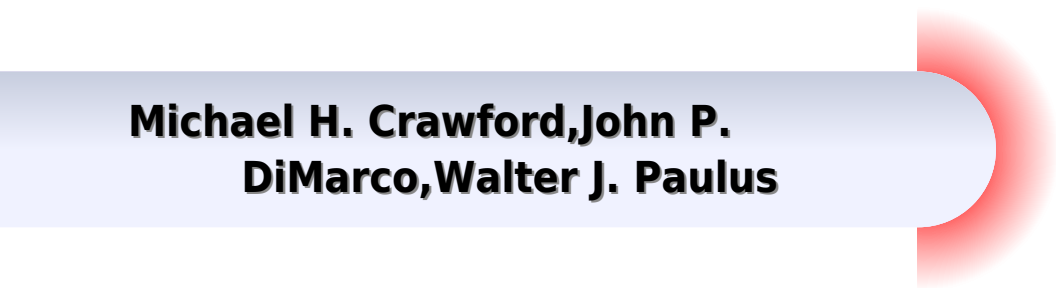


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Longterm Management Of Patients After Myocardial Infarction

**Michael H. Crawford, John P.
DiMarco, Walter J. Paulus**



Longterm Management Of Patients After Myocardial Infarction:

Long-Term Management of Patients After Myocardial Infarction C. Tissa Kappagoda,P. V. Greenwood,1987-11-01

Coronary Care Manual Peter L. Thompson,2010-12-03 The Coronary Care Manual has been designed as a practical manual for the management of the acute coronary patient and aims to achieve a balance between the large and rapidly changing evidence base and practical application in the CCU ICU ED and ambulance The book has been written by a group of Australian and international experts for medical nursing and paramedic staff working in these areas This edition covers a broad range of coronary care medicine in enough detail to eliminate the need to refer to a larger reference book providing a portable companion for a night on call Completely redesigned with new artwork the manual is organized to suit academics and practitioners alike covers a broad range of coronary care medicine provides specific advice on the management of common clinical problems eliminates the need to refer to a larger reference book features a consistent style and focus with standardised artwork for figures is now also available as an eBook A code inside the Coronary Care Manual enables a full text download allowing you to browse and search electronically make notes and bookmarks in the electronic files and highlight material

Principles and Practice of Geriatric Medicine M.S. John Pathy,Alan J. Sinclair,John E. Morley,2006-02-03 The fourth edition of the highly acclaimed Principles and Practice of Geriatric Medicine provides an account of the fundamental changes associated with ageing which are essential to our understanding and management of the elderly sick population The title has been extensively revised and updates to reflect the enormous changes in treatment options and medical conditions emerged since publication of the third edition Written by worldwide experts of international repute this is the most up to date and comprehensive single reference source currently available Principles Practice of Geriatric Medicine Fourth Edition incorporates More than 30 new chapters including Preventive geriatrics Anorexia of Aging Managements of Weight Loss Dehydration Vitamins and Minerals in the Elderly Cancer and Aging Mild Cognitive Impairment Treatment of Behavioral Disorders The Older Patient with Down s Syndrome Drug Abuse in Older People Breast Cancer Women s health A truly global perspective including new chapter on Care of the elderly in Israel old age in a young land Geriatric Medicine in China Geriatric medicine education in Europe Geriatrics from the European Union Perspective India Day Hospitals Perspectives from Latin America The title will be indispensable for all those involved in the treatment of older patients Gerontologists to keep up to date with the latest developments in the field General practitioners and specialists in health policy and community care who increasingly have to deal with a significant number of older people Academic researchers in geriatric medicine who are in need for an all encompassing reference work Medical registrars UK residents US in order to pass their exams Teachers of Geriatric Medicine Hospital libraries with increasing budgets to spend on much needed resource in this growing field Professionals within the pharmaceutical industry in order to monitor treatment options and new prescription developments

Cardiovascular Therapeutics E-Book Elliott M. Antman,2012-09-17 Manage cardiovascular problems

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Cumulated Index Medicus ,1994 **Drugs for the Heart E-Book** Lionel H. Opie,Bernard J. Gersh,2011-12-01 The new edition of this market leading cardiac drug resource equips you with the latest advances in cardiovascular pharmacology one of the most rapidly changing areas of medicine It not only offers in depth information on all of the drug classes used to treat heart disease but also covers new drug classes drug use for single and multiple problem management and more Dynamic full color drawings illustrate key pharmacological and physiological actions and a user friendly organization directs you to the information you need An increased emphasis on the practical use of drugs saves you valuable time in researching relevant information Features the practice proven experience of two well known editors who represent the best possible combination of clinical and research expertise in cardiovascular therapeutics Offers easy to access useful information on when to use each drug and for what conditions in a chapter entitled Which Drug for Which Disease Discusses the management of single diseases and multiple comorbidities Summarizes each drug class at the end of chapters to expedite reference Incorporates all new drugs preparations and clinical trial data in each chapter equipping you to make the most up to date informed clinical decisions Offers expanded coverage of comorbid diseases through new chapters on metabolic syndrome hyperglycemia and diabetes Features an increased emphasis on the practical use of drugs through highlighted sections and key illustrations saving you time in searching for relevant information Presents the work of several new contributors who represent a broad international perspective to equip you with a global view of cardiovascular pharmacology **Index Medicus** ,2001

Geriatric Medicine Christine K. Cassel, Rosanne Leipzig, Harvey Jay Cohen, Eric B. Larson, Diane E. Meier, 2006-05-29

Since the publication of the third edition of Geriatric Medicine extraordinary advances have occurred in the science of aging and the potential for biomedical research to give us answers to many if not most of the age related disorders that threaten the quality of life in older years At the most basic level the successful mapping of the human genome was declared complete in the fall of 2000 Understanding the map of the human genome is as important as understanding the map of genomes of important laboratory species ranging from the microscopic worms and fruit flies used in most classic genetic studies to rodents such as laboratory mice and eventually to primates on which much of the research on the aging human brain is done The genetic maps of all of these species including our own does not answer clinical questions but it does open the door to dramatic rapid and efficient answers to questions about the genetic polymorphisms related to diseases in humans The telomerase story also unfolded since the third edition Telomerase is an enzyme responsible for maintaining the telomeres the redundant DNA portions at the end of chromosomes whose shortening seems to be linked directly to cell senescence apoptosis and the control over cell death which at the level of the individual cell seems to be linked to the decline of organ function and eventually aging and death within the organism

Reichel's Care of the Elderly Christine Arenson, Jan Busby-Whitehead, Kenneth Brummel-Smith, James G. O'Brien, Mary H. Palmer, William Reichel, 2009-02-09 The sixth edition remains the pioneering text for the practising physician confronted with the unique problems of an increasingly elderly population Dr William Reichel's formative text is designed as a practical and useful guide for health specialists from medical students to practicing physicians This book is not a collection of subspecialty chapters but rather emphasizes the clinical management of the geriatric patient with simple to complex problems The editors have reviewed every chapter and have included the most up to date advances in the care of the elderly New chapters include hormonal therapy in post menopausal women drug therapy for Alzheimer's sufferers alternative medicine the chronic understaffing of nursing homes management of delirium and ethical issues Comprehensive and written for any clinicians caring for older patients including family physicians general internists nurse practitioners geriatricians and other specialists this esteemed text provides practical and trusted advice

Hemostasis and Thrombosis Victor J. Marder, William C. Aird, Joel S. Bennett, Sam Schulman, Gilbert C. White, II, 2012-12-27 Since publication of the First Edition in 1982 Hemostasis and Thrombosis has established itself as the pre eminent book in the field of coagulation disorders No other book is as inclusive in scope with coverage of the field from the standpoint of both basic scientists and clinicians This comprehensive resource details the essentials of bleeding and thrombotic disorders and the management of patients with these and related problems and delivers the most up to date information on normal biochemistry and function of platelets or endothelial cells as well as in depth discussions of the pharmacology of anticoagulant fibrinolytic and hemostatic drugs NEW to the Sixth Edition A new team of editors each a leader in his field assures you of fresh authoritative perspectives Full color throughout A companion website that offers full

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Handbook of Cerebrovascular Diseases, Revised and Expanded Harold P. Adams, 2004-10-29 Spanning a wide array of topics relating to the diagnosis and treatment of cerebrovascular disease this reference collects the latest studies and recommendations from a team of 75 leading authorities on the subject including the management of subarachnoid hemorrhage the treatment of acute ischemic stroke and aneurysms and surgical interventions

Cardiology E-Book Michael H. Crawford, John P. DiMarco, Walter J. Paulus, 2009-09-18 With your heavy case load you can t afford to waste time searching for answers Cardiology 3rd Edition by Drs Crawford DiMarco and Paulus offers you just the practical problem based guidance you need to quickly overcome any clinical challenge 8 color coded sections cover the 8 major clinical syndromes of cardiovascular disease each section a virtual mini textbook on its topic 40 new chapters keep you up to date with the latest advances in the field while more than 2 000 lavish high quality illustrations color photographs tables and ECGs capture clinical manifestations as they present in practice It s current actionable information that you can put to work immediately for your patients Offers a problem based approach that integrates basic science diagnostic investigations and therapeutic management in one place for each cardiovascular disease so you can quickly find all of the actionable knowledge you need without flipping from one section to another Features introductory bulleted highlights in each chapter that present the most pertinent information at a glance Presents abundant algorithms to expedite clinical decision making Includes more than 2 000 lavish high quality illustrations color photographs tables and ECGs that capture clinical manifestations as they present in practice and promote readability and retention Includes 40 new chapters including Inherited Arrhythmia Syndromes Implantable Cardioverter Defibrillators and Cardiac Resynchronization Therapy in CHD Management of the Cyanotic Patient with CHD Special Problems for the Cardiology Consultant Dealing with Bariatric Gastric Bypass and many more that equip you with all of the latest knowledge Presents Special Problem sections many new to this edition that provide practical advice on problems that can be difficult to treat

Reichel's Care of the Elderly Jan Busby-Whitehead, Samuel C. Durso, Christine Arenson, Mary H. Palmer, Rebecca Elon, William Reichel, 2022-07-21 A clinical guide for all health specialists offering practical relevant and comprehensive information on managing the elderly patient

Critical Pathways in Cardiovascular Medicine Christopher P. Cannon, Patrick T. O'Gara, 2007 Full text medical e book

Multimodality Imaging in Cardiovascular Medicine Christopher M. Kramer, 2010-10-19 A Doody s Core Title 2012 New applications of echocardiography nuclear magnetic resonance cardiovascular magnetic resonance and cardiac computed tomography are rapidly developing and it is imperative that trainees and practitioners alike remain up to date in the latest developments It is becoming increasingly

difficult to remain abreast of these advances in each individual modality and thus it is no longer practical to focus on one at a time. In addition, training guidelines are changing and multimodality training has become the norm. **Multimodality Imaging in Cardiovascular Medicine** presents a clear and in-depth review of the available technologies and evidence supporting their appropriate clinical applications. Hundreds of outstanding images are included to support and augment the discussions from the leading experts in each modality. For maximum clinical value, rather than organize the content by imaging modality, the book is organized by disease so that the reader can utilize the book in real-time problem solving and decision making in daily clinical practice. Features of **Multimodality Imaging in Cardiovascular Medicine** include more than 350 multimodality imaging examples of cardiovascular pathophysiology. Corresponding text places the images into context at the interface with patient care. State-of-the-art chapters contributed by the leading imaging experts.

Sabiston Textbook of Surgery E-Book
 Courtney M. Townsend Jr., R. Daniel Beauchamp, B. Mark Evers, Kenneth L. Mattox, 2015-05-26
 LIC Sabiston Textbook of Surgery

Braunwald's Heart Disease E-Book
 Robert O. Bonow, Douglas L. Mann, Douglas P. Zipes, Peter Libby, 2011-02-25

Braunwald's Heart Disease remains your indispensable source for definitive state-of-the-art answers on every aspect of contemporary cardiology. Edited by Drs Robert O. Bonow, Douglas L. Mann, Douglas P. Zipes, and Peter Libby, this dynamic multimedia reference helps you apply the most recent knowledge in molecular biology and genetics, imaging, pharmacology, interventional cardiology, electrophysiology, and much more. Weekly updates online, personally selected by Dr. Braunwald, continuously keep you current on the most important new developments affecting your practice. Enhanced premium online content includes new dynamic cardiac imaging videos, heart sound recordings, and podcasts. With sweeping updates throughout and contributions from a who's who of global cardiology, **Braunwald's** is the cornerstone of effective practice. Continuously access the most important new developments affecting your practice with weekly updates personally selected by Dr. Braunwald, including focused reviews, hot off the press commentaries, and late-breaking clinical trials. Practice with confidence and overcome your toughest challenges with advice from the top minds in cardiology today who synthesize the entire state of current knowledge and summarize all of the most recent ACC/AHA practice guidelines. Locate the answers you need fast thanks to a user-friendly, full-color design with more than 1,200 color illustrations. Search the complete contents online at www.expertconsult.com. Stay on top of the latest advances in molecular imaging, intravascular ultrasound, cardiovascular regeneration, and tissue engineering; device therapy for advanced heart failure; atrial fibrillation management; structural heart disease; Chagas heart disease; ethics in cardiovascular medicine; the design and conduct of clinical trials; and many other timely topics. Hone your clinical skills with new dynamic cardiac imaging videos, heart sound recordings, and podcasts at www.expertconsult.com.

Acute Coronary Syndromes: A Companion to Braunwald's Heart Disease E-Book
 Pierre Theroux, 2010-09-24

Acute Coronary Syndromes: A Companion to Braunwald's Heart Disease covers the state-of-the-art scientific and clinical information you need to rapidly evaluate and manage acute coronary syndromes. Dr. Pierre

Theroux and his team of expert contributors present advances in diagnostic and imaging techniques such as biomarkers nuclear cardiology echocardiography and multislice CT secondary prevention and new antiplatelet anti ischemic and gene therapies Tap into the most definitive knowledge available from one of the leading experts in the field and a stellar cast of contributors Understand the special considerations for the care of acute coronary syndromes in the emergency department and the coronary care unit Effectively handle the treatment of special populations and chronic patients thanks to coverage of these challenges See techniques and procedures in greater detail and clarity through the all new full color design Approach treatment with a global perspective from the new section on Population Based Perspective that discusses the INTERHEART study insights from the REACH registry lessons learned from European registries and ACS in North America Gain a comprehensive understanding of ACS through coverage of pathophysiology molecular mechanisms the role of the immune system and brand new chapters on cell necrosis and cell regeneration and pharmacogenetics in the section on Disease Based Perspectives Integrate the latest testing and treatment techniques into your practice thanks to new chapters on biomarkers in acute ischemic heart disease the role of noninvasive testing in prognostic risk stratification the culprit lesions and patient at risk non responsiveness to antiplatelet therapy bleeding in the acute coronary syndromes and the refractory patient

Stem Cell and Gene Therapy for Cardiovascular Disease Emerson c. Perin, Leslie W. Miller, Doris Taylor, James T. Willerson, 2015-08-21 Stem Cell and Gene Therapy for Cardiovascular Disease is a state of the art reference that combines in one place the breadth and depth of information available on the topic As stem cell and gene therapies are the most cutting edge therapies currently available for patients with heart failure each section of the book provides information on medical trials from contributors and specialists from around the world including not only what has been completed but also what is planned for future research and trials Cardiology researchers basic science clinicians fellows residents students and industry professionals will find this book an invaluable resource for further study on the topic Provides information on stem and gene therapy medical trials from contributors and specialists around the world including not only what has been completed but also what is planned for future research and trials Presents topics that can be applied to allogeneic cells mesenchymal cells gene therapy cardiomyocytes iPS cells MAPC s and organogenesis Covers the three areas with the greatest clinical trials to date chronic limb ischemia chronic angina and acute MI Covers the prevailing opinions on how to harness the body s natural repair mechanisms Ideal resource for cardiology researchers basic science clinicians fellows residents students and industry professionals

Coronary Care Medicine E. Antman, J.D. Rutherford, 2012-12-06 Attention to reducing the major risk factors Contemporary coronary care involves a associated with the development of arterio multitude of measures efforts to prevent the sclerosis has been widespread and appears to acute event thrombolytic therapy to abort have lowered the incidence of coronary artery infarction pharmacological measures to delay disease Nevertheless acute myocardial and reduce ischemic cell death monitoring of infarction and related ischemic syndromes the hemodynamic consequences of myocardial represent

the most common causes of death as infarction treatment of acute pump failure use well as one of the principal reasons for of modern electrical devices as well as a large hospitalization in the industrialized world In number of new drugs to prevent and treat light of this care of the patient with acute cardiac arrhythmias and finally identification coronary disease remains a major medical prior to hospital discharge of patients who are at challenge high risk for recurrent infarction or sudden The approach to managing patients with death and the choice of the appropriate acute myocardial infarction can be said to have management approach evolved through three major phases For the This fine book provides comprehensive first half century after Herrick s landmark descriptions of these various aspects of paper describing this condition was published in contemporary coronary care It is accurate 1912 management consisted primarily of thorough and easily readable

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Table of Contents Longterm Management Of Patients After Myocardial Infarction

1. Understanding the eBook Longterm Management Of Patients After Myocardial Infarction
 - The Rise of Digital Reading Longterm Management Of Patients After Myocardial Infarction
 - Advantages of eBooks Over Traditional Books
2. Identifying Longterm Management Of Patients After Myocardial Infarction
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Longterm Management Of Patients After Myocardial Infarction
 - User-Friendly Interface
4. Exploring eBook Recommendations from Longterm Management Of Patients After Myocardial Infarction
 - Personalized Recommendations
 - Longterm Management Of Patients After Myocardial Infarction User Reviews and Ratings
 - Longterm Management Of Patients After Myocardial Infarction and Bestseller Lists
5. Accessing Longterm Management Of Patients After Myocardial Infarction Free and Paid eBooks
 - Longterm Management Of Patients After Myocardial Infarction Public Domain eBooks
 - Longterm Management Of Patients After Myocardial Infarction eBook Subscription Services

- Longterm Management Of Patients After Myocardial Infarction Budget-Friendly Options
- 6. Navigating Longterm Management Of Patients After Myocardial Infarction eBook Formats
 - ePub, PDF, MOBI, and More
 - Longterm Management Of Patients After Myocardial Infarction Compatibility with Devices
 - Longterm Management Of Patients After Myocardial Infarction Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Longterm Management Of Patients After Myocardial Infarction
 - Highlighting and Note-Taking Longterm Management Of Patients After Myocardial Infarction
 - Interactive Elements Longterm Management Of Patients After Myocardial Infarction
- 8. Staying Engaged with Longterm Management Of Patients After Myocardial Infarction
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Longterm Management Of Patients After Myocardial Infarction
- 9. Balancing eBooks and Physical Books Longterm Management Of Patients After Myocardial Infarction
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Longterm Management Of Patients After Myocardial Infarction
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Longterm Management Of Patients After Myocardial Infarction
 - Setting Reading Goals Longterm Management Of Patients After Myocardial Infarction
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Longterm Management Of Patients After Myocardial Infarction
 - Fact-Checking eBook Content of Longterm Management Of Patients After Myocardial Infarction
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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