

500426

# CARDIOLOGY UPDATE

Reviews for Physicians

1983 Edition

Elliot Rapaport, M.D.

*Editor-in-Chief*

500426

# **CARDIOLOGY UPDATE**

## **Reviews for Physicians**

1983 Edition

500427

**Elliot Rapaport, M.D.**  
*Editor-in-Chief*

Professor of Medicine  
University of California, San Francisco  
Chief, Cardiology Service  
San Francisco General Hospital  
San Francisco, California



**ELSEVIER BIOMEDICAL**  
New York • Amsterdam • Oxford

Elsevier Science Publishing Co., Inc.  
52 Vanderbilt Avenue, New York, New York 10017

Sole distributors outside the United States and Canada:

Elsevier Science Publishers B.V.  
P.O. Box 211, 1000 AE Amsterdam, The Netherlands

© 1983 by Elsevier Science Publishing Co., Inc.

ISBN: 0-444-00763-6  
ISSN: 0163-1675

Manufactured in the United States of America

## PREFACE

CARDIOLOGY UPDATE 1983 is the third in a series designed to present topics of current interest in Cardiology. These reviews are written in a manner to stimulate not only the interest of the cardiologist and cardiovascular surgeon but also internists, pediatricians, cardiology trainees, housestaff, and students. The articles are not intended to present the authors' own recent research work but rather to review the state-of-the-art as of 1983. The authors are outstanding authorities who have made many major contributions in their field.

CARDIOLOGY UPDATE 1983 compliments the previous volumes published in 1979 and 1981 and covers subjects not dealt with in-depth in these earlier editions. The 1983 volume goes into detail on the new procedure of coronary angioplasty, covers the area of arteriographic assessment of coronary disease, introduces the interesting area of intra-operative evaluation of coronary obstructions, reassesses exercise stress testing, deals with recent advances in diagnosis and management of peripheral vascular disease, presents the role of surgery in acute ischemic states, reviews the always fascinating topic of hypertrophic obstructive cardiomyopathy, looks at newer aspects of sinus node disease and bundle branch block, updates the present status of the antiarrhythmic drug, bretylium, covers a number of important areas in the field of hypertension including the problem of management in the very young and the

very old, and concludes with a discussion of contrast echocardiography. We believe that all of these areas will be of interest to the practicing physician.

The Editors, once again, wish to invite your comments and criticisms. We would especially be indebted for your suggestions for topics that would be of interest for future volumes.

Elliot Rapaport, M.D.

CARDIOLOGY UPDATE 1983 is the third in a series designed to present topics of current interest in Cardiology. These reviews are written in a manner to stimulate not only the interest of the cardiologist and cardiovascular surgeon but also internists, pediatricians, cardiologists, nurses, hospitalists, and students. The studies are not intended to present the authors' own recent research work but rather to review the state-of-the-art as of 1983. The authors are outstanding authorities who have made many major contributions to their field.

CARDIOLOGY UPDATE 1983 complements the previous volumes published in 1979 and 1981 and covers subjects not dealt with in-depth in these earlier editions. The 1983 volume goes into detail on the new procedure of coronary angioplasty, covers the area of arteriovenous assessment of coronary disease, introduces the interesting area of intraoperative evaluation of coronary obstructions, reassesses exercise stress testing, deals with recent advances in diagnosis and management of peripheral vascular disease, presents the role of surgery in acute ischemic states, reviews the always fascinating topic of hypertrophic obstructive cardiomyopathy, looks at newer aspects of valvular disease and heart transplantation, updates the present status of the angiotensin converting enzyme, covers a number of important areas in the field of hypertension including the problem of management in the very young and the

## CONTRIBUTORS

**JOSEPH A. ABBOTT, M.D.**

Clinical Professor of Medicine, University of California, San Francisco, Bishop, California

**JEFFREY L. ANDERSON, M.D., F.A.C.C.**

Associate Professor of Internal Medicine (Cardiology), University of Utah College of Medicine, Salt Lake City, Utah

**JOHN J. BERGAN, M.D.**

Magerstadt Professor of Surgery and Chief, Division of Vascular Surgery, Northwestern University Medical School, Chicago, Illinois; Attending Surgeon, Northwestern Memorial Hospital, Chicago, Illinois

**EDWARD L. BOLSON, M.S.C.S.**

Director, Cardiovascular Computation Laboratory, University of Washington School of Medicine, Seattle, Washington

**B. GREG BROWN, M.D., Ph.D.**

Associate Professor of Medicine, University of Washington, Seattle, Washington; Established Investigator, American Heart Association

**JOHN J. COGAN, M.D., F.A.C.C.**

Assistant Professor of Medicine, John A. Burns, University of Hawaii Medical School, Honolulu, Hawaii



**WILLARD M. DAGGETT, M.D.**

Professor of Surgery, Harvard Medical School, Boston, Massachusetts; Visiting Surgeon, Massachusetts General Hospital, Boston, Massachusetts

**JAWAHAR DESAI, M.D.**

Assistant Clinical Professor of Medicine, University of California, San Francisco, California; Assistant Chief of Cardiology, Valley Medical Center, Fresno, California

**HAROLD T. DODGE, M.D.**

Professor of Medicine, Director, Cardiovascular Research and Training Center, University of Washington School of Medicine, Seattle, Washington

**DONALD B. DOTY, M.D.**

Professor of Surgery, Division of Thoracic-Cardiovascular Surgery, Department of Surgery, The University of Iowa Hospitals and Clinics, Iowa City, Iowa

**HARRIET P. DUSTAN, M.D.**

Director, Cardiovascular Research and Training Center, University of Alabama, Birmingham, Alabama

**CHARLES L. EASTHAM, B.A.**

Department of Internal Medicine, Cardiovascular Division, The University of Iowa Hospitals and Clinics, Iowa City, Iowa

**RAY W. GIFFORD, JR., M.D.**

Chairman, Department of Hypertension and Nephrology, The Cleveland Clinic Foundation, Cleveland, Ohio

**AUGUSTUS GRANT, M.B., Ch.B., Ph.D.**

Division of Cardiology, Duke University Medical Center, Durham, North Carolina

**ANDREAS R. GRUENTZIG, M.D.**

Department of Medicine (Cardiology), Emory University Hospital and Clinic, Atlanta, Georgia

**JOHN P. HARRIS, F.R.C.S., F.R.A.C.S.**

Senior Lecturer in Surgery, University of Sydney, Sydney, Australia

**LOREN F. HIRATZKA, M.D.**

Assistant Professor of Surgery, Division of Thoracic-Cardiovascular Surgery, Department of Surgery, The University of Iowa Hospitals and Clinics, Iowa City, Iowa

**MARK S. HOCHBERG, M.D.**

Chief Resident in Cardiothoracic Surgery, Massachusetts General Hospital, Boston, Massachusetts

**NORMAN M. KAPLAN, M.D.**

Professor of Internal Medicine, University of Texas Southwestern Medical School, Dallas, Texas

**CHARLES R. KERR, M.D.**

Assistant Professor, Division of Cardiology, Department of Medicine, University of British Columbia, Vancouver, British Columbia, Canada

**MELVIN L. MARCUS, M.D.**

Professor of Medicine, Cardiology Division, Department of Medicine, The University of Iowa Hospitals and Clinics and Veterans Administration Hospitals, Iowa City, Iowa

**RICHARD S. MELTZER, M.D.**

Director, Noninvasive Laboratory, Cardiology Division, Mt. Sinai Medical Center, New York City, New York

**RICHARD K. MYLER, M.D.**

Associate Clinical Professor of Medicine, University of California, San Francisco, San Francisco, California; Medical Director, San Francisco Heart Institute, San Francisco, California

**SUZANNE OPARIL, M.D.**

Professor of Medicine, Associate Professor of Physiology and Biophysics, The University of Alabama in Birmingham, Birmingham, Alabama

**ROBERT W. PETERS, M.D.**

Director, Coronary Care Unit, Baltimore Veterans Administration Medical Center, Baltimore, Maryland; Associate Professor of Medicine, University of Maryland School of Medicine, Baltimore, Maryland

**ROBERT B. PETERSEN, Ph.D.**

Statistical Associate, Cardiology Section, Veterans Administration Wadsworth Hospital Center, Los Angeles, California

**CYNTHIA D. PIERCE, B.S.**

Laboratory Research Associate, Cardiology Section, Veterans Administration Wadsworth Hospital Center, Los Angeles, California

**JOS ROELANDT, M.D.**

Director, Division of Clinical Echocardiography, Thoraxcenter, Erasmus University, Rotterdam, The Netherlands

**NEIL D. RUDO, Ph.D., M.D.**

Redwood Clinic, Redwood, California

**MARY JANE SAUVÉ, M.S., R.N.**

Clinical Research Associate, University of California, San Francisco, San Francisco, California

**MELVIN M. SCHEINMAN, M.D.**

Professor of Medicine, University of California, San Francisco, San Francisco, California

**PRAVIN M. SHAH, M.D.**

Professor of Medicine and Chief, Cardiology Division, Wadsworth Veterans Administration Medical Center/University of California, Los Angeles School of Medicine, Los Angeles, California

**L. THOMAS SHEFFIELD, M.D.**

Professor of Medicine, Director, Noninvasive Cardiovascular Diagnostic Laboratories, The University of Alabama in Birmingham, Birmingham, Alabama



**SIMON H. STERTZER, M.D., F.A.C.C.**

Chief, Hemodynamics Laboratory, Lenox Hill Hospital, New York City, New York;  
Associate Professor of Clinical Medicine, New York Medical College, New York City,  
New York

**HAROLD C. STRAUSS, M.D., C.M.**

Division of Cardiology, Department of Medicine and Department of Pharmacology,  
Duke University Medical Center, Durham, North Carolina

**THOMAS L. WENGER, M.D.**

Division of Cardiology, Department of Medicine and Department of Pharmacology,  
Duke University Medical Center, Durham, North Carolina; Senior Clinical Research  
Scientist, Burroughs & Wellcome Company, Durham, North Carolina

**CARL W. WHITE, M.D.**

Director, Cardiac Catheterization Laboratory, Cardiovascular Division, Department of  
Internal Medicine, University of Iowa Hospitals and Clinics, Iowa City, Iowa

**KATHERINE WILLIAMS, B.S.**

Department of Medicine, University of California, San Francisco, San Francisco,  
California

**SHERRY R. WINTERITZ, M.D.**

Instructor in Medicine, The University of Alabama in Birmingham, Birmingham,  
Alabama

**CREIGHTON B. WRIGHT, M.D.**

Professor of Surgery, Division of Thoracic-Cardiovascular Surgery, Department of  
Surgery, The University of Iowa Hospitals and Clinics, Iowa City, Iowa

**JAMES S.T. YAO, M.D., Ph.D.**

Professor of Surgery, Northwestern University Medical School, Chicago, Illinois;  
Attending Surgeon and Director, Blood Flow Laboratory, Northwestern Memorial  
Hospital, Chicago, Illinois

# CONTENTS

Preface	ix
Contributors	ix
<b>CORONARY ANGIOPLASTY</b>	1
Richard K. Myler, M.D., Andreas R. Gruentzig, M.D., and Simon H. Stertz, M.D.	
History	1
Technique and Technology	5
Clinical Findings	18
Clinical and Anatomic Indications	24
Discussion	27
The Future	59
<b>ARTERIOGRAPHIC ASSESSMENT OF CORONARY DISEASE: ADVANTAGES, LIMITATIONS, AND CLINICAL USES OF A COMPUTER-ASSISTED METHOD</b>	67
B. Greg Brown, M.D., Ph.D., Robert B. Petersen, Ph.D., Cynthia D. Pierce, B.S., Edward L. Bolson, M.S.C.S., and Harold T. Dodge, M.D.	
Clinical Objectives of Arteriography	68
Technical Aspects of Arteriographic Image Quality	70
Consideration of Pathophysiologic Mechanisms	71

Current Clinical Analysis of Arteriographic Information	71
Quantitative Analysis of Arteriographic Information	74
Clinical Investigation Using Computer-assisted Angiometry	82
<b>INTRAOPERATIVE EVALUATION OF THE FUNCTIONAL SIGNIFICANCE OF CORONARY OBSTRUCTIONS</b>	<b>99</b>
Creighton B. Wright, M.D., Charles L. Eastham, B.A., Donald B. Doty, M.D., Loren F. Hiratzka, M.D., Carl W. White, M.D., and Melvin L. Marcus, M.D.	
Clinical Evaluation of the Physiologic Significance of Coronary Obstructions	100
A Doppler System for Studying Coronary Blood Flow Velocity in Patients	102
Studies of Phasic Coronary Blood Flow Velocity and Coronary Reactive Hyperemia in Humans	106
Studies in Patients with Coronary Artery Disease	109
Limitations	114
Goals	115
<b>REASSESSMENT OF EXERCISE STRESS TESTING</b>	<b>119</b>
L. Thomas Sheffield, M.D.	
Changing Concepts	119
Methods of Exercise Stress Testing	125
Interpretation of Exercise Test Results	131
Recommended Exercise Test Protocol	138
<b>RECENT ADVANCES IN THE DIAGNOSIS AND TREATMENT OF PERIPHERAL ARTERIAL AND VENOUS DISORDERS</b>	<b>151</b>
John P. Harris, M.D., Neil D. Rudo, Ph.D., M.D., James S.T. Yao, M.D., Ph.D., and John J. Bergan, M.D.	
Occlusive Arterial Disease	151
Aneurysmal Arterial Disease	156
Embolization	157
Venous Disorders	158
Extracranial Cerebrovascular Disease	160
Conclusions	161
<b>THE ROLE OF SURGERY IN ACUTE ISCHEMIC STATES</b>	<b>163</b>
Mark S. Hochberg, M.D., and Willard M. Daggett, M.D.	
Acute Unstable Angina	164
Acute Infarction	166
Cardiogenic Shock	167
Postinfarction Ventricular Septal Defects	168
Mitral Valve Incompetence Secondary to Acute Ischemia	170
<b>HYPERTROPHIC OBSTRUCTIVE CARDIOMYOPATHY</b>	<b>175</b>
Pravin M. Shah, M.D.	
Pathology	175
Pathophysiology	177
Etiology	178
Natural History	179
Clinical Features	180
Laboratory Diagnosis	185
Management	189

<b>CURRENT DIAGNOSTIC AND THERAPEUTIC MANEUVERS IN PATIENTS WITH SINUS NODE DISEASE</b>	<b>19</b>
Harold C. Strauss, M.D., C.M., Thomas L. Wenger, M.D., Charles R. Kerr, M.D., Augustus O. Grant, M.B., Ch.B., Ph.D., and Melvin M. Scheinman, M.D.	
Noninvasive Evaluation	194
Invasive Electrophysiologic Evaluation	196
Evaluation of Carotid Sinus Hypersensitivity	208
Clinical Use of Provocative Tests	209
Treatment	211
Summary	212
 <b>BUNDLE BRANCH BLOCK: ANATOMIC, ELECTROPHYSIOLOGIC, AND CLINICAL CORRELATES</b>	 <b>219</b>
Robert W. Peters, M.D., Melvin M. Scheinman, M.D., Mary Jane Sauvé, R.N., M.S., Katherine Williams, B.S., Jawahar Desai, M.D., Joseph Abbott, M.D., and John Cogan, M.D.	
Anatomy	219
Histopathology	220
Electrocardiographic Diagnosis of Bundle Branch Block	221
Fascicular Blocks	223
Electrophysiology of the Atrioventricular Conduction System	224
Bundle Branch Block and Acute Myocardial Infarction	227
Chronic Bundle Branch Block	231
Summary	236
 <b>BRETYLIUM: AN UPDATE ON PHARMACOKINETIC STUDIES AND CLINICAL USES</b>	 <b>241</b>
Jeffrey L. Anderson, M.D.	
Hemodynamic Effects	242
Electrophysiologic Effects	243
Kinetics of Antifibrillatory Effects: Correlation with Myocardial Drug	244
Pharmacokinetics of Bretylium in Humans	246
Dosage and Administration	252
Adverse Effects and Contraindications	254
Clinical Results and Recommended Uses	255
Related Antiarrhythmic Drugs	259
 <b>NONPHARMACOLOGIC TREATMENT OF HYPERTENSION</b>	 <b>265</b>
Norman M. Kaplan, M.D.	
The Rationale for Nonpharmacologic Therapy	266
Caloric Restriction	269
Dietary Sodium Restriction	270
Relaxation Therapy	275
Exercise	277
Alcohol	278
Surgical Procedures	278
The Problem of Compliance	279
Summary	279

<b>SALT AND HYPERTENSION</b>	285
Harriet P. Dustan, M.D.	
Epidemiologic Studies	286
Salt and Human Hypertension	289
Salt Loading in Normotension	293
Salt and Experimental Models of Hypertension	295
Mechanisms of Salt-dependent Hypertension	298
<b>TREATMENT OF SYSTOLIC HYPERTENSION IN THE ELDERLY</b>	307
Ray W. Gifford, Jr., M.D.	
Definitions	307
Prevalence of Hypertension in the Elderly	308
Is It Normal for Blood Pressure to Increase with Age?	309
Prognosis	309
Pathophysiology	310
Management	313
Summary	319
<b>THE EVALUATION AND MANAGEMENT OF HYPERTENSION IN CHILDREN AND ADOLESCENTS</b>	323
Sherry R. Winternitz, M.D., and Suzanne Oparil, M.D.	
Definition of the Problem	323
When and How to Measure Blood Pressure in Children	324
The Diagnostic Evaluation of the Hypertensive Child	325
Guidelines for Treatment of "Essential" Hypertension	331
Summary and Conclusions	337
<b>CONTRAST ECHOCARDIOGRAPHY</b>	339
Richard S. Meltzer, M.D., and Jos Roelandt, M.D.	
Clinical Applications of Contrast Echocardiography	341
Future Possibilities	347
Conclusions	348
<b>Index</b>	353

# CORONARY ANGIOPLASTY

Richard K. Myler, M.D.

Andreas R. Gruentzig, M.D. and

Simon H. Stertzer, M.D.

## HISTORY

Interventional angiocardiology had its inception in Eberswald, Germany, in 1929, when Forssman,<sup>27</sup> looking for "a safer approach for intracardiac drug injection," placed a catheter from his basilic vein into his right atrium. Although this experiment met with consideration skepticism by the medical community, the era of invasive cardiology had begun.

Since then, the cardiovascular catheter has been primarily a diagnostic tool, although interest in its use as a therapeutic agent has continued. Catheters have been used to create intra-atrial communications in transposition of the great vessels,<sup>90</sup> to close patent ductus arteriosus<sup>85,93</sup> and certain atrial septal defects,<sup>67</sup> to interrupt inferior vena caval return in patients with recurrent pulmonary embolic disease,<sup>77</sup> and to treat atrioventricular block with a variety of ingenious pacemaker devices.

From the Departments of Medicine (Cardiology), University of California, San Francisco, California, Emory University Hospital and Clinic, Atlanta, Georgia, and Lenox Hill Hospital, New York, New York



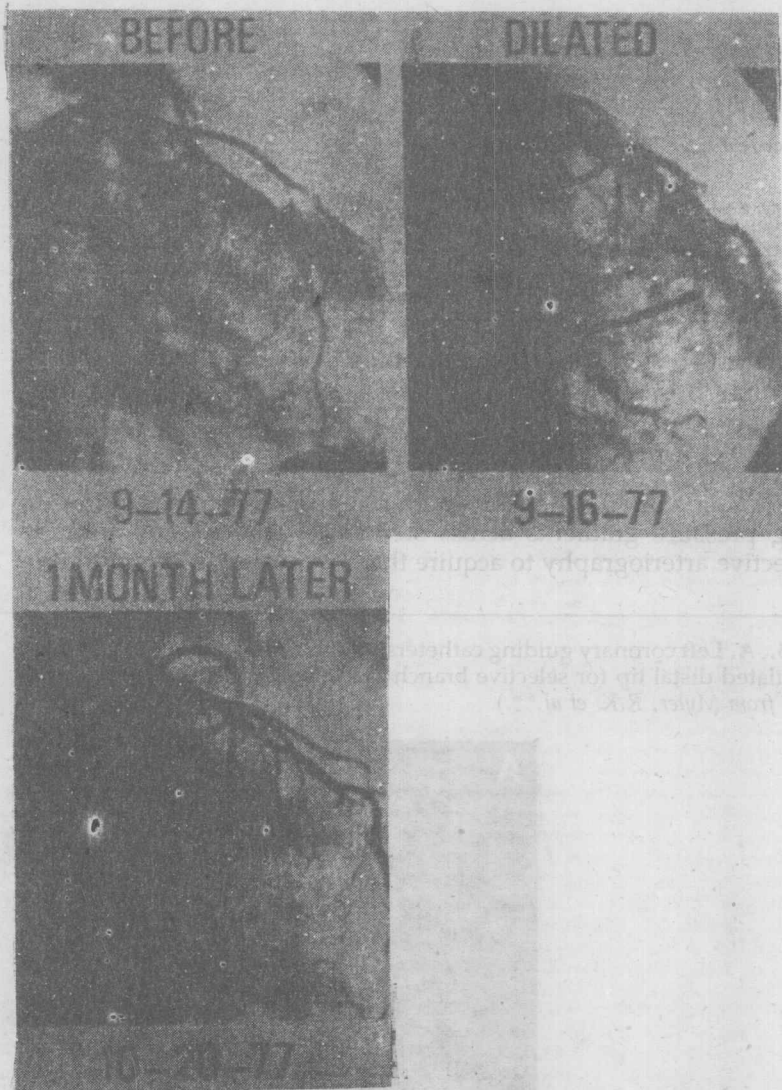
<u>Investigator</u>	<u>Country</u>	<u>Year Initiated</u>
Dotter & Judkins	U.S.A.	1964
Zeitler	Germany	1967
Grüntzig	Switzerland	1974

FIGURE 1. History of peripheral transluminal angioplasty.

A particularly imaginative therapeutic catheter application was introduced by Dotter and Judkins<sup>22</sup> in 1964 to improve blood flow in peripheral arteries with arteriosclerotic obstructive disease. They used a coaxial catheter system and called the method transluminal angioplasty.<sup>21-24</sup> After their pioneering efforts, many European investigators, in particular Zeitler<sup>116-119</sup> and Porstmann,<sup>111</sup> applied the Dotter technique and gathered extensive data in a large number of patients. Gruentzig<sup>30,32,33</sup> altered the Dotter multiple-catheter system and developed a double-lumen catheter that had, at its distal end, a distensible balloon with a fixed outer diameter when inflated. The catheter allowed a smaller puncture site and permitted circumferential pressure on the arteriosclerotic plaque. Used in the iliac and femoral-popliteal arteries, the Gruentzig angioplasty catheter achieved an initial patency rate of 86% and a 3 year cumulative patency rate of 73%<sup>35</sup> (Figure 1).

FIGURE 2. Intraoperative view of the first human coronary angioplasty, performed in San Francisco, May 1977, Gruentzig, Myler, Hanna, and Crew.





**FIGURE 3.** First percutaneous transluminal coronary angioplasty, performed in catheterization laboratory, Zurich, September 1977, by Gruentzig.

In 1976 Gruentzig miniaturized his peripheral angioplasty catheter system to perform coronary angioplasty, initially in a canine model and later in human cadaver experiments.<sup>31,38-40</sup> Then, Gruentzig, Myler, Hanna and Turina<sup>41</sup> performed the first intraoperative coronary angioplasties to examine this technique critically in living human atherosclerosis and to determine if distal embolic debris would be produced. In downstream

Grüntzig (Zürich)	—Animal Experiments with Dog Ligature Stenosis	1976
	Cadaver Studies	1976
(Zurich, S.F.)	—During CABG	1977
<b>Initial PTCA Procedures</b>		
Grüntzig	—Zürich	— 9/77
Grüntzig & Kaltenbach	—Frankfurt	—11/77
Myler	—San Francisco	— 3/78
Stertzer	—NYC	— 3/78

**FIGURE 4.** History of percutaneous transluminal coronary angioplasty. CABG—coronary artery bypass grafting.

Millipore filters designed to collect effluent after intraoperative coronary angioplasty, embolic debris was never noted (Figure 2).

There followed a period of "probing" human coronary arteries, recording pressure gradients across stenotic lesions, and performing supraselective arteriography to acquire the experience necessary to pro-

**FIGURE 5. A.** Left coronary guiding catheters; Judkins type. On left (note circle) with angulated distal tip for selective branch placement. (USCI) (Reprinted with permission from Myler, R.K. et al.<sup>80a</sup>.)

