

MEDICAL RADIOLOGY

Diagnostic Imaging and Radiation Oncology

Editorial Board

L.W. Brady, Philadelphia · M. W. Donner (†), Baltimore

H.-P. Heilmann, Hamburg · F. Heuck, Stuttgart



Interventional Neuroradiology

Contributors

H. Alvarez · A. Berenstein · I. S. Choi · G. M. Debrun · J. M. Eskridge
G. Fabris · R. Garcia-Monaco · G. Guglielmi · V. V. Halbach
P. Lasjaunias · A. Lavaroni · M. Leonardi · G. Rodesch
A. Setton · A. Valavanis · S. M. Wolpert · F. Zanella · H. Zeumer

Edited by
Anton Valavanis

Foreword by
Martin W. Donner and Friedrich Heuck

With 86 Figures and 26 Tables

Springer-Verlag
Berlin Heidelberg New York London Paris
Tokyo HongKong Barcelona Budapest

ANTON VALAVANIS, M. D., Professor
Abteilung für Neuroradiologie
Departement Medizinische Radiologie
Universitätsspital Zürich
Frauenklinikstrasse 10
8091 Zürich, Switzerland

MEDICAL RADIOLOGY · Diagnostic Imaging and Radiation Oncology

Continuation of
Handbuch der medizinischen Radiologie
Encyclopedia of Medical Radiology

ISBN-13: 978-3-642-84436-2 e-ISBN-13: 978-3-642-84434-8

DOI: 10.1007/978-3-642-84434-8

Library of Congress Cataloging-in-Publication Data

Interventional neuroradiology/contributors, A. Berenstein . . . [et al.]; edited by Anton Valavanis; foreword by Martin W. Donner and Friedrich Heuck. p. cm. – (Medical radiology) Includes bibliographical references and index.

1. Nervous system-Interventional radiology. I. Berenstein, Alex, 1947 – . II. Valavanis, A. (Anton), 1952 – . III. Series. [DNLM: 1. Central Nervous System Diseases-radiotherapy. 2. Neuroradiography. 3. Radiography, Interventional. WL300 I635 1993] RD594.15.I6 1993 617.4'8059-dc20 DNLM/DLC 93-12634

This work is subject to copyright. All rights are reserved whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1993

Softcover reprint of the hardcover 1st edition 1993

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Product liability: The publishers cannot guarantee the accuracy of any information about dosage and application contained in this book. In every individual case the user must check such information by consulting the relevant literature.

Reproduction of the illustrations: G. Dreher, Württembergische Graphische Kunstanstalt GmbH, Stuttgart
Typesetting: Best-set Typesetter Ltd., Hong Kong

21/3130-543210 – Printed on acid-free paper

Foreword

The methods of interventional neuroradiology represent a distinct and difficult branch within the new field of interventional radiology. The editor of this volume, Anton Valavanis, is a pioneer in this area, and one of the outstanding neuroradiologists in the world. Furthermore, he has brought together the foremost scientists and clinical neuroradiologists in the field to present the individual chapters.

The book gives an overview of the state of the art in interventional neuroradiology. Each of the 12 chapters is devoted to a disease which can be treated by interventional neuroradiological techniques. Pertinent information is provided on anatomical detail, technical background, and clinical aspects; in each case a detailed description of the indications, techniques, and possible complications of interventional neuroradiology is provided. Due consideration is given to the endovascular and nonvascular applications of the techniques.

This book is the first comprehensive update of interventional neuroradiology and will acquaint the reader with well-established facts, recent advances, and future perspectives within this new discipline. It will be of special value to those working in neuroradiology but will also prove very helpful for neurosurgeons, neurologists, and ophthalmologists, as well as all physicians and researchers in the clinical neurosciences.

We hope that the book will meet with the reception and success that it undoubtedly merits.

Baltimore/Stuttgart

MARTIN W. DONNER (†)
FRIEDRICH HEUCK

Preface

In an evolving, complex, “surgical” field such as interventional neuroradiology neither a book nor a series of didactic books can replace proper training. With this in mind, this volume was conceived primarily to inform its readers on the current state of the art in interventional neuroradiology, which initially evolved from an endovascular occlusive technique based on craniocerebral and spinal angiography. The aim of this endovascular technique was to occlude arteries feeding vascular malformations, carrying aneurysms, or supplying neoplasms in the head and neck area, the brain, and the spinal cord. Despite some success in achieving this goal, the endovascular approach was generally far inferior to direct surgical elimination of such lesions and neither the concept of endovascular treatment nor the endovascular techniques employed at that time were widely accepted or popular during this initial period of development in the 1960s and early 1970s.

During the 1970s and early 1980s there were significant break-throughs, which influenced and determined the further evolution and growth in the field. These include the introduction of flow-guided, detachable and nondetachable microballoons for occlusions of vessels, obliteration of arteriovenous fistulas, endovascular obliteration of certain aneurysms, and for achieving flow control and performing functional hemodynamic testing; the production, experimental evaluation, and clinical application of a wide variety of embolic agents and materials for obliteration of vascular malformations, devascularization of tumors, and occlusion of arteries, such as microparticulate agents, polymerizing and nonpolymerizing fluid materials, and devices such as microcoils and seeds; and the development of highly flexible, flow-dependent or steerable microcatheters for superselective navigation within the arterial and venous vascular territories of the central nervous system and the head and neck area.

A further important contribution to the growing field was the introduction of the concept of functional vascular anatomy, which provided the theoretical framework for the practice of interventional neuroradiology. This concept helped to better understand the composition of vascular lesions, to identify selective targets for endovascular obliteration, to diagnose potentially dangerous vessels, to detect weak angioarchitectural points within vascular malformations, and to develop specific endovascular protocols for the endovascular exploration and embolization of the various diseases amenable to endovascular treatment. This functional approach based on sound anatomic knowledge greatly contributed to reducing morbidity and mortality and in increasing the efficiency of interventional neuroradiology.

During the 1980s and early 1990s the activities and scope of interventional neuroradiology expanded. The initially occlusive endovascular techniques were modified to be applicable as recanalizing endovascular techniques. Ballon angioplasty became available for treating certain atherosclerotic and other stenotic lesions of the brachiocephalic arteries and for treating vasospasm of intracranial arteries. In addition to this, the endovascular approach has been used to deliver selectively into the vascular system chemotherapeutic agents for the treatment of cerebral malignancies, fibrinolytic agents for the treatment of acute thrombotic occlusions of the vertebrobasilar, carotid, and, recently, ophthalmic arterial systems and of major dural venous sinuses; and vasodilating agents for the treatment of vasospasm. These evolving techniques need to be further defined in terms of indications, timing of the procedure, and long-lasting efficiency.

At the same time interventional neuroradiology also found extravascular applications. Percutaneous approaches under direct imaging control have been developed for the management of spinal disk and degenerative disease as well as for stereotactic purposes.

Finally, in the early 1990s the technique of endovascular electrothrombosis using electrolytically detachable microcoils was developed and experimentally tested and is already being applied in the treatment of intracranial aneurysms. Besides opening new avenues in the treatment of aneurysms, this technique may well find other endovascular applications in the future such as in vascular malformations, arteriovenous fistulas, and acute hemorrhagic conditions, comparable to bipolar coagulation in neurosurgery.

Based on this progress, interventional neuroradiology gained increasing acceptance in the fields of neurosurgery, head and neck surgery, and other related specialties. Interventional neuroradiologic techniques are now being applied preoperatively, to transform inoperable lesions into operable ones and to facilitate surgery, curatively, to treat a number of lesions definitively, and palliatively, to improve the natural history of diseases which cannot be cured by any of the techniques available.

Several centers for interventional neuroradiology around the world have already been established and others will be created in the near future as a response to the need for such an activity. Their scope is to provide an adequate patient care, to perform experimental and clinical research necessary for the advancement of the field, to evaluate continuously and critically the results obtained by endovascular treatment and to train individuals who have decided to devote their professional activity to this fascinating but also cumbersome discipline.

This volume aims to inform interested physicians of the concepts governing the current practice of interventional neuroradiology and of the various techniques currently available, with their advantages, disadvantages, and limitations. It is the hope of the editor and the authors that it will also provide insight into the established and often critical role of interventional neuroradiology among neurosurgeons, head and neck surgeons, and other clinical and basic neuroscientists challenged to understand and treat the diseases described in this book.

Zurich, June 1993

ANTON VALAVANIS

Contents

1	Embolization of Vascular Lesions of the Head and Neck R. GARCIA-MONACO, P. LASJAUNIAS, H. ALVAREZ, and G. RODESCH.	1
2	Endovascular Management of Carotid Cavernous Fistulas G. M. DEBRUN	23
3	Embolization of Dural Arteriovenous Malformations V. V. HALBACH	35
4	Embolization of Epistaxis A. VALAVANIS and A. SETTON	55
5	Embolization of Intracranial and Skull Base Tumors A. VALAVANIS	63
6	Endovascular Treatment of Arteriovenous Malformations of the Brain A. BERENSTEIN, P. LASJAUNIAS, and I. S. CHOI	93
7	Endovascular Treatment of Intracranial Aneurysms with Detachable Coils and Electrothrombosis G. GUGLIELMI	111
8	Angioplasty of Vasospasm J. M. ESKRIDGE	123
9	Embolization of Arteriovenous Malformations of the Spinal Cord G. RODESCH, P. LASJAUNIAS, and A. BERENSTEIN	135
10	Superselective Therapy for Cerebral Gliomas S. M. WOLPERT	151
11	Local Intra-arterial Fibrinolysis in the Vertebrobasilar and Carotid Territories H. ZEUMER and F. ZANELLA	159
12	Percutaneous Diskectomy and Chemonucleolysis M. LEONARDI, G. FABRIS, and A. LAVARONI	173
	Subject Index	191
	List of Contributors	195