

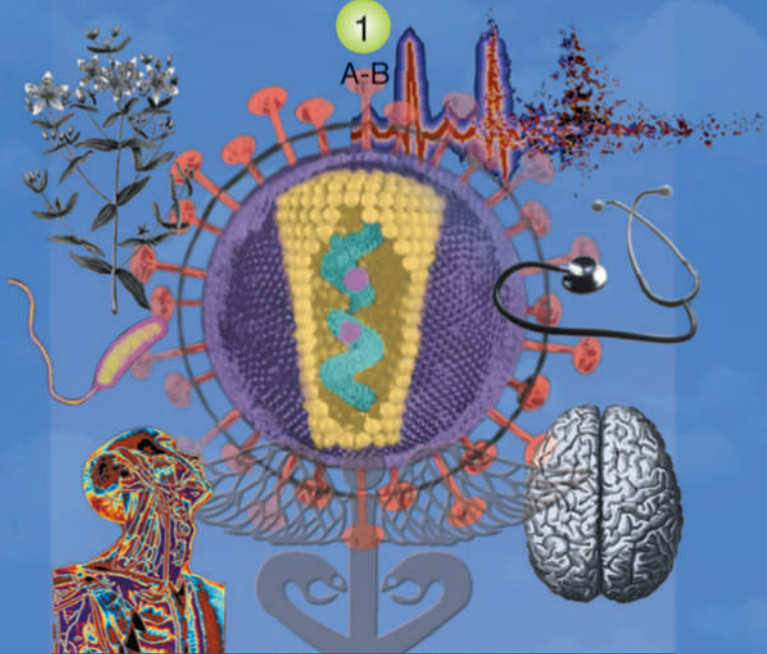
The GALE ENCYCLOPEDIA *of* MEDICINE

SECOND EDITION

VOLUME

1

A-B



JACQUELINE L. LONGE, EDITOR

The GALE
ENCYCLOPEDIA
of MEDICINE

SECOND EDITION

The GALE
ENCYCLOPEDIA
of MEDICINE
SECOND EDITION

VOLUME

1

A-B

JACQUELINE L. LONGE, EDITOR
DEIRDRE S. BLANCHFIELD, ASSOCIATE EDITOR

GALE GROUP



THOMSON LEARNING

Detroit • New York • San Diego • San Francisco
Boston • New Haven, Conn. • Waterville, Maine
London • Munich

The GALE ENCYCLOPEDIA of MEDICINE SECOND EDITION

STAFF

Jacqueline L. Longe, *Project Editor*
Deirdre S. Blanchfield, *Associate Editor*
Christine B. Jeryan, *Managing Editor*

Donna Olendorf, *Senior Editor*
Stacey Blachford, *Associate Editor*
Kate Kretschmann, Melissa C. McDade, Ryan
Thomason, *Assistant Editors*

Mark Springer, *Technical Specialist*
Andrea Lopeman, *Programmer/Analyst*

Barbara J. Yarrow, *Manager, Imaging and Multimedia
Content*

Robyn V. Young, *Project Manager, Imaging and
Multimedia Content*

Dean Dauphinais, *Senior Editor, Imaging and
Multimedia Content*

Kelly A. Quin, *Editor, Imaging and Multimedia Content*
Leitha Etheridge-Sims, Mary K. Grimes, Dave Oblender,
Image Catalogers

Pamela A. Reed, *Imaging Coordinator*

Randy Bassett, *Imaging Supervisor*

Robert Duncan, *Senior Imaging Specialist*

Dan Newell, *Imaging Specialist*

Christine O'Bryan, *Graphic Specialist*

Maria Franklin, *Permissions Manager*

Margaret A. Chamberlain, *Permissions Specialist*

Michelle DiMercurio, *Senior Art Director*

Mike Logusz, *Graphic Artist*

Mary Beth Trimper, *Manager, Composition and
Electronic Prepress*

Evi Seoud, *Assistant Manager, Composition Purchasing
and Electronic Prepress*

Dorothy Maki, *Manufacturing Manager*

Wendy Blurton, *Senior Manufacturing Specialist*

Since this page cannot legibly accommodate all copyright notices, the acknowledgments constitute an extension of the copyright notice.

While every effort has been made to ensure the reliability of the information presented in this publication, the Gale Group neither guarantees the accuracy of the data contained herein nor assumes any responsibility for errors, omissions or discrepancies. The Gale Group accepts no payment for listing, and inclusion in the publication of any organization, agency, institution, publication, service, or individual does not imply endorsement of the editor or publisher. Errors brought to the attention of the publisher and verified to the satisfaction of the publisher will be corrected in future editions.

This book is printed on recycled paper that meets Environmental Protection Agency standards.

The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences-Permanence Paper for Printed Library Materials, ANSI Z39.48-1984.

This publication is a creative work fully protected by all applicable copyright laws, as well as by misappropriation, trade secret, unfair competition, and other applicable laws. The authors and editor of this work have added value to the underlying factual material herein through one or more of the following: unique and original selection, coordination, expression, arrangement, and classification of the information.

Gale Group and design is a trademark used herein under license.

All rights to this publication will be vigorously defended.

Copyright © 2002
Gale Group
27500 Drake Road
Farmington Hills, MI 48331-3535

All rights reserved including the right of reproduction in whole or in part in any form.

ISBN 0-7876-5489-2 (set)
0-7876-5490-6 (Vol. 1)
0-7876-5491-4 (Vol. 2)
0-7876-5492-2 (Vol. 3)
0-7876-5493-0 (Vol. 4)
0-7876-5494-9 (Vol. 5)

Printed in the United States of America
10 9 8 7 6 5 4 3 2 1

Library of Congress Cataloging-in-Publication Data

Gale encyclopedia of medicine / Jacqueline L. Longe, editor;
Deirdre S. Blanchfield, associate editor — 2nd ed.

p. cm.

Includes bibliographical references and index.

Contents: Vol. 1. A-B — v. 2. C-F — v. 3.
G-M — v. 4. N-S — v. 5. T-Z.

ISBN 0-7876-5489-2 (set: hardcover) — ISBN 0-7876-5490-6
(vol. 1) — ISBN 0-7876-5491-4 (vol. 2) — ISBN 0-7876-5492-2
(vol. 3) — ISBN 0-7876-5493-0 (vol. 4) — ISBN 0-7876-5494-9
(vol. 5)

1. Internal medicine—Encyclopedias. I. Longe, Jacqueline L.
II. Blanchfield, Deirdre S. III. Gale Research Company.

RC41.G35 2001
616'.003—dc21

2001051245

CONTENTS

Introduction.....	ix
Advisory Board.....	xi
Contributors	xiii
Entries	
Volume 1: A-B	1
Volume 2: C-F	625
Volume 3: G-M	1375
Volume 4: N-S	2307
Volume 5: T-Z	3237
Organizations	3603
General Index.....	3625

PLEASE READ—IMPORTANT INFORMATION

The *Gale Encyclopedia of Medicine 2* is a medical reference product designed to inform and educate readers about a wide variety of disorders, conditions, treatments, and diagnostic tests. The Gale Group believes the product to be comprehensive, but not necessarily definitive. It is intended to supplement, not replace, consultation with a physician or other healthcare practitioner. While the Gale Group has made substantial efforts to provide information that is accurate, comprehensive, and up-to-date, the Gale Group makes no representations or warranties of any

kind, including without limitation, warranties of merchantability or fitness for a particular purpose, nor does it guarantee the accuracy, comprehensiveness, or timeliness of the information contained in this product. Readers should be aware that the universe of medical knowledge is constantly growing and changing, and that differences of medical opinion exist among authorities. Readers are also advised to seek professional diagnosis and treatment for any medical condition, and to discuss information obtained from this book with their health care provider.

INTRODUCTION

The *Gale Encyclopedia of Medicine 2 (GEM2)* is a one-stop source for medical information on nearly 1,700 common medical disorders, conditions, tests, and treatments, including high-profile diseases such as AIDS, Alzheimer's disease, cancer, and heart attack. This encyclopedia avoids medical jargon and uses language that laypersons can understand, while still providing thorough coverage of each topic. The *Gale Encyclopedia of Medicine 2* fills a gap between basic consumer health resources, such as single-volume family medical guides, and highly technical professional materials.

SCOPE

Almost 1,700 full-length articles are included in the *Gale Encyclopedia of Medicine 2*, including disorders/conditions, tests/procedures, and treatments/therapies. Many common drugs are also covered, with generic drug names appearing first and brand names following in parentheses, eg. acetaminophen (Tylenol). Throughout the *Gale Encyclopedia of Medicine 2*, many prominent individuals are highlighted as sidebar biographies that accompany the main topical essays. Articles follow a standardized format that provides information at a glance. Rubrics include:

Disorders/Conditions	Tests/Treatments
Definition	Definition
Description	Purpose
Causes and symptoms	Precautions
Diagnosis	Description
Treatment	Preparation
Alternative treatment	Aftercare
Prognosis	Risks
Prevention	Normal/Abnormal results
Resources	Resources
Key terms	Key terms

In recent years there has been a resurgence of interest in holistic medicine that emphasizes the connection between mind and body. Aimed at achieving and maintaining good health rather than just eliminating disease,

this approach has come to be known as alternative medicine. The *Gale Encyclopedia of Medicine 2* includes a number of essays on alternative therapies, ranging from traditional Chinese medicine to homeopathy and from meditation to aromatherapy. In addition to full essays on alternative therapies, the encyclopedia features specific **Alternative treatment** sections for diseases and conditions that may be helped by complementary therapies.

INCLUSION CRITERIA

A preliminary list of diseases, disorders, tests and treatments was compiled from a wide variety of sources, including professional medical guides and textbooks as well as consumer guides and encyclopedias. The general advisory board, made up of public librarians, medical librarians and consumer health experts, evaluated the topics and made suggestions for inclusion. The list was sorted by category and sent to *GEM2* medical advisors, certified physicians with various medical specialties, for review. Final selection of topics to include was made by the medical advisors in conjunction with the Gale Group editor.

ABOUT THE CONTRIBUTORS

The essays were compiled by experienced medical writers, including physicians, pharmacists, nurses, and other health care professionals. *GEM2* medical advisors reviewed the completed essays to insure that they are appropriate, up-to-date, and medically accurate.

HOW TO USE THIS BOOK

The *Gale Encyclopedia of Medicine 2* has been designed with ready reference in mind.

- Straight **alphabetical arrangement** allows users to locate information quickly.
- Bold-faced terms function as **print hyperlinks** that point the reader to related entries in the encyclopedia.

- **Cross-references** placed throughout the encyclopedia direct readers to where information on subjects without entries can be found. Synonyms are also cross-referenced.
- A list of **key terms** are provided where appropriate to define unfamiliar terms or concepts.
- Valuable **contact information** for organizations and support groups is included with each entry. The appendix contains an extensive list of organizations arranged in alphabetical order.
- **Resources section** directs users to additional sources of medical information on a topic.
- A comprehensive **general index** allows users to easily target detailed aspects of any topic, including Latin names.

GRAPHICS

The *Gale Encyclopedia of Medicine 2* is enhanced with over 675 color images, including photos, charts, tables, and customized line drawings.

ADVISORY BOARD

A number of experts in the library and medical communities provided invaluable assistance in the formulation of this encyclopedia. Our advisory board performed a myriad of duties, from defining the scope of coverage to reviewing individual entries for accuracy and accessibility. The editor would like to express her appreciation to them.

MEDICAL ADVISORS

**A. Richard Adrouny, M.D.,
F.A.C.P.**

*Clinical Assistant Professor of
Medicine*
Division of Oncology
Stanford University
Director of Medical Oncology
Community Hospital of Los Gatos-
Saratoga
Los Gatos, CA

Laurie Barclay, M.D.

Neurological Consulting Services
Tampa, FL

Kenneth J. Berniker, M.D.

Attending Physician
Emergency Department
Kaiser Permanente Medical Center
Vallejo, CA

Rosalyn Carson-DeWitt, M.D.

Durham, NC

Robin Dipasquale, N.D.

Clinical Faculty
Bastyr University
Seattle, WA

Faye Fishman, D.O.

Randolph, NJ

J. Gary Grant, M.D.

Pacific Grove, CA

Laith F. Gulli, M.D.

M.Sc., M.Sc.(MedSci), MSA,
Msc.Psych., MRSNZ
FRSH, FRIPHH, FAIC, FZS
DAPA, DABFC, DABCI

*Consultant Psychotherapist in
Private Practice*
Lathrup Village, MI

L. Anne Hirschel, D.D.S.

Southfield, MI

Larry I. Lutwick M.D., F.A.C.P.

Director, Infectious Diseases
VA Medical Center
Brooklyn, NY

**Ira Michelson, M.D., M.B.A.,
F.A.C.O.G.**

Physician and Clinical Instructor
University of Michigan
Ann Arbor, MI

Susan Mockus, M.D.

Scientific Consultant
Seattle, WA

**Ralph M. Myerson, M.D.,
F.A.C.P.**

Clinical Professor of Medicine
Medical College of Pennsylvania-
Hahnemann University
Philadelphia, PA

Ronald Pies, M.D.

Clinical Professor of Psychiatry
Tufts University
School of Medicine
Boston, MA

Lecturer on Psychiatry
Harvard Medical School
Cambridge, MA

Lee A. Shratter, M.D.

Staff Radiologist

The Permanente Medical Group
Richmond, CA

Amy B. Tuteur, M.D.

Sharon, MA

LIBRARIAN ADVISORS

Maureen O. Carleton, MLIS

Medical Reference Specialist
King County Library System
Bellevue, WA

Elizabeth Clewis Crim, MLS

Collection Specialist
Prince William Public Library, VA

Valerie J. Lawrence, MLS

Assistant Librarian
Western States Chiropractic
College
Portland, OR

Barbara J. O'Hara, MLS

Adult Services Librarian
Free Library of Philadelphia, PA

Alan M. Rees, MLS

Professor Emeritus
Case Western Reserve University
Cleveland, OH

CONTRIBUTORS

Margaret Alic, Ph.D.

Science Writer
Eastsound, WA

Janet Byron Anderson

Linguist/Language Consultant
Rocky River, OH

Lisa Andres, M.S., C.G.C.

*Certified Genetic Counselor and
Medical Writer*
San Jose, CA

Greg Annussek

Medical Writer/Editor
New York, NY

Bill Asenjo, M.S., C.R.C.

Science Writer
Iowa City, IA

Sharon A. Aufox, M.S., C.G.C.

Genetic Counselor
Rockford Memorial Hospital
Rockford, IL

Sandra Bain Cushman

*Massage Therapist, Alexander
Technique Practitioner*
Charlottesville, VA

Howard Baker

Medical Writer
North York, Ontario

Laurie Barclay, M.D.

Neurological Consulting Services
Tampa, FL

Jeanine Barone

Nutritionist, Exercise Physiologist
New York, NY

Julia R. Barrett

Science Writer
Madison, WI

Donald G. Barstow, R.N.

Clinical Nurse Specialist
Oklahoma City, OK

Carin Lea Beltz, M.S.

*Genetic Counselor and Program
Director*
The Center for Genetic Counseling
Indianapolis, IN

Linda K. Bennington, C.N.S.

Science Writer
Virginia Beach, VA

Issac R. Berniker

Medical Writer
Vallejo, CA

Kathleen Berrisford, M.S.V.

Science Writer

Bethanne Black

Medical Writer
Atlanta, GA

**Jennifer Bowjanowski, M.S.,
C.G.C.**

Genetic Counselor
Children's Hospital Oakland
Oakland, CA

Michelle Q. Bosworth, M.S., C.G.C.

Genetic Counselor
Eugene, OR

Barbara Boughton

Health and Medical Writer
El Cerrito, CA

Cheryl Branche, M.D.

Retired General Practitioner
Jackson, MS

Michelle Lee Brandt

Medical Writer
San Francisco, CA

Maury M. Breecher, Ph.D.

Health Communicator/Journalist
Northport, AL

Ruthan Brodsky

Medical Writer
Bloomfield Hills, MI

Tom Brody, Ph.D.

Science Writer
Berkeley, CA

Leonard C. Bruno, Ph.D.

Medical Writer
Chevy Chase, MD

Diane Calbrese

*Medical Sciences and Technology
Writer*
Silver Spring, Maryland

Richard H. Camer

Editor
International Medical News Group
Silver Spring, MD

Rosalyn Carson-DeWitt, M.D.

Medical Writer
Durham, NC

Lata Cherath, Ph.D.

Science Writing Intern
Cancer Research Institute
New York, NY

Linda Chrisman

Massage Therapist and Educator
Oakland, CA

Lisa Christenson, Ph.D.

Science Writer
Hamden, CT

Geoffrey N. Clark, D.V.M.

Editor
Canine Sports Medicine Update
Newmarket, NH

Rhonda Cloos, R.N.

Medical Writer
Austin, TX

Gloria Cooksey, C.N.E

Medical Writer
Sacramento, CA

Amy Cooper, M.A., M.S.I.

Medical Writer
Vermillion, SD

David A. Cramer, M.D.

Medical Writer
Chicago, IL

Esther Csapo Rastega, R.N., B.S.N.

Medical Writer
Holbrook, MA

Arnold Cua, M.D.

Physician
Brooklyn, NY

Tish Davidson, A.M.

Medical Writer
Fremont, California

Dominic De Bellis, Ph.D.

Medical Writer/Editor
Mahopac, NY

Lori De Milto

Medical Writer
Sicklerville, NJ

Robert S. Dinsmoor

Medical Writer
South Hamilton, MA

Stephanie Dionne, B.S.

Medical Writer
Ann Arbor, MI

Martin W. Dodge, Ph.D.

Technical Writer/Editor
Centinela Hospital and Medical
Center
Inglewood, CA

David Doermann

Medical Writer
Salt Lake City, UT

Stefanie B. N. Dugan, M.S.

Genetic Counselor
Milwaukee, WI

Doug Dupler, M.A.

Science Writer
Boulder, CO

Thomas Scott Eagan

Student Researcher
University of Arizona
Tucson, AZ

Altha Roberts Edgren

Medical Writer
Medical Ink
St. Paul, MN

Karen Ericson, R.N.

Medical Writer
Estes Park, CO

**L. Fleming Fallon Jr., M.D.,
Dr.PH**

*Associate Professor of Public
Health*
Bowling Green State University
Bowling Green, OH

Faye Fishman, D.O.

Physician
Randolph, NJ

Janis Flores

Medical Writer
Lexikon Communications
Sebastopol, CA

Risa Flynn

Medical Writer
Culver City, CA

Paula Ford-Martin

Medical Writer
Chaplin, MN

Janie F. Franz

Writer
Grand Forks, ND

Sallie Freeman, Ph.D., B.S.N.

Medical Writer
Atlanta, GA

Rebecca J. Frey, Ph.D.

*Research and Administrative
Associate*
East Rock Institute
New Haven, CT

Cynthia L. Frozena, R.N.

Nurse, Medical Writer
Manitowoc, WI

Ron Gasbarro, Pharm.D.

Medical Writer
New Milford, PA

Julie A. Gelderloos

Biomedical Writer
Playa del Rey, CA

Gary Gilles, M.A.

Medical Writer
Wauconda, IL

Harry W. Golden

Medical Writer
Shoreline Medical Writers
Old Lyme, CT

Debra Gordon

Medical Writer
Nazareth, PA

Megan Gourley

Writer
Germantown, MD

Jill Granger, M.S.

Senior Research Associate
University of Michigan
Ann Arbor, MI

Alison Grant

Medical Writer
Averill Park, NY

Elliot Greene, M.A.

*former president, American
Massage Therapy Association*
Massage Therapist
Silver Spring, MD

Peter Gregutt

Writer
Asheville, NC

Laith F. Gulli, M.D.

M.Sc., M.Sc.(MedSci), M.S.A.,
Msc.Psych, MRSNZ
FRSH, FRIPHH, FAIC, FZS
DAPA, DABFC, DABCI
*Consultant Psychotherapist in
Private Practice*
Lathrup Village, MI

Kapil Gupta, M.D.

Medical Writer
Winston-Salem, NC

Maureen Haggerty

Medical Writer
Ambler, PA

Clare Hanrahan

Medical Writer
Asheville, NC

Ann M. Haren
Science Writer
 Madison, CT

Judy C. Hawkins, M.S.
Genetic Counselor
 The University of Texas Medical
 Branch
 Galveston, TX

Caroline Helwick
Medical Writer
 New Orleans, LA

David Helwig
Medical Writer
 London, Ontario

Lisette Hilton
Medical Writer
 Boca Raton, FL

Katherine S. Hunt, M.S.
Genetic Counselor
 University of New Mexico Health
 Sciences Center
 Albuquerque, NM

Kevin Hwang, M.D.
Medical Writer
 Morristown, NJ

Holly Ann Ishmael, M.S., C.G.C.
Genetic Counselor
 The Children's Mercy Hospital
 Kansas City, MO

Dawn A. Jacob, M.S.
Genetic Counselor
 Obstetrix Medical Group of Texas
 Fort Worth, TX

Sally J. Jacobs, Ed.D.
Medical Writer
 Los Angeles, CA

Michelle L. Johnson, M.S., J.D.
Patent Attorney and Medical Writer
 Portland, OR

Paul A. Johnson, Ed.M.
Medical Writer
 San Diego, CA

Cindy L. A. Jones, Ph.D.
Biomedical Writer
 Sagescript Communications
 Lakewood, CO

David Kaminstein, M.D.
Medical Writer

West Chester, PA

Beth A. Kapes
Medical Writer
 Bay Village, OH

Christine Kuehn Kelly
Medical Writer
 Havertown, PA

Bob Kirsch
Medical Writer
 Ossining, NY

Joseph Knight, P.A.
Medical Writer
 Winton, CA

Melissa Knopper
Medical Writer
 Chicago, IL

Karen Krajewski, M.S., C.G.C.
Genetic Counselor
 Assistant Professor of Neurology
 Wayne State University
 Detroit, MI

Jeanne Krob, M.D., F.A.C.S.
Physician, writer
 Pittsburgh, PA

Jennifer Lamb
Medical Writer
 Spokane, WA

Richard H. Lampert
Senior Medical Editor
 W.B. Saunders Co.
 Philadelphia, PA

Jeffrey P. Larson, R.P.T.
Physical Therapist
 Sabin, MN

Jill Lasker
Medical Writer
 Midlothian, VA

Kristy Layman
Music Therapist
 East Lansing, MI

Victor Leipzig, Ph.D.
Biological Consultant
 Huntington Beach, CA

Lorraine Lica, Ph.D.
Medical Writer
 San Diego, CA

John T. Lohr, Ph.D.
*Assistant Director, Biotechnology
 Center*
 Utah State University
 Logan, UT

Larry Lutwick, M.D., F.A.C.P.
Director, Infectious Diseases
 VA Medical Center
 Brooklyn, NY

Suzanne M. Lutwick
Medical Writer
 Brooklyn, NY

Nicole Mallory, M.S.
Medical Student
 Wayne State University
 Detroit, MI

Warren Maltzman, Ph.D.
Consultant, Molecular Pathology
 Demarest, NJ

Adrienne Massel, R.N.
Medical Writer
 Beloit, WI

Ruth E. Mawyer, R.N.
Medical Writer
 Charlottesville, VA

Richard A. McCartney M.D.
*Fellow, American College of
 Surgeons*
*Diplomat American Board of
 Surgery*
 Richland, WA

Bonny McClain, Ph.D.
Medical Writer
 Greensboro, NC

Sally C. McFarlane-Parrott
Medical Writer
 Ann Arbor, MI

Mercedes McLaughlin
Medical Writer
 Phoenixville, CA

Alison McTavish, M.Sc.
Medical Writer and Editor
 Montreal, Quebec

Liz Meszaros
Medical Writer
 Lakewood, OH

Betty Mishkin
Medical Writer
 Skokie, IL

Barbara J. Mitchell
Medical Writer
 Hallstead, PA

Mark A. Mitchell, M.D.
Medical Writer
 Seattle, WA

Susan J. Montgomery
Medical Writer
 Milwaukee, WI

Louann W. Murray, PhD
Medical Writer
 Huntington Beach, CA

Bilal Nasser, M.Sc.
Senior Medical Student
 Universidad Iberoamericana
 Santo Domingo, Dominican
 Republic

Laura Ninger
Medical Writer
 Weehawken, NJ

Nancy J. Nordenson
Medical Writer
 Minneapolis, MN

Teresa Norris, R.N.
Medical Writer
 Ute Park, NM

Lisa Papp, R.N.
Medical Writer
 Cherry Hill, NJ

Patience Paradox
Medical Writer
 Bainbridge Island, WA

Barbara J. Pettersen
Genetic Counselor
 Genetic Counseling of Central
 Oregon
 Bend, OR

Genevieve Pham-Kanter, M.S.
Medical Writer
 Chicago, IL

Collette Placek
Medical Writer
 Wheaton, IL

J. Ricker Polsdorfer, M.D.
Medical Writer
 Phoenix, AZ

Scott Polzin, M.S., C.G.C.
Medical Writer
 Buffalo Grove, IL

Elizabeth J. Pulcini, M.S.
Medical Writer
 Phoenix, Arizona

Nada Quercia, M.S., C.C.G.C.
Genetic Counselor
 Division of Clinical and Metabolic
 Genetics
 The Hospital for Sick Children
 Toronto, ON, Canada

Ann Quigley
Medical Writer
 New York, NY

Robert Ramirez, B.S.
Medical Student
 University of Medicine & Dentistry
 of New Jersey
 Stratford, NJ

Kulbir Rang, D.O.
Medical Doctor and Writer
 New York, NY

**Esther Csapo Rastegari, Ed.M.,
 R.N./B.S.N.**
Registered Nurse, Medical Writer
 Holbrook, MA

Toni Rizzo
Medical Writer
 Salt Lake City, UT

Martha Robbins
Medical Writer
 Evanston, IL

Richard Robinson
Medical Writer
 Tucson, AZ

Nancy Ross-Flanigan
Science Writer
 Belleville, MI

**Anna Rovid Spickler, D.V.M.,
 Ph.D.**
Medical Writer
 Moorehead, KY

Belinda Rowland, Ph.D.
Medical Writer
 Voorheesville, NY

Andrea Ruskin, M.D.
 Whittingham Cancer Center
 Norwalk, CT

Laura Ruth, Ph.D.
*Medical, Science, & Technology
 Writer*
 Los Angeles, CA

Karen Sandrick
Medical Writer
 Chicago, IL

Kausalya Santhanam, Ph.D.
Technical Writer
 Branford, CT

Jason S. Schliesser, D.C.
Chiropractor
 Holland Chiropractic, Inc.
 Holland, OH

Joan Schonbeck
Medical Writer
 Nursing
 Massachusetts Department of
 Mental Health
 Marlborough, MA

Laurie Heron Seaver, M.D.
Clinical Geneticist
 Greenwood Genetic Center
 Greenwood, SC

Catherine Seeley
Medical Writer

**Kristen Mahoney Shannon, M.S.,
 C.G.C.**
Genetic Counselor
 Center for Cancer Risk Analysis
 Massachusetts General Hospital
 Boston, MA

Kim A. Sharp, M.Ln.
Writer
 Richmond, TX

Judith Sims, M.S.
Medical Writer
 Logan, UT

Joyce S. Siok, R.N.
Medical Writer
 South Windsor, CT

Jennifer Sisk
Medical Writer
 Havertown, PA

Patricia Skinner
Medical Writer
 Amman, Jordan

Genevieve Slomski, Ph.D.
Medical Writer
 New Britain, CT

Stephanie Slon
Medical Writer
 Portland, OR

Linda Wasmer Smith
Medical Writer
 Albuquerque, NM

Java O. Solis, M.S.
Medical Writer
 Decatur, GA

Elaine Souder, PhD
Medical Writer
 Little Rock, AR

Jane E. Spehar
Medical Writer
 Canton, OH

Lorraine Steefel, R.N.
Medical Writer
 Morganville, NJ

Kurt Sternlof
Science Writer
 New Rochelle, NY

Roger E. Stevenson, M.D.
Director
 Greenwood Genetic Center
 Greenwood, SC

Dorothy Stonely
Medical Writer
 Los Gatos, CA

Liz Swain
Medical Writer
 San Diego, CA

Deanna M. Swartout-Corbeil, R.N.
Medical Writer
 Thompsons Station, TN

Keith Tatarelli, J.D.
Medical Writer

Mary Jane Tenerelli, M.S.
Medical Writer
 East Northport, NY

Catherine L. Tesla, M.S., C.G.C.
Senior Associate, Faculty
 Dept. of Pediatrics, Division of
 Medical Genetics
 Emory University School of
 Medicine
 Atlanta, GA

Bethany Thivierge
Biotechnical Writer/Editor
Technicality Resources
 Rockland, ME

Mai Tran, Pharm.D.
Medical Writer
 Troy, MI

Carol Turkington
Medical Writer
 Lancaster, PA

Judith Turner, B.S.
Medical Writer
 Sandy, UT

Amy B. Tuteur, M.D.
Medical Advisor
 Sharon, MA

Samuel Uretsky, Pharm.D.
Medical Writer
 Wantagh, NY

Amy Vance, M.S., C.G.C.
Genetic Counselor
 GeneSage, Inc.
 San Francisco, CA

Michael Sherwin Walston
Student Researcher
 University of Arizona
 Tucson, AZ

Ronald Watson, Ph.D.
Science Writer
 Tucson, AZ

Ellen S. Weber, M.S.N.
Medical Writer
 Fort Wayne, IN

Ken R. Wells
Freelance Writer
 Laguna Hills, CA

Jennifer F. Wilson, M.S.
Science Writer
 Haddonfield, NJ

Kathleen D. Wright, R.N.
Medical Writer
 Delmar, DE

Jennifer Wurges
Medical Writer
 Rochester Hills, MI

Mary Zoll, Ph.D.
Science Writer
 Newton Center, MA

Jon Zonderman
Medical Writer
 Orange, CA

Michael V. Zuck, Ph.D.
Medical Writer
 Boulder, CO

A

Abdominal aorta ultrasound see **Abdominal ultrasound**

Abdominal aortic aneurysm see **Aortic aneurysm**

Abdominal hernia see **Hernia**

Abdominal thrust see **Heimlich maneuver**

Abdominal ultrasound

Definition

Ultrasound technology allows doctors to “see” inside a patient without resorting to surgery. A transmitter sends high frequency sound waves into the body, where they bounce off the different tissues and organs to produce a distinctive pattern of echoes. A receiver “hears” the returning echo pattern and forwards it to a computer, which translates the data into an image on a television screen. Because ultrasound can distinguish subtle variations between soft, fluid-filled tissues, it is particularly useful in providing diagnostic images of the abdomen. Ultrasound can also be used in treatment.

Purpose

The potential medical applications of ultrasound were first recognized in the 1940s as an outgrowth of the sonar technology developed to detect submarines during World War II. The first useful medical images were produced in the early 1950s, and, by 1965, ultrasound quality had improved to the point that it came into general medical use. Improvements in the technology, application, and interpretation of ultrasound continue. Its low cost, versatility, safety and speed have brought it into the top drawer of medical imaging techniques.

While **pelvic ultrasound** is widely known and commonly used for fetal monitoring during **pregnancy**, ultrasound is also routinely used for general abdominal imaging. It has great advantage over x-ray imaging technologies in that it does not damage tissues with ionizing radiation. Ultrasound is also generally far better than plain x rays at distinguishing the subtle variations of soft tissue structures, and can be used in any of several modes, depending on the need at hand.

As an imaging tool, abdominal ultrasound generally is warranted for patients afflicted with: chronic or acute abdominal **pain**; abdominal trauma; an obvious or suspected abdominal mass; symptoms of liver disease, pancreatic disease, **gallstones**, spleen disease, kidney disease and urinary blockage; or symptoms of an abdominal **aortic aneurysm**. Specifically:

- **Abdominal pain.** Whether acute or chronic, pain can signal a serious problem—from organ malfunction or injury to the presence of malignant growths. Ultrasound scanning can help doctors quickly sort through potential causes when presented with general or ambiguous symptoms. All of the major abdominal organs can be studied for signs of disease that appear as changes in size, shape and internal structure.
- **Abdominal trauma.** After a serious accident, such as a car crash or a fall, internal bleeding from injured abdominal organs is often the most serious threat to survival. Neither the injuries nor the bleeding are immediately apparent. Ultrasound is very useful as an initial scan when abdominal trauma is suspected, and it can be used to pinpoint the location, cause, and severity of hemorrhaging. In the case of puncture **wounds**, from a bullet for example, ultrasound can locate the foreign object and provide a preliminary survey of the damage. The easy portability and versatility of ultrasound technology has brought it into common emergency room use, and even into limited ambulance service.
- **Abdominal mass.** Abnormal growths—tumors, cysts, abscesses, scar tissue and accessory organs—can be

located and tentatively identified with ultrasound. In particular, potentially malignant solid tumors can be distinguished from benign fluid-filled cysts and abscesses. Masses and malformations in any organ or part of the abdomen can be found.

- **Liver disease.** The types and underlying causes of liver disease are numerous, though **jaundice** tends to be a general symptom. Ultrasound can differentiate between many of the types and causes of liver malfunction, and is particularly good at identifying obstruction of the bile ducts and **cirrhosis**, which is characterized by abnormal fibrous growths and reduced blood flow.
- **Pancreatic disease.** Inflammation and malformation of the pancreas are readily identified by ultrasound, as are pancreatic stones (calculi), which can disrupt proper functioning.
- **Gallstones.** Gallstones cause more hospital admissions than any other digestive malady. These calculi can cause painful inflammation of the gallbladder and also obstruct the bile ducts that carry digestive enzymes from the gallbladder and liver to the intestines. Gallstones are readily identifiable with ultrasound.
- **Spleen disease.** The spleen is particularly prone to injury during abdominal trauma. It may also become painfully inflamed when beset with infection or **cancer**. These conditions also lend themselves well to ultrasonic inspection and diagnosis.
- **Kidney disease.** The kidneys are also prone to traumatic injury and are the organs most likely to form calculi, which can block the flow of urine and cause blood **poisoning** (uremia). A variety of diseases causing distinct changes in kidney morphology can also lead to complete kidney failure. Ultrasound imaging has proven extremely useful in diagnosing kidney disorders.
- **Abdominal aortic aneurysm.** This is a bulging weak spot in the abdominal aorta, which supplies blood directly from the heart to the entire lower body. These aneurysms are relatively common and increase in prevalence with age. A burst aortic aneurysm is imminently life-threatening. However, they can be readily identified and monitored with ultrasound before acute complications result.

Ultrasound technology can also be used for treatment purposes, most frequently as a visual aid during surgical procedures—such as guiding needle placement to drain fluid from a cyst, or to extract tumor cells for biopsy. Increasingly, direct therapeutic applications for ultrasound are being developed.

The direct therapeutic value of ultrasonic waves lies in their mechanical nature. They are shock waves, just like audible sound, and vibrate the materials through which

they pass. These vibrations are mild, virtually unnoticeable at the frequencies and intensities used for imaging. Properly focused however, high-intensity ultrasound can be used to heat and physically agitate targeted tissues.

High-intensity ultrasound is used routinely to treat soft tissue injuries, such as strains, tears and associated scarring. The heating and agitation are believed to promote rapid healing through increased circulation. Strongly focused, high-intensity, high-frequency ultrasound can also be used to physically destroy certain types of tumors, as well as gallstones and other types of calculi. Developing new treatment applications for ultrasound is an active area of medical research.

Precautions

Properly performed, ultrasound imaging is virtually without risk or side effects. Some patients report feeling a slight tingling and/or warmth while being scanned, but most feel nothing at all. Ultrasound waves of appropriate frequency and intensity are not known to cause or aggravate any medical condition, though any woman who thinks she might be pregnant should raise the issue with her doctor before undergoing an abdominal ultrasound.

The value of ultrasound imaging as a medical tool, however, depends greatly on the quality of the equipment used and the skill of the medical personnel operating it. Improperly performed and/or interpreted, ultrasound can be worse than useless if it indicates that a problem exists where there is none, or fails to detect a significant condition. Basic ultrasound equipment is relatively inexpensive to obtain, and any doctor with the equipment can perform the procedure whether qualified or not. Patients should not hesitate to verify the credentials of technicians and doctors performing ultrasounds, as well as the quality of the equipment used and the benefits of the proposed procedure.

In cases where ultrasound is used as a treatment tool, patients should educate themselves about the proposed procedure with the help of their doctors—as is appropriate before any surgical procedure. Also, any abdominal ultrasound procedure, diagnostic or therapeutic, may be hampered by a patient's body type or other factors, such as the presence of excessive bowel gas (which is opaque to ultrasound). In particular, very obese people are often not good candidates for abdominal ultrasound.

Description

Ultrasound includes all sound waves above the frequency of human hearing—about 20 thousand hertz, or cycles per second. Medical ultrasound generally uses frequencies between one and 10 million hertz (1-10 MHz).

KEY TERMS

Accessory organ—A lump of tissue adjacent to an organ that is similar to it, but which serves no important purpose, if functional at all. While not necessarily harmful, such organs can cause problems if they grow too large or become cancerous. In any case, their presence points to an underlying abnormality in the parent organ.

Benign—In medical usage, benign is the opposite of malignant. It describes an abnormal growth that is stable, treatable and generally not life-threatening.

Biopsy—The surgical removal and analysis of a tissue sample for diagnostic purposes. Usually, the term refers to the collection and analysis of tissue from a suspected tumor to establish malignancy.

Calculus—Any type of hard concretion (stone) in the body, but usually found in the gallbladder, pancreas and kidneys. They are formed by the accumulation of excess mineral salts and other organic material such as blood or mucous. Calculi (pl.) can cause problems by lodging in and obstructing the proper flow of fluids, such as bile to the intestines or urine to the bladder.

Cirrhosis—A chronic liver disease characterized by the invasion of connective tissue and the degeneration of proper functioning—jaundice is often an accompanying symptom. Causes of cirrhosis include alcoholism, metabolic diseases, syphilis and congestive heart disease.

Common bile duct—The branching passage through which bile—a necessary digestive enzyme—travels from the liver and gallbladder into the small intestine. Digestive enzymes from the pancreas also enter the intestines through the common bile duct.

Computed tomography scan (CT scan)—A specialized type of x-ray imaging that uses highly focused and relatively low energy radiation to produce detailed two-dimensional images of soft tissue structures, particularly the brain. CT scans are the chief competitor to ultrasound and can yield higher quality images not disrupted by bone or gas. They are, however, more cumbersome, time consuming

and expensive to perform, and they use ionizing electromagnetic radiation.

Doppler—The Doppler effect refers to the apparent change in frequency of sound wave echoes returning to a stationary source from a moving target. If the object is moving toward the source, the frequency increases; if the object is moving away, the frequency decreases. The size of this frequency shift can be used to compute the object's speed—be it a car on the road or blood in an artery. The Doppler effect holds true for all types of radiation, not just sound.

Frequency—Sound, whether traveling through air or the human body, produces vibrations—molecules bouncing into each other—as the shock wave travels along. The frequency of a sound is the number of vibrations per second. Within the audible range, frequency means pitch—the higher the frequency, the higher a sound's pitch.

Ionizing radiation—Radiation that can damage living tissue by disrupting and destroying individual cells at the molecular level. All types of nuclear radiation—x rays, gamma rays and beta rays—are potentially ionizing. Sound waves physically vibrate the material through which they pass, but do not ionize it.

Jaundice—A condition that results in a yellow tint to the skin, eyes and body fluids. Bile retention in the liver, gallbladder and pancreas is the immediate cause, but the underlying cause could be as simple as obstruction of the common bile duct by a gallstone or as serious as pancreatic cancer. Ultrasound can distinguish between these conditions.

Malignant—The term literally means growing worse and resisting treatment. It is used as a synonym for cancerous and connotes a harmful condition that generally is life-threatening.

Morphology—Literally, the study of form. In medicine, morphology refers to the size, shape and structure rather than the function of a given organ. As a diagnostic imaging technique, ultrasound facilitates the recognition of abnormal morphologies as symptoms of underlying conditions.

Higher frequency ultrasound waves produce more detailed images, but are also more readily absorbed and so cannot penetrate as deeply into the body. Abdominal ultrasound imaging is generally performed at frequencies between 2-5 MHz.

An ultrasound machine consists of two parts: the transducer and the analyzer. The transducer both produces the sound waves that penetrate the body and receives the reflected echoes. Transducers are built around piezoelectric ceramic chips. (Piezoelectric refers to electricity that is produced when you put pressure on certain crystals such as quartz). These ceramic chips react to electric pulses by producing sound waves (they are transmitting waves) and react to sound waves by producing electric pulses (receiving). Bursts of high frequency electric pulses supplied to the transducer causes it to produce the scanning sound waves. The transducer then receives the returning echoes, translates them back into electric pulses and sends them to the analyzer—a computer that organizes the data into an image on a television screen.

Because sound waves travel through all the body's tissues at nearly the same speed—about 3,400 miles per hour—the microseconds it takes for each echo to be received can be plotted on the screen as a distance into the body. The relative strength of each echo, a function of the specific tissue or organ boundary that produced it, can be plotted as a point of varying brightness. In this way, the echoes are translated into a picture. Tissues surrounded by bone or filled with gas (the stomach, intestines and bowel) cannot be imaged using ultrasound, because the waves are blocked or become randomly scattered.

Four different modes of ultrasound are used in medical imaging:

- **A-mode.** This is the simplest type of ultrasound in which a single transducer scans a line through the body with the echoes plotted on screen as a function of depth. This method is used to measure distances within the body and the size of internal organs. Therapeutic ultrasound aimed at a specific tumor or calculus is also A-mode, to allow for pinpoint accurate focus of the destructive wave energy.
- **B-mode.** In B-mode ultrasound, a linear array of transducers simultaneously scans a plane through the body that can be viewed as a two-dimensional image on screen. Ultrasound probes containing more than 100 transducers in sequence form the basis for these most commonly used scanners, which cost about \$50,000.
- **M-Mode.** The M stands for motion. A rapid sequence of B-mode scans whose images follow each other in sequence on screen enables doctors to see and measure range of motion, as the organ boundaries that produce reflections move relative to the probe. M-

mode ultrasound has been put to particular use in studying heart motion.

- **Doppler mode.** **Doppler ultrasonography** includes the capability of accurately measuring velocities of moving material, such as blood in arteries and veins. The principle is the same as that used in radar guns that measure the speed of a car on the highway. Doppler capability is most often combined with B-mode scanning to produce images of blood vessels from which blood flow can be directly measured. This technique is used extensively to investigate valve defects, arteriosclerosis and **hypertension**, particularly in the heart, but also in the abdominal aorta and the portal vein of the liver. These machines cost about \$250,000.

The actual procedure for a patient undergoing an abdominal ultrasound is relatively simple, regardless of the type of scan or its purpose. **Fasting** for at least eight hours prior to the procedure ensures that the stomach is empty and as small as possible, and that the intestines and bowels are relatively inactive. Fasting also allows the gall bladder to be seen, as it contracts after eating and may not be seen if the stomach is full. In some cases, a full bladder helps to push intestinal folds out of the way so that the gas they contain does not disrupt the image. The patient's abdomen is then greased with a special gel that allows the ultrasound probe to glide easily across the skin while transmitting and receiving ultrasonic pulses.

This procedure is conducted by a doctor with the assistance of a technologist skilled in operating the equipment. The probe is moved around the abdomen to obtain different views of the target areas. The patient will likely be asked to change positions from side to side and to hold their breath as necessary to obtain the desired views. Discomfort during the procedure is minimal.

The many types and uses of ultrasound technology makes it difficult to generalize about the time and costs involved. Relatively simple imaging—scanning a suspicious abdominal mass or a suspected abdominal aortic aneurysm—will take about half an hour to perform and will cost a few hundred dollars or more, depending on the quality of the equipment, the operator and other factors. More involved techniques such as multiple M-mode and Doppler-enhanced scans, or cases where the targets not well defined in advance, generally take more time and are more expensive.

Regardless of the type of scan used and the potential difficulties encountered, ultrasound remains faster and less expensive than **computed tomography scans (CT)**, its primary rival in abdominal imaging. Furthermore, as abdominal ultrasounds are generally undertaken as “medically necessary” procedures designed to detect the presence of suspected abnormalities, they are covered

under most types of major medical insurance. As always, though, the patient would be wise to confirm that their coverage extends to the specific procedure proposed. For nonemergency situations, most underwriters stipulate prior approval as a condition of coverage.

Specific conditions for which ultrasound may be selected as a treatment option—certain types of tumors, lesions, **kidney stones** and other calculi, muscle and ligament injuries, etc.—are described in detail under the appropriate entries in this encyclopedia.

Preparation

A patient undergoing abdominal ultrasound will be advised by their physician about what to expect and how to prepare. As mentioned above, preparations generally include fasting and arriving for the procedure with a full bladder, if necessary. This preparation is particularly useful if the gallbladder, ovaries or veins are to be examined.

Aftercare

In general, no aftercare related to the abdominal ultrasound procedure itself is required.

Risks

Abdominal ultrasound carries with it no recognized risks or side effects, if properly performed using appropriate frequency and intensity ranges. Sensitive tissues, particularly those of the reproductive organs, could possibly sustain damage if violently vibrated by overly intense ultrasound waves. In general though, such damage would only result from improper use of the equipment.

Any woman who thinks she might be pregnant should raise this issue with her doctor before undergoing an abdominal ultrasound, as a fetus in the early stages of development could be injured by ultrasound meant to probe deeply recessed abdominal organs.

Normal results

As a diagnostic imaging technique, a normal abdominal ultrasound is one that indicates the absence of the suspected condition that prompted the scan. For example, symptoms such as a persistent **cough**, labored breathing, and upper abdominal pain suggest the possibility of, among other things, an abdominal aortic aneurysm. An ultrasound scan that indicates the absence of an aneurysm would rule out this life-threatening condition and point to other, less serious causes.

Abnormal results

Because abdominal ultrasound imaging is generally undertaken to confirm a suspected condition, the results

of a scan often will prove abnormal—that is they will confirm the diagnosis, be it kidney stones, cirrhosis of the liver or an aortic aneurysm. At that point, appropriate medical treatment as prescribed by a patient's doctor is in order. See the relevant disease and disorder entries in this encyclopedia for more information.

Resources

BOOKS

- Hall, Rebecca. *The Ultrasonic Handbook: Clinical, Etiologic and Pathologic Implications of Sonographic Findings*. Philadelphia: Lippincott, 1993.
- Kevles, Bettyann Holtzmann. *Naked to the Bone: Medical Imaging in the Twentieth Century*. New Brunswick, NJ: Rutgers University Press, 1997.
- Kremkau, Frederick W. *Diagnostic Ultrasound: Principles and Instruments*. Philadelphia: W. B. Saunders Co., 1993.
- Shtasel, Philip. *Medical Tests and Diagnostic Procedures: A Patient's Guide to Just What the Doctor Ordered*. New York: Harper & Row, 1991.
- Tempkin, Betty Bates. *Ultrasound Scanning: Principles and Protocols*. Philadelphia: W. B. Saunders Co., 1993.
- The Patient's Guide to Medical Tests*. Ed. Barry L. Zaret, et al. Boston: Houghton Mifflin, 1997.

PERIODICALS

- "Ultrasound Detects Stomach Problems." *USA Today Magazine* (October 1992): 5.
- Freundlich, Naomi. "Ultrasound: What's Wrong with this Picture?" *Business Week* (15 September 1997): 84-5.
- McDonagh, D. Brian. "Ultrasound: Unsung Medical Hero." *USA Today Magazine* (September 1996): 66-7.
- Murray, Maxine. "Basics of Ultrasonography." *Student British Medical Journal* (August 1996): 269-72.
- Tait, N., and J. M. Little. "The Treatment of Gallstones." *British Medical Journal* (8 July 1995): 99-105.

ORGANIZATIONS

- American College of Gastroenterology. 4900 B South 31st St., Arlington, VA 22206-1656. (703) 820-7400. <<http://www.acg.gi.org>>.
- American Institute of Ultrasound in Medicine. 14750 Sweitzer Lane, Suite 100, Laurel, MD 20707-5906. (800) 638-5352. <<http://www.aium.org>>.
- American Society of Radiologic Technologists. 15000 Central Ave., SE, Albuquerque, NM 87123-3917. (505) 298-4500. <<http://www.asrt.org>>.

Kurt Richard Sternlof

Abdominal wall defects

Definition

Abdominal wall defects are birth (congenital) defects that allow the stomach or intestines to protrude.

KEY TERMS

Hernia—Movement of a structure into a place it does not belong.

Umbilical—Referring to the opening in the abdominal wall where the blood vessels from the placenta enter.

Viscera—Any of the body's organs located in the chest or abdomen.

Description

Many unexpected and fascinating events occur during the development of a fetus inside the womb. The stomach and intestines begin development outside the baby's abdomen and only later does the abdominal wall enclose them. Occasionally, either the umbilical opening is too large, or it develops improperly, allowing the bowels or stomach to remain outside or squeeze through the abdominal wall.

Causes and symptoms

There are many causes for **birth defects** that still remain unclear. Presently, the cause(s) of abdominal wall defects is unknown, and any symptoms the mother may have to indicate that the defects are present in the fetus are nondescript.

Diagnosis

At birth, the problem is obvious, because the base of the umbilical cord at the navel will bulge or, in worse cases, contain viscera (internal organs). Before birth, an ultrasound examination may detect the problem. It is always necessary in children with one birth defect to look for others, because birth defects are usually multiple.

Treatment

Abdominal wall defects are effectively treated with surgical repair. Unless there are accompanying anomalies, the surgical procedure is not overly complicated. The organs are normal, just misplaced. However, if the defect is large, it may be difficult to fit all the viscera into the small abdominal cavity.

Prognosis

If there are no other defects, the prognosis after surgical repair of this condition is relatively good. However,

10% of those with more severe or additional abnormalities die from it. The organs themselves are fully functional; the difficulty lies in fitting them inside the abdomen. The condition is, in fact, a **hernia** requiring only replacement and strengthening of the passageway through which it occurred. After surgery, increased pressure in the stretched abdomen can compromise the function of the organs inside.

Prevention

Some, but by no means all, birth defects are preventable by early and attentive prenatal care, good **nutrition**, supplemental **vitamins**, diligent avoidance of all unnecessary drugs and chemicals—especially tobacco—and other elements of a healthy lifestyle.

Resources

PERIODICALS

Dunn, J. C., and E. W. Fonkalsrud. "Improved Survival of Infants with Omphalocele." *American Journal of Surgery* 173 (April 1997): 284-7.

Langer, J. C. "Gastroschisis and Omphalocele." *Seminars in Pediatric Surgery* 5 (May 1996): 124-8.

J. Ricker Polsdorfer, MD

Abnormal heart rhythms see **Arrhythmias**

ABO blood typing see **Blood typing and crossmatching**

ABO incompatibility see **Erythroblastosis fetalis**

Abortion, habitual see **Recurrent miscarriage**

Abortion, partial birth

Definition

Partial birth abortion is a method of late-term abortion that terminates a **pregnancy** and results in the **death** and intact removal of a fetus. This procedure is most commonly referred to as intact dilatation and extraction (D & X).

Purpose

Partial birth abortion, or D&X, is performed to end a pregnancy and results in the death of a fetus, typically in

the late second or third trimester. Although D&X is highly controversial, some physicians argue that it has advantages that make it a preferable procedure in some circumstances. One perceived advantage is that the fetus is removed largely intact, allowing for better evaluation and **autopsy** of the fetus in cases of known fetal anomalies. Intact removal of the fetus may also confer a lower risk of puncturing the uterus or damaging the cervix. Another perceived advantage is that D&X ends the pregnancy without requiring the woman to go through labor, which may be less emotionally traumatic than other methods of late-term abortion. In addition, D&X may offer a lower cost and shorter procedure time.

Precautions

Women considering D&X should be aware of the highly controversial nature of this procedure. A controversy common to all late-term abortions is whether the fetus is viable, or able to survive outside of the woman's body. A specific area of controversy with D&X is that fetal death does not occur until after most of the fetal body has exited the uterus. Several states have taken legal action to limit or ban D&X and many physicians who perform abortions do not perform D&X. This may restrict the availability of this procedure to women seeking late-term abortion.

Description

Intact D&X, or partial birth abortion first involves administration of medications to cause the cervix to dilate, usually over the course of several days. Next, the physician rotates the fetus to a footling breech position. The body of the fetus is then drawn out of the uterus feet first, until only the head remains inside the uterus. Then, the physician uses an instrument to puncture the base of the skull, which collapses the fetal head. Typically, the contents of the fetal head are then partially suctioned out, which results in the death of the fetus, and reduces the sizes of the fetal head enough to allow it to pass through the cervix. The dead and otherwise intact fetus is then removed from the woman's body.

Preparation

Medical preparation for D&X involves an outpatient visit to administer medications, such as *laminaria*, to cause the cervix to begin dilating.

In addition, preparation may involve fulfilling local legal requirements, such as a mandatory waiting period, counseling, or an informed consent procedure reviewing stages of fetal development, **childbirth**, alternative abortion methods, and adoption.

KEY TERMS

Cervix—The narrow outer end of the uterus that separates the uterus from the vaginal canal.

Footling breech—A position of the fetus while in the uterus where the feet of the fetus are nearest the cervix would be the first part of the fetus to exit the uterus, with the head of the fetus being the last part to exit the uterus.

Laminaria—A medical product made from a certain type of seaweed that is physically placed near the cervix to cause it to dilate.

Aftercare

D&X typically does not require an overnight hospital stay, so a follow up appointment may be scheduled to monitor the woman for any complications.

Risks

With all abortion, the later in pregnancy an abortion is performed, the more complicated the procedure and the greater the risk of injury to the woman. In addition to associated emotion reactions, D&X carries the risk of injury to the woman, including heavy bleeding, blood clots, damage to the cervix or uterus, pelvic infection, and anesthesia-related complications. There is also a risk of incomplete abortion, meaning that the fetus is not dead when removed from the woman's body. Possible long-term risks include difficulty becoming pregnant or carrying a future pregnancy to term.

Normal results

The expected outcome of D&X is the termination of a pregnancy with removal of a dead fetus from the woman's body.

Resources

PERIODICALS

Epner, Janet E., et al. "Late-term Abortion." *JAMA* 280, no. 8 (26 August 1998): 724-729.

Sprang, M. LeRoy, and Neerhof, Mark G. "Rationale for Banning Abortions Late in Pregnancy." *JAMA* (26 August 1998): 744-747.

Swomley, John M. "The 'Partial-birth' Debate in 1998." *Humanist* (March/April 1998): 5-7.

Grimes, David A. "The Continuing Need for Late Abortion." *JAMA* (26 August 1998): 747-750.

ORGANIZATIONS

Planned Parenthood Federation of America. 810 Seventh Ave., New York, NY 10019. (212) 541-7800. FAX: (212) 245-1845.

OTHER

Status of partial-birth abortion laws in the states. Othmer Institute at Planned Parenthood of NYC. 2000.

Stefanie B. N. Dugan, M.S.

Abortion, selective

Definition

Selective abortion, also known as selective reduction, refers to choosing to abort a fetus, typically in a multi-fetal **pregnancy**, to decrease the health risks to the mother in carrying and giving birth to more than one or two babies, and also to decrease the risk of complications to the remaining fetus(es). The term selective abortion also refers to choosing to abort a fetus for reasons such as the woman is carrying a fetus which likely will be born with some birth defect or impairment, or because the sex of the fetus is not preferred by the individual.

Purpose

A woman may decide to abort for health reasons, for example, she is at higher risk for complications during pregnancy because of a disorder or disease such as diabetes.

However, selective reduction is recommended often in cases of multi-fetal pregnancy, or the presence of more than one fetus, typically, at least three or more fetuses. In the general population, multi-fetal pregnancy happens in only about 1-2% of pregnant women. But multi-fetal pregnancies occur far more often in women using fertility drugs.

Precautions

Because women or couples who use fertility drugs have made an extra effort to become pregnant, it is possible that the individuals may be unwilling or uncomfortable with the decision to abort a fetus in cases of multi-fetal pregnancy. Individuals engaging in fertility treatment should be made aware of the risk of multi-fetal pregnancy and consider the prospect of recommended reduction before undergoing fertility treatment.

Description

Selective reduction is usually performed between nine and 12 weeks of pregnancy and is most successful

when performed in early pregnancy. It is a simple procedure and can be performed on an outpatient basis. A needle is inserted into the woman's stomach or vagina and potassium chloride is injected into the fetus.

Preparation

Individuals who have chosen selective reduction to safeguard the remaining fetuses should be counseled prior to the procedure. Individuals should receive information regarding the risks of a multi-fetal pregnancy to both the fetuses and the mother compared with the risks after the reduction.

Individuals seeking an abortion for any reason should consider the ethical implications whether it be because the fetus is not the preferred sex or because the fetus would be born with a severe birth defect.

Aftercare

Counseling should continue after the abortion because it is a traumatic event. Individuals may feel guilty about choosing one fetus over another. Mental health professionals should be consulted throughout the process.

Risks

About 75% of women who undergo selective reduction will go into **premature labor**. About 4-5% of women undergoing selective reduction also miscarry one or more of the remaining fetuses. The risks associated with multi-fetal pregnancy is considered higher.

Normal results

In cases where a multi-fetal pregnancy, three or more fetuses, is reduced to two, the twin fetuses typically develop as they would as if they were conceived as twins.

Resources**BOOKS**

Knobil, Ernst and Jimmy D. Neill, editors. "Abortion." In *Encyclopedia of Reproduction*. San Diego: Academic Press, 1998, pp.1-5.

Scott, James R., editor. "Induced Abortion." In *Danforth's Obstetrics and Gynecology*. Philadelphia: Lippincott Williams & Wilkins, 1999, pp.567-578.

PERIODICALS

Author unspecified. "Multiple Pregnancy Associated With Infertility Therapy." *American Society for Reproductive Medicine, A Practice Committee Report* (November 2000): 1-8.

KEY TERMS

Multi-fetal pregnancy—A pregnancy of two or more fetuses.

Selective reduction—Typically referred to in cases of multifetal pregnancy, when one or more fetuses are aborted to preserve the viability of the remaining fetuses and decrease health risks to the mother.

ORGANIZATIONS

The American Society for Reproductive Medicine. 1209 Montgomery Highway, Birmingham, AL 35216-2809. (205) 978-5000. <<http://www.asrm.org>>.

The Alan Guttmacher Institute. 120 Wall Street, New York, NY 10005. (212) 248-1111. <<http://www.agi-usa.org>>.

Meghan M. Gourley

Abortion, spontaneous see **Miscarriage**

Abortion, therapeutic

Definition

Therapeutic abortion is the intentional termination of a **pregnancy** before the fetus can live independently. Abortion has been a legal procedure in the United States since 1973.

Purpose

An abortion may be performed whenever there is some compelling reason to end a pregnancy. Women have abortions because continuing the pregnancy would cause them hardship, endanger their life or health, or because prenatal testing has shown that the fetus will be born with severe abnormalities.

Abortions are safest when performed within the first six to 10 weeks after the last menstrual period. The calculation of this date is referred to as the gestational age and is used in determining the stage of pregnancy. For example, a woman who is two weeks late having her period is said to be six weeks pregnant, because it is six weeks since she last menstruated.

About 90% of women who have abortions do so before 13 weeks and experience few complications. Abortions performed between 13-24 weeks have a higher

rate of complications. Abortions after 24 weeks are extremely rare and are usually limited to situations where the life of the mother is in danger.

Precautions

Most women are able to have abortions at clinics or outpatient facilities if the procedure is performed early in pregnancy. Women who have stable diabetes, controlled epilepsy, mild to moderate high blood pressure, or who are HIV positive can often have abortions as outpatients if precautions are taken. Women with heart disease, previous **endocarditis**, **asthma**, lupus erythematosus, uterine fibroid tumors, blood clotting disorders, poorly controlled epilepsy, or some psychological disorders usually need to be hospitalized in order to receive special monitoring and medications during the procedure.

Description

Very early abortions

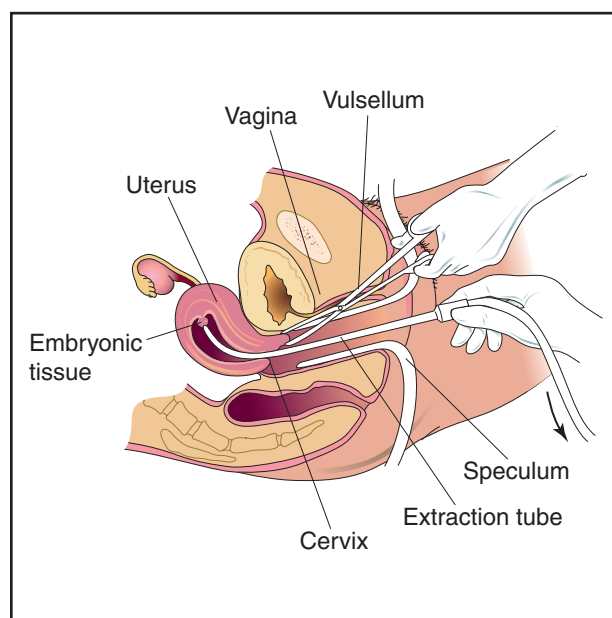
Between five and seven weeks, a pregnancy can be ended by a procedure called menstrual extraction. This procedure is also sometimes called menstrual regulation, mini-suction, or preemptive abortion. The contents of the uterus are suctioned out through a thin (3-4 mm) plastic tube that is inserted through the undilated cervix. Suction is applied either by a bulb syringe or a small pump.

Another method is called the “morning after” pill, or emergency **contraception**. Basically, it involves taking high doses of birth control pills within 24 to 48 hours of having unprotected sex. The high doses of hormones causes the uterine lining to change so that it will not support a pregnancy. Thus, if the egg has been fertilized, it is simply expelled from the body.

There are two types of emergency contraception. One type is identical to ordinary birth control pills, and uses the hormones estrogen and progestin. This type is available with a prescription under the brand name Preven. But women can even use their regular birth control pills for emergency contraception, after they check with their doctor about the proper dose. About half of women who use birth control pills for emergency contraception get nauseated and 20 percent vomit. This method cuts the risk of pregnancy 75 percent.

The other type of morning-after pill contains only one hormone: progestin, and is available under the brand name Plan B. It is more effective than the first type with a lower risk of **nausea and vomiting**. It reduces the risk of pregnancy 89 percent.

Women should check with their physicians regarding the proper dose of pills to take, as it depends on the



Between 5 and 7 weeks, a pregnancy can be ended by a procedure called menstrual extraction. The contents of the uterus are suctioned out through a thin extraction tube that is inserted through the undilated cervix. (Illustration by Electronic Illustrators Group.)

brand of birth control pill. Not all birth control pills will work for emergency contraception.

Menstrual extractions are safe, but because the amount of fetal material is so small at this stage of development, it is easy to miss. This results in an incomplete abortion that means the pregnancy continues.

First trimester abortions

The first trimester of pregnancy includes the first 13 weeks after the last menstrual period. In the United States, about 90% of abortions are performed during this period. It is the safest time in which to have an abortion, and the time in which women have the most choice of how the procedure is performed.

MEDICAL ABORTIONS. Medical abortions are brought about by taking medications that end the pregnancy. The advantages of a first trimester medical abortion are:

- The procedure is non-invasive; no surgical instruments are used.
- Anesthesia is not required.
- Drugs are administered either orally or by injection.
- The procedure resembles a natural **miscarriage**.

Disadvantages of a medical abortion are:

- The effectiveness decreases after the seventh week.

- The procedure may require multiple visits to the doctor.
- Bleeding after the abortion lasts longer than after a surgical abortion.
- The woman may see the contents of her womb as it is expelled.

Two different medications can be used to bring about an abortion. Methotrexate (Rheumatrex) works by stopping fetal cells from dividing which causes the fetus to die.

On the first visit to the doctor, the woman receives an injection of methotrexate. On the second visit, about a week later, she is given misoprostol (Cytotec), an oxygenated unsaturated cyclic fatty acid responsible for various hormonal reactions such as muscle contraction (prostaglandin), that stimulates contractions of the uterus. Within two weeks, the woman will expel the contents of her uterus, ending the pregnancy. A follow-up visit to the doctor is necessary to assure that the abortion is complete.

With this procedure, a woman will feel cramping and may feel nauseated from the misoprostol. This combination of drugs is 90-96% effective in ending pregnancy.

Mifepristone (RU-486), which goes by the brand name Mifeprex, works by blocking the action of progesterone, a hormone needed for pregnancy to continue, then stimulates uterine contractions thus ending the pregnancy. It can be taken as much as 49 days after the first day of a woman's last period. On the first visit to the doctor, a woman takes a mifepristone pill. Two days later she returns and, if the miscarriage has not occurred, takes two misoprostol pills, which causes the uterus to contract. Five percent of women won't need to take misoprostol. After an observation period, she returns home.

Within four days, 90% of women have expelled the contents of their uterus and completed the abortion. Within 14 days, 95-97% of women have completed the abortion. A third follow-up visit to the doctor is necessary to confirm through observation or ultrasound that the procedure is complete. In the event that it is not, a surgical abortion is performed. Studies show that 4.5 to 8 percent of women need surgery or a blood **transfusion** after taking mifepristone, and the pregnancy persists in about 1 percent of women. In this case, surgical abortion is recommended because the fetus may be damaged. Side effects include nausea, vaginal bleeding and heavy cramping. The bleeding is typically heavier than a normal period and may last up to 16 days.

Mifepristone is not recommended for women with **ectopic pregnancy**, an **IUD**, who have been taking long-

term steroidal therapy, have bleeding abnormalities or on blood-thinners such as Coumadin.

Surgical abortions

First trimester surgical abortions are performed using vacuum aspiration. The procedure is also called dilation and evacuation (D & E), suction dilation, vacuum curettage, or suction curettage.

Advantages of a vacuum aspiration abortion are:

- It is usually done as a one-day outpatient procedure.
- The procedure takes only 10-15 minutes.
- Bleeding after the abortion lasts five days or less.
- The woman does not see the products of her womb being removed.

Disadvantages include:

- The procedure is invasive; surgical instruments are used.
- Infection may occur.

During a vacuum aspiration, the woman's cervix is gradually dilated by expanding rods inserted into the cervical opening. Once dilated, a tube attached to a suction pump is inserted through the cervix and the contents of the uterus are suctioned out. The procedure is 97-99% effective. The amount of discomfort a woman feels varies considerably. Local anesthesia is often given to numb the cervix, but it does not mask uterine cramping. After a few hours of rest, the woman may return home.

Second trimester abortions

Although it is better to have an abortion during the first trimester, some second trimester abortions may be inevitable. The results of **genetic testing** are often not available until 16 weeks. In addition, women, especially teens, may not have recognized the pregnancy or come to terms with it emotionally soon enough to have a first trimester abortion. Teens make up the largest group having second trimester abortions.

Some second trimester abortions are performed as a D & E. The procedures are similar to those used in the first trimester, but a larger suction tube must be used because more material must be removed. This increases the amount of cervical dilation necessary and increases the risk of the procedure. Many physicians are reluctant to perform a D & E this late in pregnancy, and for some women it is not a medically safe option.

The alternative to a D & E in the second trimester is an abortion by induced labor. Induced labor may require an overnight stay in a hospital. The day before the procedure, the woman visits the doctor for tests, and to either

KEY TERMS

Endocarditis—An infection of the inner membrane lining of the heart.

Fibroid tumors—Fibroid tumors are non-cancerous (benign) growths in the uterus. They occur in 30-40% of women over age 40, and do not need to be removed unless they are causing symptoms that interfere with a woman's normal activities.

Lupus erythematosus—A chronic inflammatory disease in which inappropriate immune system reactions cause abnormalities in the blood vessels and connective tissue.

Prostaglandin—Oxygenated unsaturated cyclic fatty acids responsible for various hormonal reactions such as muscle contraction.

Rh negative—Lacking the Rh factor, genetically determined antigens in red blood cells that produce immune responses. If an Rh negative woman is pregnant with an Rh positive fetus, her body will produce antibodies against the fetus's blood, causing a disease known as Rh disease. Sensitization to the disease occurs when the woman's blood is exposed to the fetus's blood. Rh immune globulin (RhoGAM) is a vaccine that must be given to a woman after an abortion, miscarriage, or prenatal tests in order to prevent sensitization to Rh disease.

have rods inserted in her cervix to help dilate it or to receive medication that will soften the cervix and speed up labor.

On the day of the abortion, drugs, usually prostaglandins to induce contractions, and a salt water solution, are injected into the uterus. Contractions begin, and within eight to 72 hours the woman delivers the fetus.

Side effects of this procedure include nausea, vomiting, and **diarrhea** from the prostaglandins, and **pain** from uterine cramps. Anesthesia of the sort used in **childbirth** can be given to mask the pain. Many women are able to go home a few hours after the procedure.

Very early abortions cost between \$200-\$400. Later abortions cost more. The cost increases about \$100 per week between the thirteenth and sixteenth week. Second trimester abortions are much more costly because they often involve more risk, more services, anesthesia, and sometimes a hospital stay. Insurance carriers and HMOs may or may not cover the procedure. Federal law pro-

hibits federal funds including Medicaid funds, from being used to pay for an elective abortion.

Preparation

The doctor must know accurately the stage of a woman's pregnancy before an abortion is performed. The doctor will ask the woman questions about her menstrual cycle and also do a **physical examination** to confirm the stage of pregnancy. This may be done at an office visit before the abortion or on the day of the abortion. Some states require a waiting period before an abortion can be performed. Others require parental or court consent for a child under age 18 to receive an abortion.

Despite the fact that almost half of all women in the United States have had at least one abortion by the time they reach age 45, abortion is surrounded by controversy. Women often find themselves in emotional turmoil when deciding if an abortion is a procedure they wish to undergo. Pre-abortion counseling is important in helping a woman resolve any questions she may have about having the procedure.

Aftercare

Regardless of the method used to perform the abortion, a woman will be observed for a period of time to make sure her blood pressure is stable and that bleeding is controlled. The doctor may prescribe **antibiotics** to reduce the chance of infection. Women who are Rh negative (lacking genetically determined antigens in their red blood cells that produce immune responses) should be given a human Rh immune globulin (RhoGAM) after the procedure unless the father of the fetus is also Rh negative. This prevents blood incompatibility complications in future pregnancies.

Bleeding will continue for about five days in a surgical abortion and longer in a medical abortion. To decrease the risk of infection, a woman should avoid intercourse and not use tampons and douches for two weeks after the abortion.

A follow-up visit is a necessary part of the woman's aftercare. Contraception will be offered to women who wish to avoid future pregnancies, because menstrual periods normally resume within a few weeks.

Risks

Serious complications resulting from abortions performed before 13 weeks are rare. Of the 90% of women who have abortions in this time period, 2.5% have minor complications that can be handled without hospitalization. Less than 0.5% have complications that require a hospital stay. The rate of complications increases as the pregnancy progresses.

Complications from abortions can include:

- uncontrolled bleeding
- infection
- blood clots accumulating in the uterus
- a tear in the cervix or uterus
- missed abortion where the pregnancy continues
- incomplete abortion where some material from the pregnancy remains in the uterus

Women who experience any of the following symptoms of post-abortion complications should call the clinic or doctor who performed the abortion immediately.

- severe pain
- fever over 100.4°F (38.2°C)
- heavy bleeding that soaks through more than one sanitary pad per hour
- foul-smelling discharge from the vagina
- continuing symptoms of pregnancy

Normal results

Usually the pregnancy is ended without complication and without altering future fertility.

Resources

BOOKS

Carlson, Karen J., Stephanie A. Eisenstat, and Terra Ziporyn. "Abortion." In *The Harvard Guide to Women's Health*. Cambridge, MA: Harvard University Press, 1996.

DeCherney, Alan H., and Martin L. Peroll. "Contraception and Family Planning." In *Current Obstetric and Gynecologic Diagnosis and Treatment*. Norwalk, CT: Appleton & Lange, 1994.

ORGANIZATION

National Abortion Federation. (800) 772-9100. <<http://www.prochoice.org>>.

Debra Gordon

Abrasions see **Wounds**

Abruptio placentae see **Placental abruption**

Abscess

Definition

An abscess is an enclosed collection of liquefied tissue, known as pus, somewhere in the body. It is the result of the body's defensive reaction to foreign material.

Description

There are two types of abscesses, septic and sterile. Most abscesses are septic, which means that they are the result of an infection. Septic abscesses can occur anywhere in the body. Only a germ and the body's immune response are required. In response to the invading germ, white blood cells gather at the infected site and begin producing chemicals called enzymes that attack the germ by digesting it. These enzymes act like acid, killing the germs and breaking them down into small pieces that can be picked up by the circulation and eliminated from the body. Unfortunately, these chemicals also digest body tissues. In most cases, the germ produces similar chemicals. The result is a thick, yellow liquid—pus—containing digested germs, digested tissue, white blood cells, and enzymes.

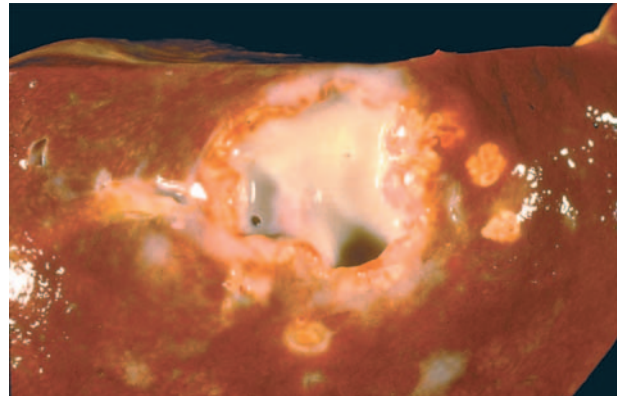
An abscess is the last stage of a tissue infection that begins with a process called inflammation. Initially, as the invading germ activates the body's immune system, several events occur:

- Blood flow to the area increases.
- The temperature of the area increases due to the increased blood supply.
- The area swells due to the accumulation of water, blood, and other liquids.
- It turns red.
- It hurts, because of the irritation from the swelling and the chemical activity.

These four signs—heat, swelling, redness, and pain—characterize inflammation.

As the process progresses, the tissue begins to turn to liquid, and an abscess forms. It is the nature of an abscess to spread as the chemical digestion liquefies more and more tissue. Furthermore, the spreading follows the path of least resistance—the tissues most easily digested. A good example is an abscess just beneath the skin. It most easily continues along beneath the skin rather than working its way through the skin where it could drain its toxic contents. The contents of the abscess also leak into the general circulation and produce symptoms just like any other infection. These include chills, **fever**, aching, and general discomfort.

Sterile abscesses are sometimes a milder form of the same process caused not by germs but by non-living irritants such as drugs. If an injected drug like penicillin is not absorbed, it stays where it was injected and may cause enough irritation to generate a sterile abscess—sterile because there is no infection involved. Sterile abscesses are quite likely to turn into hard, solid lumps as they scar, rather than remaining pockets of pus.



An amoebic abscess caused by *Entamoeba histolytica*.
(Phototake NYC. Reproduced by permission.)

Causes and symptoms

Many different agents cause abscesses. The most common are the pus-forming (pyogenic) bacteria like *Staphylococcus aureus*, which is nearly always the cause of abscesses under the skin. Abscesses near the large bowel, particularly around the anus, may be caused by any of the numerous bacteria found within the large bowel. Brain abscesses and liver abscesses can be caused by any organism that can travel there through the circulation. Bacteria, amoeba, and certain fungi can travel in this fashion. Abscesses in other parts of the body are caused by organisms that normally inhabit nearby structures or that infect them. Some common causes of specific abscesses are:

- skin abscesses by normal skin flora
- dental and throat abscesses by mouth flora
- lung abscesses by normal airway flora, **pneumonia** germs, or **tuberculosis**
- abdominal and anal abscesses by normal bowel flora

Specific types of abscesses

Listed below are some of the more common and important abscesses.

- Carbuncles and other **boils**. Skin oil glands (sebaceous glands) on the back or the back of the neck are the ones usually infected. The most common germ involved is *Staphylococcus aureus*. **Acne** is a similar condition of sebaceous glands on the face and back.
- Pilonidal abscess. Many people have as a birth defect a tiny opening in the skin just above the anus. Fecal bacteria can enter this opening, causing an infection and subsequent abscess.

KEY TERMS

Cellulitis—Inflammation of tissue due to infection.

Enzyme—Any of a number of protein chemicals that can change other chemicals.

Fallopian tubes—Part of the internal female anatomy that carries eggs from the ovaries to the uterus.

Flora—Living inhabitants of a region or area.

Pyogenic—Capable of generating pus. *Streptococcus*, *Staphylococcus*, and bowel bacteria are the primary pyogenic organisms.

Sebaceous glands—Tiny structures in the skin that produce oil (sebum). If they become plugged, sebum collects inside and forms a nurturing place for germs to grow.

Septicemia—The spread of an infectious agent throughout the body by means of the blood stream.

Sinus—A tubular channel connecting one body part with another or with the outside.

- Retropharyngeal, parapharyngeal, peritonsillar abscess. As a result of throat infections like **strep throat** and **tonsillitis**, bacteria can invade the deeper tissues of the throat and cause an abscess. These abscesses can compromise swallowing and even breathing.
- Lung abscess. During or after pneumonia, whether it's due to bacteria [common pneumonia], tuberculosis, fungi, parasites, or other germs, abscesses can develop as a complication.
- Liver abscess. Bacteria or amoeba from the intestines can spread through the blood to the liver and cause abscesses.
- Psoas abscess. Deep in the back of the abdomen on either side of the lumbar spine lie the psoas muscles. They flex the hips. An abscess can develop in one of these muscles, usually when it spreads from the appendix, the large bowel, or the fallopian tubes.

Diagnosis

The common findings of inflammation—heat, redness, swelling, and pain—easily identify superficial abscesses. Abscesses in other places may produce only generalized symptoms such as fever and discomfort. If the patient's symptoms and **physical examination** do not help, a physician may have to resort to a battery of tests to

locate the site of an abscess, but usually something in the initial evaluation directs the search. Recent or chronic disease in an organ suggests it may be the site of an abscess. Dysfunction of an organ or system—for instance, seizures or altered bowel function—may provide the clue. **Pain** and tenderness on physical examination are common findings. Sometimes a deep abscess will eat a small channel (sinus) to the surface and begin leaking pus. A sterile abscess may cause only a painful lump deep in the buttock where a shot was given.

Treatment

Since skin is very resistant to the spread of infection, it acts as a barrier, often keeping the toxic chemicals of an abscess from escaping the body on their own. Thus, the pus must be drained from the abscess by a physician. The surgeon determines when the abscess is ready for drainage and opens a path to the outside, allowing the pus to escape. Ordinarily, the body handles the remaining infection, sometimes with the help of **antibiotics** or other drugs. The surgeon may leave a drain (a piece of cloth or rubber) in the abscess cavity to prevent it from closing before all the pus has drained out.

Alternative treatment

If an abscess is directly beneath the skin, it will be slowly working its way through the skin as it is more rapidly working its way elsewhere. Since chemicals work faster at higher temperatures, applications of hot compresses to the skin over the abscess will hasten the digestion of the skin and eventually result in its breaking down, releasing the pus spontaneously. This treatment is best reserved for smaller abscesses in relatively less dangerous areas of the body—limbs, trunk, back of the neck. It is also useful for all superficial abscesses in their very early stages. It will “ripen” them.

Contrast **hydrotherapy**, alternating hot and cold compresses, can also help assist the body in resorption of the abscess. There are two homeopathic remedies that work to rebalance the body in relation to abscess formation, *Silica* and *Hepar sulphuris*. In cases of septic abscesses, bentonite clay packs (bentonite clay and a small amount of *Hydrastis* powder) can be used to draw the infection from the area.

Prognosis

Once the abscess is properly drained, the prognosis is excellent for the condition itself. The reason for the abscess (other diseases the patient has) will determine the overall outcome. If, on the other hand, the abscess ruptures into neighboring areas or permits the infectious

agent to spill into the bloodstream, serious or fatal consequences are likely. Abscesses in and around the nasal sinuses, face, ears, and scalp may work their way into the brain. Abscesses within an abdominal organ such as the liver may rupture into the abdominal cavity. In either case, the result is life threatening. Blood **poisoning** is a term commonly used to describe an infection that has spilled into the blood stream and spread throughout the body from a localized origin. Blood poisoning, known to physicians as septicemia, is also life threatening.

Of special note, abscesses in the hand are more serious than they might appear. Due to the intricate structure and the overriding importance of the hand, any hand infection must be treated promptly and competently.

Prevention

Infections that are treated early with heat (if superficial) or antibiotics will often resolve without the formation of an abscess. It is even better to avoid infections altogether by taking prompt care of open injuries, particularly puncture **wounds**. Bites are the most dangerous of all, even more so because they often occur on the hand.

Resources

BOOKS

- Bennett, J. Claude, and Fred Plum, eds. *Cecil Textbook of Medicine*. Philadelphia: W. B. Saunders Co., 1996.
- Current Medical Diagnosis and Treatment*, 1996. 35th ed. Ed. Stephen McPhee, et al. Stamford: Appleton & Lange, 1995.
- Harrison's Principles of Internal Medicine*. Ed. Anthony S. Fauci, et al. New York: McGraw-Hill, 1997.

J. Ricker Polsdorfer, MD

Abscess drainage see **Abscess incision and drainage**

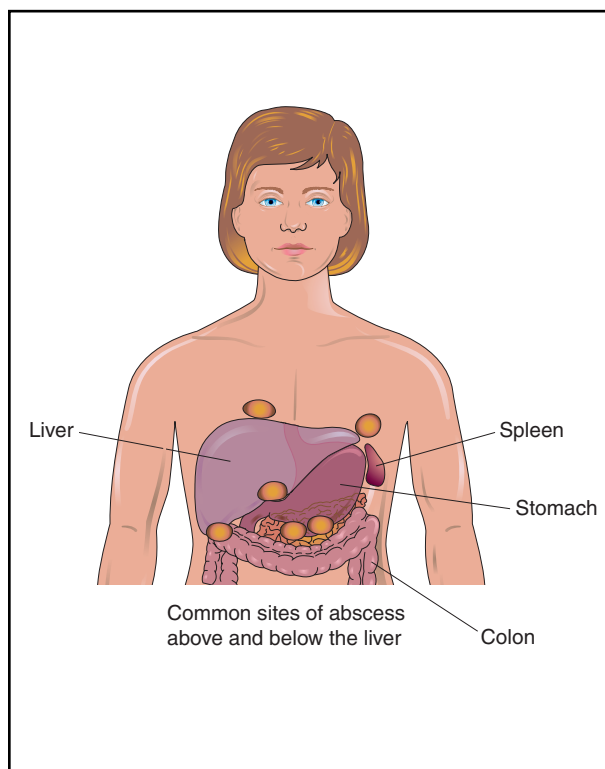
Abscess incision & drainage

Definition

An infected skin nodule that contains pus may need to be drained via a cut if it does not respond to **antibiotics**. This allows the pus to escape, and the infection to heal.

Purpose

An **abscess** is a pus-filled sore, usually caused by a bacterial infection. The pus is made up of both live and dead organisms and destroyed tissue from the white



Although abscesses are often found in the soft tissue under the skin, such as the armpit or the groin, they may develop in any organ, such as the liver. (Illustration by Electronic Illustrators Group.)

blood cells that were carried to the area to fight the infection. Abscesses are often found in the soft tissue under the skin, such as the armpit or the groin. However, they may develop in any organ, and are commonly found in the breast and gums. Abscesses are far more serious and call for more specific treatment if they are located in deep organs such as the lung, liver or brain.

Because the lining of the abscess cavity tends to interfere with the amount of the drug that can penetrate the source of infection from the blood, the cavity itself may require draining. Once an abscess has fully formed, it often does not respond to antibiotics. Even if the antibiotic does penetrate into the abscess, it doesn't function as well in that environment.

Precautions

An abscess can usually be diagnosed visually, although an imaging technique such as a computed tomography scan may be used to confirm the extent of the abscess before drainage. Such procedures may also be needed to localize internal abscesses, such as those in the abdominal cavity or brain.

KEY TERMS

White blood cells—Cells that protect the body against infection.

Description

A doctor will cut into the lining of the abscess, allowing the pus to escape either through a drainage tube or by leaving the cavity open to the skin. How big the incision is depends on how quickly the pus is encountered.

Once the abscess is opened, the doctor will clean and irrigate the wound thoroughly with saline. If it is not too large or deep, the doctor may simply pack the abscess wound with gauze for 24–48 hours to absorb the pus and discharge.

If it is a deeper abscess, the doctor may insert a drainage tube after cleaning out the wound. Once the tube is in place, the surgeon closes the incision with simple stitches, and applies a sterile dressing. Drainage is maintained for several days to help prevent the abscess from reforming.

Preparation

The skin over the abscess will be cleansed by swabbing gently with an antiseptic solution.

Aftercare

Much of the **pain** around the abscess will be gone after the surgery. Healing is usually very fast. After the tube is taken out, antibiotics may be continued for several days. Applying heat and keeping the affected area elevated may help relieve inflammation.

Risks

If there is any scarring, it is likely to become much less noticeable as time goes on, and eventually almost invisible. Occasionally, an abscess within a vital organ (such as the brain) damages enough surrounding tissue that there is some permanent loss of normal function.

Normal results

Most abscesses heal after drainage alone; others require drainage and antibiotic drug treatment.

Resources

BOOKS

Turkington, Carol A., and Jeffrey S. Dover. *Skin Deep*. New York: Facts on File, 1998.

ORGANIZATIONS

National Institute of Arthritis and Musculoskeletal and Skin Diseases. 9000 Rockville Pike, Bldg. 31, Rm 9A04, Bethesda, MD 20892.

Carol A. Turkington

Abuse

Definition

Abuse is defined as any thing that is harmful, injurious, or offensive. Abuse also includes excessive and wrongful misuse of anything. There are several major types of abuse: physical and sexual abuse of a child or an adult, substance abuse, elderly abuse, and emotional abuse.

Description

Physical abuse of a child is the infliction of injury by an other person. The injuries can include punching, kicking, biting, burning, beating, or pulling the victim's hair. The physical abuse inflicted on a child can result in **bruises, burns, poisoning**, broken bones, and internal hemorrhages. Physical assault against an adult primarily occurs with women, usually in the form of domestic violence. It is estimated that approximately three million children witness domestic violence every year.

Sexual abuse of a child refers to sexual behavior between an adult and child or between two children, one of whom is dominant or significantly older. The sexual behaviors can include touching breasts, genitals, and buttocks; either dressed or undressed. The behavior can also include exhibitionism, cunnilingus, fellatio, or penetration of the vagina or anus with sexual organs or objects.

Pornographic photography is also used in sexual abuse with children. Reported sex offenders are 97% male. Females are more often perpetrators in child-care settings, since children may confuse sexual abuse by a female with normal hygiene care. Sexual abuse by stepfathers is five times more common than with biological fathers. Sexual abuse of daughters by stepfathers or fathers is the most common form of incest.

Sexual abuse can also take the form of rape. The legal definition of rape includes only slight penile penetration in the victim's outer vulva area. Complete erection and ejaculation are not necessary. Rape is the perpetration of an act of sexual intercourse whether:

- will is overcome by force or fear (from threats or by use of drugs).

- mental impairment renders the victim incapable of rational judgment.
- if the victim is below the legal age established for consent.

Substance abuse is an abnormal pattern of substance usage leading to significant distress or impairment. The criteria include one or more of the following occurring within a 12-month period:

- recurrent substance use resulting in failure to fulfill obligations at home, work, or school.
- using substance in situations that are physically dangerous (i.e., while driving).
- recurrent substance-related legal problems.
- continued usage despite recurrent social and interpersonal problems (i.e., arguments and fights with significant other).

Abuse in the elderly is common and occurs mostly as a result of caretaker burnout, due to the high level of dependency frail, elderly patients usually require. Abuse can be manifested by physical signs, fear, and delaying or not reporting the need for advanced medical care. Elderly patients may also exhibit financial abuse (money or possessions taken away) and abandonment.

Emotional abuse generally continues even after physical assaults have stopped. In most cases it is a personally tailored form of verbal or gesture abuse expressed to illicit a provoked response.

Causes and symptoms

Children who have been abused usually have a variety of symptoms that encompass behavioral, emotional, and psychosomatic problems. Children who have been physically abused tend to be more aggressive, angry, hostile, depressed, and have low self-esteem. Additionally, they exhibit fear, **anxiety**, and nightmares. Severe psychological problems may result in suicidal behavior or posttraumatic **stress** disorder. Physically abused children may complain of physical illness even in the absence of a cause. They may also suffer from eating disorders and encopresis. Children who are sexually abused may exhibit abnormal sexual behavior in the form of aggressiveness and hyperarousal. Adolescents may display promiscuity, sexual acting out, and—in some situations—homosexual contact.

Physical abuse directed towards adults can ultimately lead to **death**. Approximately 50% of women murdered in the United States were killed by a former or current male partner. Approximately one-third of emergency room consultations by women were prompted due to domestic violence. Female victims who are married also have a higher rate of internal injuries and unconscious-

KEY TERMS

Encopresis—Abnormalities relating to bowel movements that can occur as a result of stress or fear.

ness than victims of stranger assault (mugging, robbery). Physical abuse or rape can also occur between married persons and persons of the same gender. Perpetrators usually sexually assault their victims to dominate, hurt, and debase them. It is common for physical and sexual violence to occur at the same time. A large percentage of sexually assaulted persons were also physically abused in the form of punching, beating, or threatening the victim with a weapon such as a gun or knife. Usually males who are hurt and humiliated tend to physical assault persons whom they are intimately involved with, such as spouses and/or children. Males who assault a female tend to have experienced or witnessed violence during childhood. They also tend to abuse alcohol, to be sexually assaultive, and are at increased risk for assaultive behavior directed against children. Jealous males tend to monitor the women's movements and whereabouts and to isolate other sources of protection and support. They interpret their behavior as betrayal of trust and this causes resentment and explosive anger outbursts during periods of losing control. Males may also use aggression against females in an effort to control and intimidate partners.

Abuse in the elderly usually occurs in the frail, elderly community. The caretaker is usually the perpetrator. Caretaker abuse can be suspected if there is evidence suggesting behavioral changes in the elderly person when the caretaker is present. Additionally, elderly abuse can be possible if there are delays between injuries and treatment, inconsistencies between injury and explanations, lack of hygiene or clothing, and prescriptions not being filled.

Diagnosis

Children who are victims of domestic violence are frequently injured attempting to protect their mother from an abusive partner. Injuries are visible by inspection or self-report. Physical abuse of an adult may also be evident by inspection with visible cuts and/or bruises or self report.

Sexual abuse of both a child and an adult can be diagnosed with a history from the victim. Victims can be assessed for ejaculatory evidence from the perpetrator. Ejaculatory specimens can be retrieved from the mouth, rectum, and clothing. Tests for **sexually transmitted diseases** may be performed.

Elderly abuse can be suspected if the elderly patient demonstrates a fear from the caretaker. Additionally, elderly abuse can be suspected if there are signs indicating intentional delay of required medical care or a change in medical status.

Substance abuse can be suspected in a person who continues to indulge in their drug of choice despite recurrent negative consequences. The diagnosis can be made after administration of a comprehensive bio-psychosocial exam and standardized chemical abuse assessments by a therapist.

Treatment

Children who are victims of physical or sexual abuse typically require psychological support and medical attention. A complaint may be filed with the local family social services that will initiate investigations. The authorities will usually follow up the allegation or offense. Children may also be referred for psychological evaluation and/or treatment. The victim may be placed in foster care pending the investigation outcome. The police may also investigate physical and sexual abuse of an adult. The victim may require immediate medical care and long-term psychological treatment. It is common for children to be adversely affected by domestic violence situations and the local family services agency may be involved.

Substance abusers should elect treatment, either inpatient or outpatient, depending on severity of **addiction**. Long term treatment and/or medications may be utilized to assist in abstinence. The patient should be encouraged to participate in community centered support groups.

Prognosis

The prognosis depends on the diagnosis. Usually victims of physical and sexual abuse require therapy to deal with emotional distress associated with the incident. Perpetrators require further psychological evaluation and treatment. Victims of abuse may have a variety of emotional problems including depression, acts of suicide, or anxiety. Children of sexual abuse may as adults enter abusive relationships or have problems with intimacy. The substance abuser may experience relapses, since the cardinal feature of all addictive disorders is a tendency to return to symptoms. Elderly patients may suffer from further medical problems and/or anxiety, and in some cases neglect may precipitate death.

Prevention

Prevention programs are geared to education and awareness. Detection of initial symptoms or characteris-

tic behaviors may assist in some situations. In some cases treatment may be sought before incident. The professional treating the abused persons must develop a clear sense of the relationship dynamics and the chances for continued harm.

Resources

BOOKS

- Behrman, Richard E., et al, eds. *Nelson Textbook of Pediatrics*. 16th ed. W. B. Saunders Company, 2000.
- Duthie, Edmund H., et al, eds. *Practice of Geriatrics*. 3rd ed. W. B. Saunders Company, 1998.
- Rosen, Peter. *Emergency Medicine: Concepts and Clinical Practice*. 4th ed. Mosby-Year Book, Inc., 1998.

PERIODICALS

- Narendra, K., and S. Lazoritz. "Physical Assessment: Evaluation for Possible Physical and Sexual Abuse." *Pediatric Clinics of North America* 45 (Feb. 1998).
- Stringham, P. "Mental Health: Domestic Violence." *Primary Care; Clinics in Office Practice* 26 (June 1999).

ORGANIZATIONS

- National Clearinghouse on Child Abuse and Neglect Information. 330 C Street SW, Washington, DC 20447. (800) 392-3366.

OTHER

- Elder Abuse Prevention. <<http://www.oaktrees.org/elder>>.
- National Institute on Drug Abuse. <<http://www.nida.nih.gov>>.

Laith Farid Gulli, M.D.
Bilal Nasser, M.Sc.

Acceleration-deceleration cervical injury
see **Whiplash**

ACE inhibitors see **Angiotensin-converting enzyme inhibitors**

Acetaminophen

Definition

Acetaminophen is a medicine used to relieve **pain** and reduce **fever**.

Purpose

Acetaminophen is used to relieve many kinds of minor aches and pains—headaches, muscle aches, backaches, toothaches, menstrual cramps, arthritis, and the aches and pains that often accompany colds.

Description

This drug is available without a prescription. Acetaminophen—or APAP—is sold under various brand names, including Tylenol, Panadol, **Aspirin** Free Anacin, and Bayer Select Maximum Strength **Headache** Pain Relief Formula. Many multi-symptom cold, flu, and sinus medicines also contain acetaminophen. Check the ingredients listed on the container to see if acetaminophen is included in the product.

Studies have shown that acetaminophen relieves pain and reduces fever about as well as aspirin. But differences between these two common drugs exist. Acetaminophen is less likely than aspirin to irritate the stomach. However, unlike aspirin, acetaminophen does not reduce the redness, stiffness, or swelling that accompany arthritis.

Recommended dosage

The usual dosage for adults and children age 12 and over is 325-650 mg every 4-6 hours as needed. No more than 4 grams (4000 mg) should be taken in 24 hours. Because the drug can potentially harm the liver, people who drink alcohol in large quantities should take considerably less acetaminophen and possibly should avoid the drug completely.

For children ages 6-11 years, the usual dose is 150-300 mg, three to four times a day. Check with a physician for dosages for children under age 6 years.

Precautions

Never take more than the recommended dosage of acetaminophen unless told to do so by a physician or dentist.

Patients should not use acetaminophen for more than 10 days to relieve pain (5 days for children) or for more than 3 days to reduce fever, unless directed to do so by a physician. If symptoms do not go away—or if they get worse—contact a physician. Anyone who drinks three or more alcoholic beverages a day should check with a physician before using this drug and should never take more than the recommended dosage. A risk of liver damage exists from combining large amounts of alcohol and acetaminophen. People who already have kidney or liver disease or liver infections should also consult with a physician before using the drug. So should women who are pregnant or breastfeeding.

Smoking cigarettes may interfere with the effectiveness of acetaminophen. Smokers may need to take higher doses of the medicine, but should not take more than the recommended daily dosage unless told by a physician to do so.

KEY TERMS

Arthritis—Inflammation of the joints. The condition causes pain and swelling.

Fatigue—Physical or mental weariness.

Inflammation—A response to irritation, infection, or injury, resulting in pain, redness, and swelling.

Many drugs can interact with one another. Consult a physician or pharmacist before combining acetaminophen with any other medicine. Do not use two different acetaminophen-containing products at the same time.

Acetaminophen interferes with the results of some medical tests. Before having medical tests done, check to see whether taking acetaminophen will affect the results. Avoiding the drug for a few days before the tests may be necessary.

Side effects

Acetaminophen causes few side effects. The most common one is lightheadedness. Some people may experience trembling and pain in the side or the lower back. Allergic reactions do occur in some people, but they are rare. Anyone who develops symptoms such as a rash, swelling, or difficulty breathing after taking acetaminophen should stop taking the drug and get immediate medical attention. Other rare side effects include yellow skin or eyes, unusual bleeding or bruising, weakness, **fatigue**, bloody or black stools, bloody or cloudy urine, and a sudden decrease in the amount of urine.

Overdoses of acetaminophen may cause nausea, vomiting, sweating, and exhaustion. Very large overdoses can cause liver damage. In case of an overdose, get immediate medical attention.

Interactions

Acetaminophen may interact with a variety of other medicines. When this happens, the effects of one or both of the drugs may change or the risk of side effects may be greater. Among the drugs that may interact with acetaminophen are alcohol, **nonsteroidal anti-inflammatory drugs** (NSAIDs) such as Motrin, **oral contraceptives**, the antiseizure drug phenytoin (Dilantin), the blood-thinning drug warfarin (Coumadin), the cholesterol-lowering drug cholestyramine (Questran), the antibiotic Isoniazid, and zidovudine (Retrovir, AZT).

Check with a physician or pharmacist before combining acetaminophen with any other prescription or nonprescription (over-the-counter) medicine.

Nancy Ross-Flanigan

Acetylsalicylic acid see **Aspirin**

Achalasia

Definition

Achalasia is a disorder of the esophagus that prevents normal swallowing.

Description

Achalasia affects the esophagus, the tube that carries swallowed food from the back of the throat down into the stomach. A ring of muscle called the lower esophageal sphincter encircles the esophagus just above the entrance to the stomach. This sphincter muscle is normally contracted to close the esophagus. When the sphincter is closed, the contents of the stomach cannot flow back into the esophagus. Backward flow of stomach contents (reflux) can irritate and inflame the esophagus, causing symptoms such as **heartburn**. The act of swallowing causes a wave of esophageal contraction called peristalsis. Peristalsis pushes food along the esophagus. Normally, peristalsis causes the esophageal sphincter to relax and allow food into the stomach. In achalasia, which means “failure to relax,” the esophageal sphincter remains contracted. Normal peristalsis is interrupted and food cannot enter the stomach.

Causes and symptoms

Causes

Achalasia is caused by degeneration of the nerve cells that normally signal the brain to relax the esophageal sphincter. The ultimate cause of this degeneration is unknown. Autoimmune disease or hidden infection is suspected.

Symptoms

Dysphagia, or difficulty swallowing, is the most common symptom of achalasia. The person with achalasia usually has trouble swallowing both liquid and solid foods, often feeling that food “gets stuck” on the way down. The person has chest **pain** that is often mistaken for **angina pectoris** (cardiac pain). Heartburn and difficulty belching

are common. Symptoms usually get steadily worse. Other symptoms may include nighttime **cough** or recurrent **pneumonia** caused by food passing into the lower airways.

Diagnosis

Diagnosis of achalasia begins with a careful medical history. The history should focus on the timing of symptoms and on eliminating other medical conditions that may cause similar symptoms. Tests used to diagnose achalasia include:

- Esophageal manometry. In this test, a thin tube is passed into the esophagus to measure the pressure exerted by the esophageal sphincter.
- X ray of the esophagus. Barium may be swallowed to act as a contrast agent. Barium reveals the outlines of the esophagus in greater detail and makes it easier to see its constriction at the sphincter.
- Endoscopy. In this test, a tube containing a lens and a light source is passed into the esophagus. Endoscopy is used to look directly at the surface of the esophagus. This test can also detect tumors that cause symptoms like those of achalasia. **Cancer** of the esophagus occurs as a complication of achalasia in 2-7% of patients.

Treatment

The first-line treatment for achalasia is balloon dilation. In this procedure, an inflatable membrane or balloon is passed down the esophagus to the sphincter and inflated to force the sphincter open. Dilation is effective in about 70% of patients.

Three other treatments are used for achalasia when balloon dilation is inappropriate or unacceptable.

- Botulinum toxin injection. Injected into the sphincter, botulinum toxin paralyzes the muscle and allows it to relax. Symptoms usually return within one to two years.
- Esophagomyotomy. This surgical procedure cuts the sphincter muscle to allow the esophagus to open. Esophagomyotomy is becoming more popular with the development of techniques allowing very small abdominal incisions.
- Drug therapy. Nifedipine, a calcium-channel blocker, reduces muscle contraction. Taken daily, this drug provides relief for about two-thirds of patients for as long as two years.

Prognosis

Most patients with achalasia can be treated effectively. Achalasia does not reduce life expectancy unless esophageal carcinoma develops.

KEY TERMS

Botulinum toxin—Any of a group of potent bacterial toxins or poisons produced by different strains of the bacterium *Clostridium botulinum*. The toxins cause muscle paralysis.

Dysphagia—Difficulty in swallowing.

Endoscopy—A test in which a viewing device and a light source are introduced into the esophagus by means of a flexible tube. Endoscopy permits visual inspection of the esophagus for abnormalities.

Esophageal manometry—A test in which a thin tube is passed into the esophagus to measure the degree of pressure exerted by the muscles of the esophageal wall.

Esophageal sphincter—A circular band of muscle that closes the last few centimeters of the esophagus and prevents the backward flow of stomach contents.

Esophagomyotomy—A surgical incision through the muscular tissue of the esophagus.

Esophagus—The muscular tube that leads from the back of the throat to the entrance of the stomach.

Peristalsis—The coordinated, rhythmic wave of smooth muscle contraction that forces food through the digestive tract.

Reflux—An abnormal backward or return flow of a fluid.

Prevention

There is no known way to prevent achalasia.

Resources

BOOKS

Grendell, James H., Kenneth R. McQuaid, and Scott L. Friedman, eds. *Current Diagnosis and Treatment in Gastroenterology*. Stamford: Appleton & Lange, 1996.

Richard Robinson

Achondroplasia

Definition

Achondroplasia is the most common cause of dwarfism, or significantly abnormal short stature.



An x-ray image of an achondroplastic person's head and chest. (Custom Medical Stock Photo. Reproduced by permission.)

Description

Achondroplasia is one of a number of chondrodystrophies, in which the development of cartilage, and therefore, bone is disturbed. The disorder appears in approximately one in every 10,000 births. Achondroplasia is usually diagnosed at birth, owing to the characteristic appearance of the newborn.

Normal bone growth depends on the production of cartilage (a fibrous connective tissue). Over time, calcium is deposited within the cartilage, causing it to harden and become bone. In achondroplasia, abnormalities of this process prevent the bones (especially those in the limbs) from growing as long as they normally should, at the same time allowing the bones to become abnormally thickened. The bones in the trunk of the body and the skull are mostly not affected, although the opening from the skull through which the spinal cord passes (foramen magnum) is often narrower than normal, and the opening (spinal canal) through which the spinal cord runs in the back bones (vertebrae) becomes increasingly and abnormally small down the length of the spine.

Causes and symptoms

Achondroplasia is caused by a genetic defect. It is a dominant trait, meaning that anybody with the genetic defect will display all the symptoms of the disorder. A parent with the disorder has a 50% chance of passing it

KEY TERMS

Cartilage—A flexible, fibrous type of connective tissue which serves as a base on which bone is built.

Foramen magnum—The opening at the base of the skull, through which the spinal cord and the brain-stem pass.

Hydrocephalus—An abnormal accumulation of fluid within the brain. This accumulation can be destructive by pressing on brain structures, and damaging them.

Mutation—A new, permanent change in the structure of a gene, which can result in abnormal structure or function somewhere in the body.

Spinal canal—The opening that runs through the center of the column of spinal bones (vertebrae), and through which the spinal cord passes.

Vertebrae—The individual bones of the spinal column which are stacked on top of each other. There is a hole in the center of each bone, through which the spinal cord passes.

on to the offspring. Although achondroplasia can be passed on to subsequent offspring, the majority of cases occur due to a new mutation (change) in a gene. Interestingly enough, the defect seen in achondroplasia is one of only a few defects known to increase in frequency with increasing age of the father (many genetic defects are linked to increased age of the mother).

People with achondroplasia have abnormally short arms and legs. Their trunk is usually of normal size, as is their head. The appearance of short limbs and normal head size actually makes the head appear to be oversized. The bridge of the nose often has a scooped out appearance termed “saddle nose.” The lower back has an abnormal curvature, or sway back. The face often displays an overly prominent forehead, and a relative lack of development of the face in the area of the upper jaw. Because the foramen magnum and spinal canal are abnormally narrowed, nerve damage may occur if the spinal cord or nerves become compressed. The narrowed foramen magnum may disrupt the normal flow of fluid between the brain and the spinal cord, resulting in the accumulation of too much fluid in the brain (**hydrocephalus**). Children with achondroplasia have a very high risk of serious and repeated middle ear infections, which can result in **hearing loss**. The disease does not affect either mental capacity, or reproductive ability.

Diagnosis

Diagnosis is often made at birth due to the characteristically short limbs, and the appearance of a large head. X-ray examination will reveal a characteristic appearance to the bones, with the bones of the limbs appearing short in length, yet broad in width. A number of measurements of the bones in x-ray images will reveal abnormal proportions.

Treatment

No treatment will reverse the defect present in achondroplasia. All patients with the disease will be short, with abnormally proportioned limbs, trunk, and head. Treatment of achondroplasia primarily addresses some of the complications of the disorder, including problems due to nerve compression, hydrocephalus, bowed legs, and abnormal curves in the spine. Children with achondroplasia who develop middle ear infections (acute **otitis media**) will require quick treatment with **antibiotics** and careful monitoring in order to avoid hearing loss.

Prognosis

Achondroplasia is a disease which causes considerable deformity. However, with careful attention paid to the development of dangerous complications (nerve compression, hydrocephalus), most people are in good health, and can live a normal lifespan.

Prevention

The only form of prevention is through **genetic counseling**, which could help parents assess their risk of having a child with achondroplasia.

Resources

BOOKS

- Hall, Bryan D. “Achondroplasia.” In *Nelson Textbook of Pediatrics*, ed. Richard E. Behrman. Philadelphia: W. B. Saunders Co., 1996.
- Horton, W. A., and J. T. Hecht. “The Chondrodysplasias.” In *Connective Tissue and Its Heritable Disorders*, ed. R. M. Royce and B. Steinmann. Somerset, NJ: Wiley-Liss, 1993.
- Krane, Stephen M., and Alan L. Schiller. “Achondroplasia.” In *Harrison's Principles of Internal Medicine*, ed. Anthony S. Fauci, et al. New York: McGraw-Hill, 1997.
- Whyte, Michael, P. “Achondroplasia.” In *Cecil Textbook of Medicine*, ed. J. Claude Bennett and Fred Plum. Philadelphia: W. B. Saunders Co., 1996.

ORGANIZATIONS

- Little People of America, c/o Mary Carten. 7238 Piedmont Drive, Dallas, TX 75227-9324. (800) 243-9273.

Rosalyn Carson-DeWitt, MD

Achromatopsia see **Color blindness**

Acid indigestion see **Heartburn**

Acid phosphatase test

Definition

Acid phosphatase is an enzyme found throughout the body, but primarily in the prostate gland. Like all enzymes, it is needed to trigger specific chemical reactions. Acid phosphatase testing is done to diagnose whether **prostate cancer** has spread to other parts of the body (metastasized), and to check the effectiveness of treatment. The test has been largely supplanted by the prostate specific antigen test (PSA).

Purpose

The male prostate gland has 100 times more acid phosphatase than any other body tissue. When prostate **cancer** spreads to other parts of the body, acid phosphatase levels rise, particularly if the cancer spreads to the bone. One-half to three-fourths of persons who have metastasized prostate cancer have high acid phosphatase levels. Levels fall after the tumor is removed or reduced through treatment.

Tissues other than prostate have small amounts of acid phosphatase, including bone, liver, spleen, kidney, and red blood cells and platelets. Damage to these tissues causes a moderate increase in acid phosphatase levels.

Acid phosphatase is very concentrated in semen. Rape investigations will often include testing for the presence of acid phosphatase in vaginal fluid.

Precautions

This is not a screening test for prostate cancer. Acid phosphatase levels rise only after prostate cancer has metastasized.

Description

Laboratory testing measures the amount of acid phosphatase in a person's blood, and can determine from what tissue the enzyme is coming. For example, it is important to know if the increased acid phosphatase is from the prostate or red blood cells. Acid phosphatase from the prostate, called prostatic acid phosphatase (PAP), is the most medically significant type of acid phosphatase.

KEY TERMS

Enzyme—A substance needed to trigger specific chemical reactions.

Metastasize—Spread to other parts of the body; usually refers to cancer.

Prostate gland—A gland of the male reproductive system.

Subtle differences between prostatic acid phosphatase and acid phosphatases from other tissues cause them to react differently in the laboratory when mixed with certain chemicals. For example, adding the chemical tartrate to the test mixture inhibits the activity of prostatic acid phosphatase but not red blood cell acid phosphatase. Laboratory test methods based on these differences reveal how much of a person's total acid phosphatase is derived from the prostate. Results are usually available the next day.

Preparation

This test requires drawing about 5-10 mL of blood. The patient should not have a rectal exam or prostate massage for two to three days prior to the test.

Aftercare

Discomfort or bruising may occur at the puncture site, and the person may feel dizzy or faint. Applying pressure to the puncture site until the bleeding stops will reduce bruising. Warm packs to the puncture site will relieve discomfort.

Normal results

Normal results vary based on the laboratory and the method used.

Abnormal results

The highest levels of acid phosphatase are found in metastasized prostate cancer. Diseases of the bone, such as Paget's disease or **hyperparathyroidism**; diseases of blood cells, such as **sickle cell disease** or **multiple myeloma**; or lysosomal disorders, such as Gaucher's disease, will show moderately increased levels.

Certain medications can cause temporary increases or decreases in acid phosphatase levels. Manipulation of the prostate gland through massage, biopsy, or rectal exam before a test can increase the level.

Resources

BOOKS

- A Manual of Laboratory and Diagnostic Tests*. 5th ed. Ed. Francis Fishback. Philadelphia: Lippincott, 1996.
- Garza, Diana, and Kathleen Becan-McBride. *Phlebotomy Handbook*. 4th ed. Stamford: Appleton & Lange, 1996.

PERIODICALS

- Moul, Judd W., et al. "The Contemporary Value of Pretreatment Prostatic Acid Phosphatase to Predict Pathological Stage and Recurrence in Radical Prostatectomy Cases." *Journal of Urology* (Mar. 1998): 935-940.

Nancy J. Nordenson

Acid reflux see **Heartburn**

Acidosis see **Respiratory acidosis; Renal tubular acidosis; Metabolic acidosis**

Acne

Definition

Acne is a common skin disease characterized by pimples on the face, chest, and back. It occurs when the pores of the skin become clogged with oil, dead skin cells, and bacteria.

Description

Acne vulgaris, the medical term for common acne, is the most common skin disease. It affects nearly 17 million people in the United States. While acne can arise at any age, it usually begins at **puberty** and worsens during adolescence. Nearly 85% of people develop acne at some time between the ages of 12-25 years. Up to 20% of women develop mild acne. It is also found in some newborns.

The sebaceous glands lie just beneath the skin's surface. They produce an oil called sebum, the skin's natural moisturizer. These glands and the hair follicles within which they are found are called sebaceous follicles. These follicles open onto the skin through pores. At puberty, increased levels of androgens (male hormones) cause the glands to produce too much sebum. When excess sebum combines with dead, sticky skin cells, a hard plug, or comedo, forms that blocks the pore. Mild noninflammatory acne consists of the two types of comedones, whiteheads and blackheads.

Moderate and severe inflammatory types of acne result after the plugged follicle is invaded by *Propionibacterium acnes*, a bacteria that normally lives on the

skin. A pimple forms when the damaged follicle weakens and bursts open, releasing sebum, bacteria, and skin and white blood cells into the surrounding tissues. Inflamed pimples near the skin's surface are called papules; when deeper, they are called pustules. The most severe type of acne consists of cysts (closed sacs) and nodules (hard swellings). Scarring occurs when new skin cells are laid down to replace damaged cells.

The most common sites of acne are the face, chest, shoulders, and back since these are the parts of the body where the most sebaceous follicles are found.

Causes and symptoms

The exact cause of acne is unknown. Several risk factors have been identified:

- **Age.** Due to the hormonal changes they experience, teenagers are more likely to develop acne.
- **Gender.** Boys have more severe acne and develop it more often than girls.
- **Disease.** Hormonal disorders can complicate acne in girls.
- **Heredity.** Individuals with a family history of acne have greater susceptibility to the disease.
- **Hormonal changes.** Acne can flare up before menstruation, during **pregnancy**, and **menopause**.
- **Diet.** No foods cause acne, but certain foods may cause flare-ups.
- **Drugs.** Acne can be a side effect of drugs including tranquilizers, antidepressants, **antibiotics**, **oral contraceptives**, and anabolic steroids.
- **Personal hygiene.** Abrasive soaps, hard scrubbing, or picking at pimples will make them worse.
- **Cosmetics.** Oil-based makeup and hair sprays worsen acne.
- **Environment.** Exposure to oils and greases, polluted air, and sweating in hot weather aggravate acne.
- **Stress.** Emotional stress may contribute to acne.

Acne is usually not conspicuous, although inflamed lesions may cause **pain**, tenderness, **itching**, or swelling. The most troubling aspects of these lesions are the negative cosmetic effects and potential for scarring. Some people, especially teenagers, become emotionally upset about their condition, and have problems forming relationships or keeping jobs.

Diagnosis

Acne patients are often treated by family doctors. Complicated cases are referred to a dermatologist, a skin

disease specialist, or an endocrinologist, a specialist who treats diseases of the body's endocrine (hormones and glands) system.

Acne has a characteristic appearance and is not difficult to diagnose. The doctor takes a complete medical history, including questions about skin care, diet, factors causing flare-ups, medication use, and prior treatment. **Physical examination** includes the face, upper neck, chest, shoulders, back, and other affected areas. Under good lighting, the doctor determines what types and how many blemishes are present, whether they are inflamed, whether they are deep or superficial, and whether there is scarring or skin discoloration.

In teenagers, acne is often found on the forehead, nose, and chin. As people get older, acne tends to appear towards the outer part of the face. Adult women may have acne on their chins and around their mouths. The elderly may develop whiteheads and blackheads on the upper cheeks and skin around the eyes.

Laboratory tests are not done unless the patient appears to have a hormonal disorder or other medical problem. In this case, blood analyses or other tests may be ordered. Most insurance plans cover the costs of diagnosing and treating acne.

Treatment

Acne treatment consists of reducing sebum production, removing dead skin cells, and killing bacteria with topical drugs and oral medications. Treatment choice depends upon whether the acne is mild, moderate, or severe.

Drugs

TOPICAL DRUGS. Treatment for mild noninflammatory acne consists of reducing the formation of new comedones with topical tretinoin, benzoyl peroxide, adapalene, or salicylic acid. Tretinoin is especially effective because it increases turnover (**death** and replacement) of skin cells. When complicated by inflammation, topical antibiotics may be added to the treatment regimen. Improvement is usually seen in two to four weeks.

Topical medications are available as cream, gel, lotion, or pad preparations of varying strengths. They include antibiotics (agents that kill bacteria), such as erythromycin, clindamycin (Cleocin-T), and meclocycline (Meclan); comedolytics (agents that loosen hard plugs and open pores) such as the vitamin A acid tretinoin (Retin-A), salicylic acid, adapalene (Differin), resorcinol, and sulfur. Drugs that act as both comedolytics and antibiotics, such as benzoyl peroxide, azelaic acid (Azelex), or benzoyl peroxide plus erythromycin (Benza-



Acne vulgaris affecting a woman's face. Acne is the general name given to a skin disorder in which the sebaceous glands become inflamed. (Photograph by Biophoto Associates, Photo Researchers, Inc. Reproduced by permission.)

mycin), are also used. These drugs may be used for months to years to achieve disease control.

After washing with mild soap, the drugs are applied alone or in combination, once or twice a day over the entire affected area of skin. Possible side effects include mild redness, peeling, irritation, dryness, and an increased sensitivity to sunlight that requires use of a sunscreen.

ORAL DRUGS. Oral antibiotics are taken daily for two to four months. The drugs used include tetracycline, erythromycin, minocycline (Minocin), doxycycline, clindamycin (Cleocin), and trimethoprim-sulfamethoxazole (Bactrim, Septra). Possible side effects include allergic reactions, stomach upset, vaginal yeast infections, **dizziness**, and tooth discoloration.

The goal of treating moderate acne is to decrease inflammation and prevent new comedone formation. One effective treatment is topical tretinoin along with a topical

KEY TERMS

Androgens—Male sex hormones that are linked with the development of acne.

Antiandrogens—Drugs that inhibit the production of androgens.

Antibiotics—Medicines that kill bacteria.

Comedo—A hard plug composed of sebum and dead skin cells. The mildest type of acne.

Comedolytic—Drugs that break up comedones and open clogged pores.

Corticosteroids—A group of hormones produced by the adrenal glands with different functions, including regulation of fluid balance, androgen activity, and reaction to inflammation.

Estrogens—Hormones produced by the ovaries, the female sex glands.

Isotretinoin—A drug that decreases sebum production and dries up acne pimples.

Sebaceous follicles—A structure found within the skin that houses the oil-producing glands and hair follicles, where pimples form.

Sebum—An oily skin moisturizer produced by sebaceous glands.

Tretinoin—A drug that works by increasing the turnover (death and replacement) of skin cells.

or oral antibiotic. A combination of topical benzoyl peroxide and erythromycin is also very effective. Improvement is normally seen within four to six weeks, but treatment is maintained for at least two to four months.

A drug reserved for the treatment of severe acne, oral isotretinoin (Accutane), reduces sebum production and cell stickiness. It is the treatment of choice for severe acne with cysts and nodules, and is used with or without topical or oral antibiotics. Taken for four to five months, it provides long-term disease control in up to 60% of patients. If the acne reappears, another course of isotretinoin may be needed by about 20% of patients, while another 20% may do well with topical drugs or oral antibiotics. Side effects include temporary worsening of the acne, dry skin, nosebleeds, vision disorders, and elevated liver enzymes, blood fats and cholesterol. This drug must not be taken during pregnancy since it causes **birth defects**.

Anti-androgens, drugs that inhibit androgen production, are used to treat women who are unresponsive to other therapies. Certain types of oral contraceptives (for

example, Ortho-Tri-Cyclen) and female sex hormones (estrogens) reduce hormone activity in the ovaries. Other drugs, for example, spironolactone and **corticosteroids**, reduce hormone activity in the adrenal glands. Improvement may take up to four months.

Oral corticosteroids, or anti-inflammatory drugs, are the treatment of choice for an extremely severe, but rare type of destructive inflammatory acne called acne fulminans, found mostly in adolescent males. Acne conglobata, a more common form of severe inflammation, is characterized by numerous, deep, inflammatory nodules that heal with scarring. It is treated with oral isotretinoin and corticosteroids.

Other treatments

Several surgical or medical treatments are available to alleviate acne or the resulting scars:

- Comedone extraction. The comedo is removed from the pore with a special tool.
- Chemical peels. Glycolic acid is applied to peel off the top layer of skin to reduce scarring.
- Dermabrasion. The affected skin is frozen with a chemical spray, and removed by brushing or planing.
- Punch grafting. Deep scars are excised and the area repaired with small skin grafts.
- Intralesional injection. Corticosteroids are injected directly into inflamed pimples.
- Collagen injection. Shallow scars are elevated by collagen (protein) injections.

Alternative treatment

Alternative treatments for acne focus on proper cleansing to keep the skin oil-free; eating a well-balanced diet high in fiber, zinc, and raw foods; and avoiding alcohol, dairy products, **smoking**, **caffeine**, sugar, processed foods, and foods high in iodine, such as salt. Supplementation with herbs such as burdock root (*Arctium lappa*), red clover (*Trifolium pratense*), and milk thistle (*Silybum marianum*), and with nutrients such as essential fatty acids, vitamin B complex, zinc, vitamin A, and chromium is also recommended. Chinese herbal remedies used for acne include cnidium seed (*Cnidium monnieri*) and honeysuckle flower (*Lonicera japonica*). Wholistic physicians or nutritionists can recommend the proper amounts of these herbs.

Prognosis

Acne is not curable, although long-term control is achieved in up to 60% of patients treated with

isotretinoin. It can be controlled by proper treatment, with improvement taking two or more months. Acne tends to reappear when treatment stops, but spontaneously improves over time. Inflammatory acne may leave scars that require further treatment.

Prevention

There are no sure ways to prevent acne, but the following steps may be taken to minimize flare-ups:

- gentle washing of affected areas once or twice every day
- avoid abrasive cleansers
- use noncomedogenic makeup and moisturizers
- shampoo often and wear hair off face
- eat a well-balanced diet, avoiding foods that trigger flare-ups
- unless told otherwise, give dry pimples a limited amount of sun exposure
- do not pick or squeeze blemishes
- reduce stress

Resources

BOOKS

- Balch, James F., and Phyllis A. Balch. "The Disorders: Acne." In *Prescription for Nutritional Healing*, ed. Amy C. Tecklenburg, et al. New York: Avery Publishing Group, 1997.
- Bark, Joseph P. *Your Skin: An Owner's Guide*. Englewood Cliffs, NJ: Prentice Hall, 1995.
- Goldstein, Sanford M., and Richard B. Odom. "Skin & Appendages: Pustular Disorders." In *Current Medical Diagnosis and Treatment*, 1996. 35th ed. Ed. Stephen McPhee, et al. Stamford: Appleton & Lange, 1995.
- Kapchuk, Ted J., Z'ev Rosenberg, and K'an Herb Co., Inc. *K'an Herbs: Formulas by Ted Kapchuk, O.M.D.* San Francisco: Andrew Miller, 1996.

PERIODICALS

- "Adult Acne." *Harvard Women's Health Watch* (Mar. 1995): 4-5.
- Bergfeld, Wilma F. "The Evaluation and Management of Acne: Economic Considerations." *Journal of the American Academy of Dermatology* 32 (1995): S52-6.
- Billings, Laura. "Getting Clear." *Health Magazine*, Apr. 1997, 48-52.
- Christiano, Donna. "Acne Treatment Meant for Grown-Ups." *American Health* (Oct. 1994): 23-4.
- "Clearly Better New Treatments Help Adult Acne." *Prevention Magazine*, Aug. 1997, 50-51.
- Leyden, James J. "Therapy For Acne Vulgaris." *New England Journal of Medicine* 17 (Apr. 1997): 1156-1162.
- Nguyen, Quan H., Y. Alyssa Kim, and Robert A. Schwartz. "Management of Acne Vulgaris." *American Family Physician* (July 1994): 89-96.
- "Pimple Control Pill?" *Prevention Magazine*, May 1997, 132.

ORGANIZATIONS

American Academy of Dermatology. 930 N. Meacham Road, P.O. Box 4014, Schaumburg, IL 60168-4014. (847) 330-0230. <<http://www.aad.org>>.

Mercedes McLaughlin

Acne rosacea see **Rosacea**

Acoustic neurinoma see **Acoustic neuroma**

Acoustic neuroma

Definition

An acoustic neuroma is a benign tumor involving cells of the myelin sheath that surrounds the vestibulocochlear nerve (eighth cranial nerve).

Description

The vestibulocochlear nerve extends from the inner ear to the brain and is made up of a vestibular branch, often called the vestibular nerve, and a cochlear branch, called the cochlear nerve. The vestibular and cochlear nerves lie next to one another. They also run along side other cranial nerves. People possess two of each type of vestibulocochlear nerve, one that extends from the left ear and one that extends from the right ear.

The vestibular nerve transmits information concerning balance from the inner ear to the brain and the cochlear nerve transmits information about hearing. The vestibular nerve, like many nerves, is surrounded by a cover called a myelin sheath. A tumor, called a schwannoma, can sometimes develop from the cells of the myelin sheath. A tumor is an abnormal growth of tissue that results from the uncontrolled growth of cells. Acoustic neuromas are often called vestibular schwannomas because they are tumors that arise from the myelin sheath that surrounds the vestibular nerve. Acoustic neuromas are considered benign (non-cancerous) tumors since they do not spread to other parts of the body. They can occur anywhere along the vestibular nerve but are most likely to occur where the vestibulocochlear nerve passes through the tiny bony canal that connects the brain and the inner ear.

An acoustic neuroma can arise from the left vestibular nerve or the right vestibular nerve. A unilateral tumor is a tumor arising from one nerve and a bilateral tumor arises from both vestibular nerves. Unilateral acoustic neuromas usually occur spontaneously (by chance). Bilateral acoustic neuromas occur as part of a hereditary con-

dition called **Neurofibromatosis Type 2 (NF2)**. A person with NF2 has inherited a predisposition for developing acoustic neuromas and other tumors of the nerve cells.

Acoustic neuromas usually grow slowly and can take years to develop. Some acoustic neuromas remain so small that they do not cause any symptoms. As the acoustic neuroma grows it can interfere with the functioning of the vestibular nerve and can cause vertigo and balance difficulties. If the acoustic nerve grows large enough to press against the cochlear nerve, then **hearing loss** and a ringing (**tinnitus**) in the affected ear will usually occur. If untreated and the acoustic neuroma continues to grow it can press against other nerves in the region and cause other symptoms. This tumor can be life threatening if it becomes large enough to press against and interfere with the functioning of the brain.

Causes and symptoms

Causes

An acoustic neuroma is caused by a change or absence of both of the NF2 tumor suppressor genes in a nerve cell. Every person possesses a pair of NF2 genes in every cell of their body including their nerve cells. One NF2 gene is inherited from the egg cell of the mother and one NF2 gene is inherited from the sperm cell of the father. The NF2 gene is responsible for helping to prevent the formation of tumors in the nerve cells. In particular the NF2 gene helps to prevent acoustic neuromas.

Only one unchanged and functioning NF2 gene is necessary to prevent the formation of an acoustic neuroma. If both NF2 genes become changed or missing in one of the myelin sheath cells of the vestibular nerve then an acoustic neuroma will usually develop. Most unilateral acoustic neuromas result when the NF2 genes become spontaneously changed or missing. Someone with a unilateral acoustic neuroma that has developed spontaneously is not at increased risk for having children with an acoustic neuroma. Some unilateral acoustic neuromas result from the hereditary condition NF2. It is also possible that some unilateral acoustic neuromas may be caused by changes in other genes responsible for preventing the formation of tumors.

Bilateral acoustic neuromas result when someone is affected with the hereditary condition NF2. A person with NF2 is typically born with one unchanged and one changed or missing NF2 gene in every cell of their body. Sometimes they inherit this change from their mother or father. Sometimes the change occurs spontaneously when the egg and sperm come together to form the first cell of the baby. The children of a person with NF2 have a 50% chance of inheriting the changed or missing NF2 gene.

A person with NF2 will develop an acoustic neuroma if the remaining unchanged NF2 gene becomes spontaneously changed or missing in one of the myelin sheath cells of their vestibular nerve. People with NF2 often develop acoustic neuromas at a younger age. The mean age of onset of acoustic neuroma in NF2 is 31 years of age versus 50 years of age for sporadic acoustic neuromas. Not all people with NF2, however, develop acoustic neuromas. People with NF2 are at increased risk for developing **cataracts** and tumors in other nerve cells.

Most people with a unilateral acoustic neuroma are not affected with NF2. Some people with NF2, however, only develop a tumor in one of the vestibulocochlear nerves. Others may initially be diagnosed with a unilateral tumor but may develop a tumor in the other nerve a number of years later. NF2 should be considered in someone under the age of 40 who has a unilateral acoustic neuroma. Someone with a unilateral acoustic neuroma and other family members diagnosed with NF2 probably is affected with NF2. Someone with a unilateral acoustic neuroma and other symptoms of NF2 such as cataracts and other tumors may also be affected with NF2. On the other hand, someone over the age of 50 with a unilateral acoustic neuroma, no other tumors and no family history of NF2 is very unlikely to be affected with NF2.

Symptoms

Small acoustic neuromas usually only interfere with the functioning of the vestibulocochlear nerve. The most common first symptom of an acoustic neuroma is hearing loss, which is often accompanied by a ringing sound (tinnitus). People with acoustic neuromas sometimes report difficulties in using the phone and difficulties in perceiving the tone of a musical instrument or sound even when their hearing appears to be otherwise normal. In most cases the hearing loss is initially subtle and worsens gradually over time until deafness occurs in the affected ear. In approximately 10% of cases the hearing loss is sudden and severe.

Acoustic neuromas can also affect the functioning of the vestibular branch of the vestibulocochlear nerve and can cause vertigo and dysequilibrium. Twenty percent of small tumors are associated with periodic vertigo, which is characterized by **dizziness** or a whirling sensation. Larger acoustic neuromas are less likely to cause vertigo but more likely to cause dysequilibrium. Dysequilibrium, which is characterized by minor clumsiness and a general feeling of instability, occurs in nearly 50% of people with an acoustic neuroma.

As the tumor grows larger it can press on the surrounding cranial nerves. Compression of the fifth cranial nerve can result in facial **pain** and or numbness. Compression of the seventh cranial nerve can cause spasms, weakness or

KEY TERMS

Benign tumor—A localized overgrowth of cells that does not spread to other parts of the body.

Chromosome—A microscopic structure, made of a complex of proteins and DNA, that is found within each cell of the body.

Computed tomography (CT)—An examination that uses a computer to compile and analyze the images produced by x rays projected at a particular part of the body.

Cranial nerves—The set of twelve nerves found on each side of the head and neck that control the sensory and muscle functions of a number of organs such as the eyes, nose, tongue face and throat.

DNA testing—Testing for a change or changes in a gene or genes.

Gene—A building block of inheritance, made up of a compound called DNA (deoxyribonucleic acid) and containing the instructions for the production of a particular protein. Each gene is found on a specific location on a chromosome.

Magnetic resonance imaging (MRI)—A test which

uses an external magnetic field instead of x rays to visualize different tissues of the body.

Myelin sheath—The cover that surrounds many nerve cells and helps to increase the speed by which information travels along the nerve.

Neurofibromatosis type 2 (NF2)—A hereditary condition associated with an increased risk of bilateral acoustic neuromas, other nerve cell tumors and cataracts.

Protein—A substance produced by a gene that is involved in creating the traits of the human body such as hair and eye color or is involved in controlling the basic functions of the human body.

Schwannoma—A tumor derived from the cells of the myelin sheath that surrounds many nerve cells.

Tinnitus—A ringing sound or other noise in the ear.

Vertigo—A feeling of spinning or whirling.

Vestibulocochlear nerve (Eighth cranial nerve)—Nerve that transmits information, about hearing and balance from the ear to the brain.

paralysis of the facial muscles. Double vision is a rare symptom but can result when the 6th cranial nerve is affected. Swallowing and/or speaking difficulties can occur if the tumor presses against the 9th, 10th, or 12th cranial nerves.

If left untreated, the tumor can become large enough to press against and affect the functioning of the brain stem. The brain stem is the stalk like portion of the brain that joins the spinal cord to the cerebrum, the thinking and reasoning part of the brain. Different parts of the brainstem have different functions such as the control of breathing and muscle coordination. Large tumors that impact the brain stem can result in headaches, walking difficulties (gait ataxia) and involuntary shaking movements of the muscles (**tremors**). In rare cases when an acoustic neuroma remains undiagnosed and untreated it can cause nausea, vomiting, lethargy and eventually **coma**, respiratory difficulties and **death**. In the vast majority of cases, however, the tumor is discovered and treated long before it is large enough to cause such serious manifestations.

Diagnosis

Anyone with symptoms of hearing loss should undergo hearing evaluations. Pure tone and speech **audiometry**

are two screening tests that are often used to evaluate hearing. Pure tone audiometry tests to see how well someone can hear tones of different volume and pitch and speech audiometry tests to see how well someone can hear and recognize speech. An acoustic neuroma is suspected in someone with unilateral hearing loss or hearing loss that is less severe in one ear than the other ear (asymmetrical).

Sometimes an auditory brainstem response (ABR, BAER) test is performed to help establish whether someone is likely to have an acoustic neuroma. During the ABR examination, a harmless electrical impulse is passed from the inner ear to the brainstem. An acoustic neuroma can interfere with the passage of this electrical impulse and this interference can, sometimes be identified through the ABR evaluation. A normal ABR examination does not rule out the possibility of an acoustic neuroma. An abnormal ABR examination increases the likelihood that an acoustic neuroma is present but other tests are necessary to confirm the presence of a tumor.

If an acoustic neuroma is strongly suspected then **magnetic resonance imaging (MRI)** is usually performed. The MRI is a very accurate evaluation that is

able to detect nearly 100% of acoustic neuromas. Computerized tomography (CT scan, CAT scan) is unable to identify smaller tumors; but it can be used when an acoustic neuroma is suspected and an MRI evaluation cannot be performed.

Once an acoustic neuroma is diagnosed, an evaluation by genetic specialists such as a geneticist and genetic counselor may be recommended. The purpose of this evaluation is to obtain a detailed family history and check for signs of NF2. If NF2 is strongly suspected then DNA testing may be recommended. DNA testing involves checking the blood cells obtained from a routine blood draw for the common gene changes associated with NF2.

Treatment

The three treatment options for acoustic neuroma are surgery, radiation, and observation. The physician and patient should discuss the pros and cons of the different options prior to making a decision about treatment. The patient's, physical health, age, symptoms, tumor size, and tumor location should be considered.

Microsurgery

The surgical removal of the tumor or tumors is the most common treatment for acoustic neuroma. In most cases the entire tumor is removed during the surgery. If the tumor is large and causing significant symptoms, yet there is a need to preserve hearing in that ear, then only part of the tumor may be removed. During the procedure the tumor is removed under microscopic guidance and general anesthetic. Monitoring of the neighboring cranial nerves is done during the procedure so that damage to these nerves can be prevented. If preservation of hearing is a possibility, then monitoring of hearing will also take place during the surgery.

Most people stay in the hospital four to seven days following the surgery. Total recovery usually takes four to six weeks. Most people experience **fatigue** and head discomfort following the surgery. Problems with balance and head and neck stiffness are also common. The mortality rate of this type of surgery is less than 2% at most major centers. Approximately 20% of patients experience some degree of post-surgical complications. In most cases these complications can be managed successfully and do not result in long term medical problems. Surgery brings with it a risk of **stroke**, damage to the brain stem, infection, leakage of spinal fluid and damage to the cranial nerves. Hearing loss and/or tinnitus often result from the surgery. A follow-up MRI is recommended one to five years following the surgery because of possible regrowth of the tumor.

Stereotactic Radiation therapy

During stereotactic **radiation therapy**, also called radiosurgery or radiotherapy, many small beams of radiation are aimed directly at the acoustic neuroma. The radiation is administered in a single large dose, under local anesthetic and is performed on an outpatient basis. This results in a high dose of radiation to the tumor but little radiation exposure to the surrounding area. This treatment approach is limited to small or medium tumors. The goal of the surgery is to cause tumor shrinkage or at least limit the growth of the tumor. The long term efficacy and risks of this treatment approach are not known. Periodic MRI monitoring throughout the life of the patient is therefore recommended.

Radiation therapy can cause hearing loss which can sometimes occur even years later. Radiation therapy can also cause damage to neighboring cranial nerves, which can result in symptoms such as numbness, pain or paralysis of the facial muscles. In many cases these symptoms are temporary. Radiation treatment can also induce the formation of other benign or malignant schwannomas. This type of treatment may therefore be contraindicated in the treatment of acoustic neuromas in those with NF2 who are predisposed to developing schwannomas and other tumors.

Observation

Acoustic neuromas are usually slow growing and in some cases they will stop growing and even become smaller or disappear entirely. It may therefore be appropriate in some cases to hold off on treatment and to periodically monitor the tumor through MRI evaluations. Long-term observation may be appropriate for example in an elderly person with a small acoustic neuroma and few symptoms. Periodic observation may also be indicated for someone with a small and asymptomatic acoustic neuroma that was detected through an evaluation for another medical problem. Observation may also be suggested for someone with an acoustic neuroma in the only hearing ear or in the ear that has better hearing. The danger of an observational approach is that as the tumor grows larger it can become more difficult to treat.

Prognosis

The prognosis for someone with a unilateral acoustic neuroma is usually quite good provided the tumor is diagnosed early and appropriate treatment is instituted. Long term hearing loss and tinnitus in the affected ear are common, even if appropriate treatment is provided. Regrowth of the tumor is also a possibility following surgery or radiation therapy and repeat treatment may be necessary. The prognosis can be poorer for those with NF2 who have an increased risk of bilateral acoustic neuromas and other tumors.

Resources

BOOKS

- Filipo, R., and Barbara Maurizio. *Acoustic neuroma: trends and controversies: proceedings of the Symposium Acoustic Neuroma: Trends and Controversies, Rome, Italy, November 13–15, 1997*. The Hague, Netherlands: Kugler, 1999.
- Malis, Leonard. *Acoustic Neuroma*. New York: Elsevier, 1998.
- Roland, Peter, and Bradley Marple. *Diagnosis and Management of Acoustic Neuroma (Sipac)*. Alexandria, VA: American Academy of Otolaryngology—Head and Neck Survey Foundation, 1998.

PERIODICALS

- Broad, R. W. "Management of Acoustic Neuroma." In *New England Journal of Medicine*. 340(14) (8 April 1999):1119.
- Lederman G, E. Arbit, and J. Lowry. "Management of Acoustic Neuroma." *New England Journal of Medicine*. 340(14) (8 April 1999):1119–1120.
- Levo H, I. Pyykkö, and G. Blomstedt. "Non-surgical Treatment of Vestibular Schwannoma Patients." *Acta Otolaryngologica* 529 (1997): 56–8.
- O'Donoghue G.M., T. Nikolopoulos and J. Thomsen. "Management of Acoustic Neuroma." In *New England Journal of Medicine* 340(14) (8 April 1999):1120–1121.
- Rigby, P. L., et al. "Acoustic Neuroma Surgery: Outcome Analysis of Patient-Perceived Disability." In *American Journal of Otology* 18 (July 1997): 427–35.
- van Roijen, L., et al. "Costs and Effects of Microsurgery versus Radiosurgery in Treating Acoustic Neuroma." In *Acta Neurochirurgica* 139 (1997): 942–48.

ORGANIZATIONS

- Acoustic Neuroma Association. 600 Peachtree Pkwy, Suite 108, Cumming, GA 30041-6899. Phone:(770) 205-8211. Fax: (770) 205-0239. ANAusa@aol.com <<http://anausa.org>>. 28 June 2001.
- Acoustic Neuroma Association of Canada Box 369, Edmonton, AB T5J 2J6. 1-800-561-ANAC(2622). (780)428-3384. anac@compusmart.ab.ca. <<http://www.anac.ca>>. 28 June 2001.
- British Acoustic Neuroma Association. Oak House, Ransom Wood Business Park, Southwell Road West, Mansfield, Nottingham, NG21 0HJ. Tel: 01623 632143. Fax: 01623 635313. bana@btclick.com. <<http://www.ukan.co.uk/bana>>. 28 June 2001.
- Seattle Acoustic Neuroma Group. Emcityland@aol.com <<http://acousticneuromaseattle.org/entryenglish.html>>. 28 June 2001.

OTHER

- National Institute of Health Consensus Statement Online. *Acoustic Neuroma* 9(4)(11-13 December 1991). <<http://text.nlm.nih.gov/nih/cdc/www/87txt.html>>. (28 June 2001).
- University of California at San Francisco (UCSF). *Information on Acoustic Neuromas* (28 June 2001). <<http://itsa.ucsf.edu/~rkj/IndexAN.html>>.

Lisa Andres, M.S., CGC

Acquired hypogammaglobulinemia see
Common variable immunodeficiency

Acquired immunodeficiency syndrome see
AIDS

Acrocyanosis

Definition

Acrocyanosis is a decrease in the amount of oxygen delivered to the extremities. The hands and feet turn blue because of the lack of oxygen. Decreased blood supply to the affected areas is caused by constriction or spasm of small blood vessels.

Description

Acrocyanosis is a painless disorder caused by constriction or narrowing of small blood vessels in the skin of affected patients. The spasm of the blood vessels decreases the amount of blood that passes through them, resulting in less blood being delivered to the hands and feet. The hands may be the main area affected. The affected areas turn blue and become cold and sweaty. Localized swelling may also occur. Emotion and cold temperatures can worsen the symptoms, while warmth can decrease symptoms. The disease is seen mainly in women and the effect of the disorder is mainly cosmetic. People with the disease tend to be uncomfortable, with sweaty, cold, bluish colored hands and feet.

Causes and symptoms

The sympathetic nerves cause constriction or spasms in the peripheral blood vessels that supply blood to the extremities. The spasms are a contraction of the muscles in the walls of the blood vessels. The contraction decreases the internal diameter of the blood vessels, thereby decreasing the amount of blood flow through the affected area. The spasms occur on a persistent basis, resulting in long term reduction of blood supply to the hands and feet. Sufficient blood still passes through the blood vessels so that the tissue in the affected areas does not starve for oxygen or die. Mainly, blood vessels near the surface of the skin are affected.

Diagnosis

Diagnosis is made by observation of the main clinical symptoms, including persistently blue and sweaty hands and/or feet and a lack of **pain**. Cooling the hands increases the blueness, while warming the hands decreases

KEY TERMS

Sympathetic nerve—A nerve of the autonomic nervous system that regulates involuntary and automatic reactions, especially to stress.

es the blue color. The acrocyanosis patient's pulse is normal, which rules out obstructive diseases. **Raynaud's disease** differs from acrocyanosis in that it causes white and red skin coloration phases, not just bluish discoloration.

Treatment

Acrocyanosis usually isn't treated. Drugs that block the uptake of calcium (**calcium channel blockers**) and alpha-one antagonists reduce the symptoms in most cases. Drugs that dilate blood vessels are only effective some of the time. Sweating from the affected areas can be profuse and require treatment. Surgery to cut the sympathetic nerves is performed rarely.

Prognosis

Acrocyanosis is a benign and persistent disease. The main concern of patients is cosmetic. Left untreated, the disease does not worsen.

Resources

BOOKS

- Alexander, R. W., R. C. Schlant, and V. Fuster, eds. *The Heart*. 9th ed. New York: McGraw-Hill, 1998.
- Berkow, Robert, ed. *Merck Manual of Medical Information*. Whitehouse Station, NJ: Merck Research Laboratories, 1997.
- Larsen, D. E., ed. *Mayo Clinic Family Health Book*. New York: William Morrow and Co., Inc., 1996.

John T. Lohr, PhD

Acromegaly and gigantism

Definition

Acromegaly is a disorder in which the abnormal release of a particular chemical from the pituitary gland in the brain causes increased growth in bone and soft tissue, as well as a variety of other disturbances throughout the body. This chemical released from the pituitary gland is called growth hormone (GH). The body's ability to

process and use nutrients like fats and sugars is also altered. In children whose bony growth plates have not closed, the chemical changes of acromegaly result in exceptional growth of long bones. This variant is called gigantism, with the additional bone growth causing unusual height. When the abnormality occurs after bone growth stops, the disorder is called acromegaly.

Description

Acromegaly is a relatively rare disorder, occurring in approximately 50 out of every one million people (50/1,000,000). Both men and women are affected. Because the symptoms of acromegaly occur so gradually, diagnosis is often delayed. The majority of patients are not identified until they are middle aged.

Causes and symptoms

The pituitary is a small gland located at the base of the brain. A gland is a collection of cells that releases certain chemicals, or hormones, which are important to the functioning of other organs or body systems. The pituitary hormones travel throughout the body and are involved in a large number of activities, including the regulation of growth and reproductive functions. The cause of acromegaly can be traced to the pituitary's production of GH.

Under normal conditions, the pituitary receives input from another brain structure, the hypothalamus, located at the base of the brain. This input from the hypothalamus regulates the pituitary's release of hormones. For example, the hypothalamus produces growth hormone-releasing hormone (GHRH), which directs the pituitary to release GH. Input from the hypothalamus should also direct the pituitary to stop releasing hormones.

In acromegaly, the pituitary continues to release GH and ignores signals from the hypothalamus. In the liver, GH causes production of a hormone called insulin-like growth factor 1 (IGF-1), which is responsible for growth throughout the body. When the pituitary refuses to stop producing GH, the levels of IGF-1 also reach abnormal peaks. Bones, soft tissue, and organs throughout the body begin to enlarge, and the body changes its ability to process and use nutrients like sugars and fats.

In acromegaly, an individual's hands and feet begin to grow, becoming thick and doughy. The jaw line, nose, and forehead also grow, and facial features are described as "coarsening". The tongue grows larger, and because the jaw is larger, the teeth become more widely spaced. Due to swelling within the structures of the throat and sinuses, the voice becomes deeper and sounds more hollow, and patients may develop loud **snoring**. Various hormonal changes cause symptoms such as:

- heavy sweating
- oily skin
- increased coarse body hair
- improper processing of sugars in the diet (and sometimes actual diabetes)
- high blood pressure
- increased calcium in the urine (sometimes leading to kidney stones)
- increased risk of **gallstones**; and
- swelling of the thyroid gland

People with acromegaly have more skin tags, or outgrowths of tissue, than normal. This increase in skin tags is also associated with the development of growths, called polyps, within the large intestine that may eventually become cancerous. Patients with acromegaly often suffer from headaches and arthritis. The various swellings and enlargements throughout the body may press on nerves, causing sensations of local tingling or burning, and sometimes result in muscle weakness.

The most common cause of this disorder (in 90% of patients) is the development of a noncancerous tumor within the pituitary, called a pituitary adenoma. These tumors are the source of the abnormal release of GH. As these tumors grow, they may press on nearby structures within the brain, causing headaches and changes in vision. As the adenoma grows, it may disrupt other pituitary tissue, interfering with the release of other hormones. These disruptions may be responsible for changes in the menstrual cycle of women, decreases in the sexual drive in men and women, and the abnormal production of breast milk in women. In rare cases, acromegaly is caused by the abnormal production of GHRH, which leads to the increased production of GH. Certain tumors in the pancreas, lungs, adrenal glands, thyroid, and intestine produce GHRH, which in turn triggers production of an abnormal quantity of GH.

Diagnosis

Because acromegaly produces slow changes over time, diagnosis is often significantly delayed. In fact, the characteristic coarsening of the facial features is often not recognized by family members, friends, or long-time family physicians. Often, the diagnosis is suspected by a new physician who sees the patient for the first time and is struck by the patient's characteristic facial appearance. Comparing old photographs from a number of different time periods will often increase suspicion of the disease.

Because the quantity of GH produced varies widely under normal conditions, demonstrating high levels of GH in the blood is not sufficient to merit a diagnosis of acromegaly. Instead, laboratory tests measuring an



Enlarged feet is one deformity caused by acromegaly. (Custom Medical Stock Photo. Reproduced by permission.)

increase of IGF-1 (3-10 times above the normal level) are useful. These results, however, must be carefully interpreted because normal laboratory values for IGF-1 vary when the patient is pregnant, undergoing **puberty**, elderly, or severely malnourished. Normal patients will show a decrease in GH production when given a large dose of sugar (glucose). Patients with acromegaly will not show this decrease, and will often show an increase in GH production. **Magnetic resonance imaging** (MRI) is useful for viewing the pituitary, and for identifying and locating an adenoma. When no adenoma can be located, the search for a GHRH-producing tumor in another location begins.

Treatment

The first step in treatment of acromegaly is removal of all or part of the pituitary adenoma. Removal requires surgery, usually performed by entering the skull through the nose. While this surgery can cause rapid improvement of many acromegaly symptoms, most patients will also



A comparison of the right hand of a person afflicted with acromegaly (left) and the hand of a normal sized person.
(Custom Medical Stock Photo. Reproduced by permission.)

require additional treatment with medication. Bromocriptine (Parlodel) is a medication that can be taken by mouth, while octreotide (Sandostatin) must be injected every eight hours. Both of these medications are helpful in reducing GH production, but must often be taken for life and produce their own unique side effects. Some patients who cannot undergo surgery are treated with **radiation therapy** to the pituitary in an attempt to shrink the adenoma. Radiating the pituitary may take up to 10 years, however, and may also injure/destroy other normal parts of the pituitary.

Prognosis

Without treatment, patients with acromegaly will most likely die early because of the disease's effects on the heart, lungs, brain, or due to the development of **cancer** in the large intestine. With treatment, however, a patient with acromegaly may be able to live a normal lifespan.

Resources

BOOKS

- Billir, Beverly M. K., and Gilbert H. Daniels. "Growth Hormone Excess: Acromegaly and Gigantism." In *Harrison's Principles of Internal Medicine*, ed. Anthony S. Fauci, et al. New York: McGraw-Hill, 1997.
- Jameson, J. Larry. "Growth Hormone Excess: Acromegaly and Gigantism." In *Cecil Textbook of Medicine*, ed. J. Claude Bennett and Fred Plum. Philadelphia: W. B. Saunders Co., 1996.

PERIODICALS

- Jaffe, C. A. "Acromegaly: Recognition and Treatment." *Drugs* 47, no. 3 (1994): 425+.
- Krishna, A. Y. "Management of Acromegaly: A Review." *American Journal of Medical Science* 308, no. 6 (1994): 370+.
- Maugans, Todd, and Michael L. Coates. "Diagnosis and Treatment of Acromegaly." *American Family Physician* 52, no. 1 (July 1995): 207+.

KEY TERMS

Adenoma—A type of noncancerous (benign) tumor that often involves the overgrowth of certain cells found in glands.

Gland—A collection of cells that releases certain chemicals, or hormones, that are important to the functioning of other organs or body systems.

Hormone—A chemical produced in one part of the body that travels to another part of the body in order to exert an effect.

Hypothalamus—A structure within the brain responsible for a large number of normal functions throughout the body, including regulating sleep, temperature, eating, and sexual development. The hypothalamus also regulates the functions of the pituitary gland by directing the pituitary to stop or start production of its hormones.

Pituitary—A gland located at the base of the brain that produces a number of hormones, including those that regulate growth and reproductive functions. Overproduction of the pituitary hormone called growth hormone (GH) is responsible for the condition known as acromegaly.

ORGANIZATIONS

Pituitary Tumor Network Association. 16350 Ventura Blvd., #231, Encino, CA 91436. (805) 499-9973.

Rosalyn Carson-DeWitt, MD

ACT see **Alanine aminotransferase test**

ACTH test see **Adrenocorticotrophic hormone test**

Actinomyces israelii infection see **Actinomycosis**

Actinomycosis

Definition

Actinomycosis is an infection primarily caused by the bacterium *Actinomyces israelii*. Infection most often occurs in the face and neck region and is characterized by the presence of a slowly enlarging, hard, red lump.

Description

Actinomycosis is a relatively rare infection occurring in one out of 300,000 (1/300,000) people per year. It is characterized by the presence of a lump or mass that often forms, draining sinus tracts to the skin surface. Fifty percent of actinomycosis cases are of the head and neck region (also called “lumpy jaw” and “cervicofacial actinomycosis”), 15% are in the chest, 20% are in the abdomen, and the rest are in the pelvis, heart, and brain. Men are three times more likely to develop actinomycosis than women.

Causes and symptoms

Actinomycosis is usually caused by the bacterium *Actinomyces israelii*. This bacterium is normally present in the mouth but can cause disease if it enters tissues following an injury. *Actinomyces israelii* is an anaerobic bacterium which means it dislikes oxygen but grows very well in deep tissues where oxygen levels are low. **Tooth extraction**, tooth disease, **root canal treatment**, jaw surgery, or poor dental hygiene can allow *Actinomyces israelii* to cause an infection in the head and neck region.

The main symptom of cervicofacial actinomycosis is the presence of a hard lump on the face or neck. The lump may or may not be red. **Fever** occurs in some cases.

Diagnosis

Cervicofacial actinomycosis can be diagnosed by a family doctor or dentist and the patient may be referred to an oral surgeon or infectious disease specialist. The diagnosis of actinomycosis is based upon several things. The presence of a red lump with draining sinuses on the head or neck is strongly suggestive of cervicofacial actinomycosis. A recent history of tooth extraction or signs of **tooth decay** or poor dental hygiene aid in the diagnosis. Microscopic examination of the fluid draining from the sinuses shows the characteristic “sulfur granules” (small yellow colored material in the fluid) produced by *Actinomyces israelii*. A biopsy may be performed to remove a sample of the infected tissue. This procedure can be performed under local anesthesia in the doctor’s office. Occasionally the bacteria can be cultured from the sinus tract fluid or from samples of the infected tissue.

Actinomycosis in the lungs, abdomen, pelvis, or brain can be very hard to diagnose since the symptoms often mimic those of other diseases. Actinomycosis of the lungs or abdomen can resemble **tuberculosis** or **cancer**. x-ray results, the presence of draining sinus tracts, and microscopic analysis and culturing of infected tissue assist in the diagnosis.

Treatment

Actinomycosis is difficult to treat because of its dense tissue location. Surgery is often required to drain

KEY TERMS

Biopsy—The process which removes a sample of tissue for microscopic examination to aid in the diagnosis of a disease.

Sinus tract—A narrow, elongated channel in the body which allows the escape of fluid.

the lesion and/or to remove the site of infection. To kill the bacteria, large doses of penicillin are given through a vein daily for two to six weeks followed by six to twelve months of penicillin taken by mouth. Tetracycline, clindamycin, or erythromycin may be used instead of penicillin. The antibiotic therapy must be completed to insure that the infection does not return. Hyperbaric oxygen (oxygen under high pressure) therapy in combination with the antibiotic therapy has been successful.

Prognosis

Complete recovery is achieved following treatment. If left untreated, the infection may cause localized bone destruction.

Prevention

The best prevention is to maintain good dental hygiene.

Resources

OTHER

“Actinomycosis.” HealthAnswers.com. 6 Feb. 1998. <<http://www.healthanswers.com/database/ami/converted/000599.html>>.

Belinda Rowland, PhD

Activated charcoal see **Charcoal, activated**

Activated partial thromboplastin time see **Partial thromboplastin time**

Acupressure

Definition

Acupressure is a form of touch therapy that utilizes the principles of **acupuncture** and Chinese medicine. In acupressure, the same points on the body are used as in acupuncture, but are stimulated with finger pressure



Therapist working acupressure points on a woman's shoulder. (Photo Researchers, Inc. Reproduced by permission.)

instead of with the insertion of needles. Acupressure is used to relieve a variety of symptoms and **pain**.

Purpose

Acupressure massage performed by a therapist can be very effective both as prevention and as a treatment for many health conditions, including headaches, general aches and pains, colds and flu, arthritis, **allergies**, **asthma**, nervous tension, menstrual cramps, sinus problems, sprains, **tennis elbow**, and toothaches, among others. Unlike acupuncture which requires a visit to a professional, acupressure can be performed by a layperson. Acupressure techniques are fairly easy to learn, and have been used to provide quick, cost-free, and effective relief from many symptoms. Acupressure points can also be stimulated to increase energy and feelings of well-being, reduce **stress**, stimulate the immune system, and alleviate **sexual dysfunction**.

Description

Origins

One of the oldest text of Chinese medicine is the *Huang Di*, The Yellow Emperor's Classic of Internal

Medicine, which may be at least 2,000 years old. Chinese medicine has developed acupuncture, acupressure, herbal remedies, diet, **exercise**, lifestyle changes, and other remedies as part of its healing methods. Nearly all of the forms of Oriental medicine that are used in the West today, including acupuncture, acupressure, **shiatsu**, and Chinese herbal medicine, have their roots in Chinese medicine. One legend has it that acupuncture and acupressure evolved as early Chinese healers studied the puncture **wounds** of Chinese warriors, noting that certain points on the body created interesting results when stimulated. The oldest known text specifically on acupuncture points, the *Systematic Classic of Acupuncture*, dates back to 282 A.D. Acupressure is the non-invasive form of acupuncture, as Chinese physicians determined that stimulating points on the body with massage and pressure could be effective for treating certain problems.

Outside of Asian-American communities, Chinese medicine remained virtually unknown in the United States until the 1970s, when Richard Nixon became the first U.S. president to visit China. On Nixon's trip, journalists were amazed to observe major operations being performed on patients without the use of anesthetics. Instead, wide-awake patients were being operated on,

with only acupuncture needles inserted into them to control pain. At that time, a famous columnist for the *New York Times*, James Reston, had to undergo surgery and elected to use acupuncture for anesthesia. Later, he wrote some convincing stories on its effectiveness. Despite being neglected by mainstream medicine and the American Medical Association (AMA), acupuncture and Chinese medicine became a central to alternative medicine practitioners in the United States. Today, there are millions of patients who attest to its effectiveness, and nearly 9,000 practitioners in all 50 states.

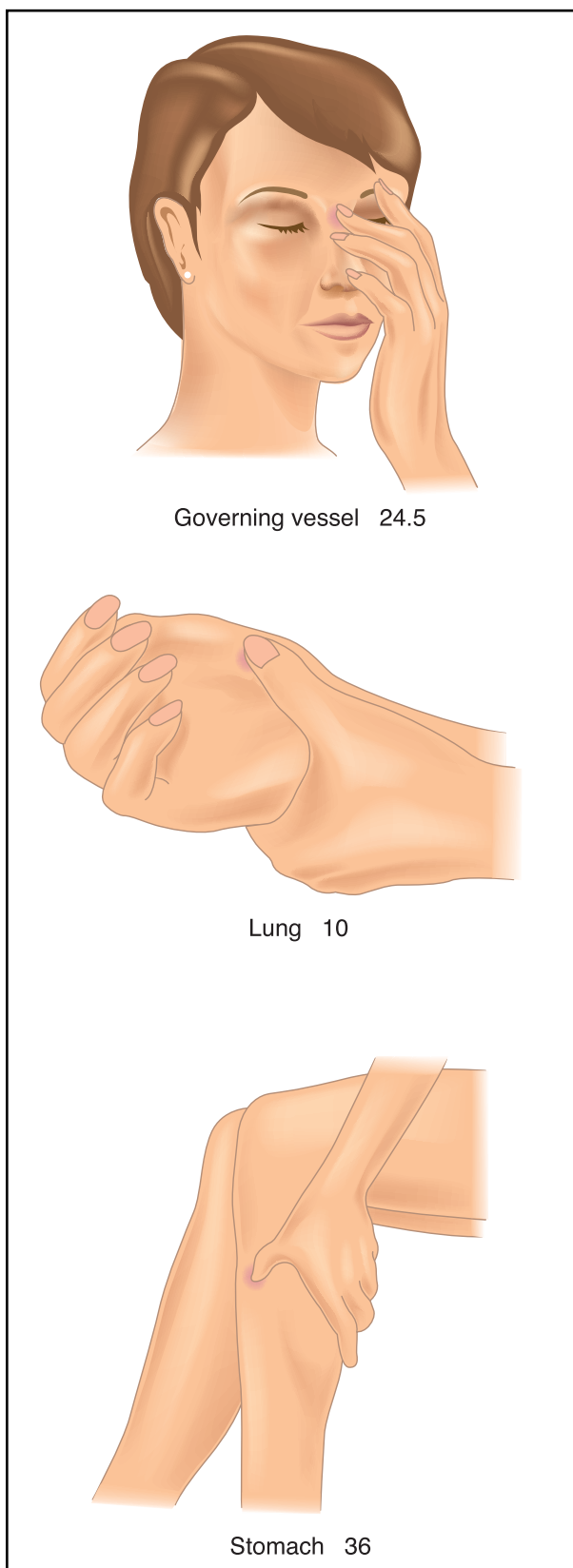
Acupressure is practiced as a treatment by Chinese medicine practitioners and acupuncturists, as well as by massage therapists. Most massage schools in American include acupressure techniques as part of their bodywork programs. Shiatsu massage is very closely related to acupressure, working with the same points on the body and the same general principles, although it was developed over centuries in Japan rather than in China. **Reflexology** is a form of bodywork based on acupressure concepts. Jin Shin Do is a bodywork technique with an increasing number of practitioners in America that combines acupressure and shiatsu principles with **qigong**, Reichian theory, and **meditation**.

Acupressure and Chinese medicine

Chinese medicine views the body as a small part of the universe, subject to laws and principles of harmony and balance. Chinese medicine does not make as sharp a distinction as Western medicine does between mind and body. The Chinese system believes that emotions and mental states are every bit as influential on disease as purely physical mechanisms, and considers factors like work, environment, and relationships as fundamental to a patient's health. Chinese medicine also uses very different symbols and ideas to discuss the body and health. While Western medicine typically describes health as mainly physical processes composed of chemical equations and reactions, the Chinese use ideas like yin and yang, chi, and the organ system to describe health and the body.

Everything in the universe has properties of yin and yang. Yin is associated with cold, female, passive, downward, inward, dark, wet. Yang can be described as hot, male, active, upward, outward, light, dry, and so on. Nothing is either completely yin or yang. These two principles always interact and affect each other, although the body and its organs can become imbalanced by having either too much or too little of either.

Chi (pronounced *chee*, also spelled *qi* or *ki* in Japanese shiatsu) is the fundamental life energy. It is found in food, air, water, and sunlight, and it travels through the body in channels called *meridians*. There are 12 major



Acupressure points to relieve hay fever, sore throat, and heartburn. (Illustration by Electronic Illustrators Group.)

KEY TERMS

Acupoint—A pressure point stimulated in acupressure.

Chi—Basic life energy.

Meridian—A channel through which chi travels in the body.

Moxibustion—An acupuncture technique that burns the herb moxa or mugwort.

Shiatsu—Japanese form of acupressure massage.

Yin/yang—Universal characteristics used to describe aspects of the natural world.

meridians in the body that transport chi, corresponding to the 12 main organs categorized by Chinese medicine.

Disease is viewed as an imbalance of the organs and chi in the body. Chinese medicine has developed intricate systems of how organs are related to physical and mental symptoms, and it has devised corresponding treatments using the meridian and pressure point networks that are classified and numbered. The goal of acupressure, and acupuncture, is to stimulate and unblock the circulation of chi, by activating very specific points, called pressure points or *acupoints*. Acupressure seeks to stimulate the points on the chi meridians that pass close to the skin, as these are easiest to unblock and manipulate with finger pressure.

Acupressure can be used as part of a Chinese physician's prescription, as a session of **massage therapy**, or as a self-treatment for common aches and illnesses. A Chinese medicine practitioner examines a patient very thoroughly, looking at physical, mental and emotional activity, taking the pulse usually at the wrists, examining the tongue and complexion, and observing the patient's demeanor and attitude, to get a complete diagnosis of which organs and meridian points are out of balance. When the imbalance is located, the physician will recommend specific pressure points for acupuncture or acupressure. If acupressure is recommended, the patient might opt for a series of treatments from a massage therapist.

In massage therapy, acupressurists will evaluate a patient's symptoms and overall health, but a massage therapist's diagnostic training isn't as extensive as a Chinese physician's. In a massage therapy treatment, a person usually lies down on a table or mat, with thin clothing on. The acupressurist will gently feel and palpate the abdomen and other parts of the body to deter-

mine energy imbalances. Then, the therapist will work with different meridians throughout the body, depending on which organs are imbalanced in the abdomen. The therapist will use different types of finger movements and pressure on different acupoints, depending on whether the chi needs to be increased or dispersed at different points. The therapist observes and guides the energy flow through the patient's body throughout the session. Sometimes, special herbs (*Artemisia vulgaris* or moxa) may be placed on a point to warm it, a process called *moxibustion*. A session of acupressure is generally a very pleasant experience, and some people experience great benefit immediately. For more chronic conditions, several sessions may be necessary to relieve and improve conditions.

Acupressure massage usually costs from \$30–70 per hour session. A visit to a Chinese medicine physician or acupuncturist can be more expensive, comparable to a visit to an allopathic physician if the practitioner is an MD. Insurance reimbursement varies widely, and consumers should be aware if their policies cover alternative treatment, acupuncture, or massage therapy.

Self-treatment

Acupressure is easy to learn, and there are many good books that illustrate the position of acupoints and meridians on the body. It is also very versatile, as it can be done anywhere, and it's a good form of treatment for spouses and partners to give to each other and for parents to perform on children for minor conditions.

While giving self-treatment or performing acupressure on another, a mental attitude of calmness and attention is important, as one person's energy can be used to help another's. Loose, thin clothing is recommended. There are three general techniques for stimulating a pressure point.

- **Tonifying** is meant to strengthen weak chi, and is done by pressing the thumb or finger into an acupoint with a firm, steady pressure, holding it for up to two minutes.
- **Dispersing** is meant to move stagnant or blocked chi, and the finger or thumb is moved in a circular motion or slightly in and out of the point for two minutes.
- **Calming** the chi in a pressure point utilizes the palm to cover the point and gently stroke the area for about two minutes.

There are many pressure points that are easily found and memorized to treat common ailments from headaches to colds.

- For headaches, toothaches, sinus problems, and pain in the upper body, the "LI4" point is recommended. It is located in the web between the thumb and index finger, on the back of the hand. Using the thumb and index finger of the other hand, apply a pinching pressure until

the point is felt, and hold it for two minutes. Pregnant women should never press this point.

- To calm the nerves and stimulate digestion, find the “CV12” point that is four thumb widths above the navel in the center of the abdomen. Calm the point with the palm, using gentle stroking for several minutes.
- To stimulate the immune system, find the “TH5” point on the back of the forearm two thumb widths above the wrist. Use a dispersing technique, or circular pressure with the thumb or finger, for two minutes on each arm.
- For headaches, sinus congestion, and tension, locate the “GB20” points at the base of the skull in the back of the head, just behind the bones in back of the ears. Disperse these points for two minutes with the fingers or thumbs. Also find the “yintang” point, which is in the middle of the forehead between the eyebrows. Disperse it with gentle pressure for two minutes to clear the mind and to relieve headaches.

Precautions

Acupressure is a safe technique, but it is not meant to replace professional health care. A physician should always be consulted when there are doubts about medical conditions. If a condition is chronic, a professional should be consulted; purely symptomatic treatment can exacerbate chronic conditions. Acupressure should not be applied to open wounds, or where there is swelling and inflammation. Areas of scar tissue, blisters, **boils**, **rashes**, or **varicose veins** should be avoided. Finally, certain acupressure points should not be stimulated on people with high or low blood pressure and on pregnant women.

Research and general acceptance

In general, Chinese medicine has been slow to gain acceptance in the West, mainly because it rests on ideas very foreign to the scientific model. For instance, Western scientists have trouble with the idea of chi, the invisible energy of the body, and the idea that pressing on certain points can alleviate certain conditions seems sometimes too simple for scientists to believe.

Western scientists, in trying to account for the action of acupressure, have theorized that chi is actually part of the neuroendocrine system of the body. Celebrated orthopedic surgeon Robert O. Becker, who was twice nominated for the Nobel Prize, wrote a book on the subject called *Cross Currents: The Promise of Electromedicine; The Perils of Electropollution*. By using precise electrical measuring devices, Becker and his colleagues showed that the body has a complex web of electromagnetic energy, and that traditional acupressure meridians and points contained amounts of energy that non-acupressure points did not.

The mechanisms of acupuncture and acupressure remain difficult to document in terms of the biochemical processes involved; numerous testimonials are the primary evidence backing up the effectiveness of acupressure and acupuncture. However, a body of research is growing that verifies the effectiveness in acupressure and acupuncture techniques in treating many problems and in controlling pain.

Resources

BOOKS

- Jarmey, Chris and John Tindall. *Acupressure for Common Ailments*. London: Gaia, 1991.
- Kakptchuk, Ted. *The Web That Has No Weaver: Understanding Chinese Medicine*. New York: Congdon and Weed, 1983.
- Warren, Frank Z., MD. *Freedom From Pain Through Acupressure*. New York: Fell, 1976.

PERIODICALS

- Massage Therapy Journal*. 820 Davis Street, Suite 100, Evanston, IL 60201-4444.

OTHER

- American Association of Oriental Medicine. <<http://www.aaom.org/>> (December 28, 2000).
- National Acupuncture and Oriental Medicine Alliance. <<http://www.acuall.org/>> (December 28, 2000).

Douglas Dupler

Acupressure, foot see **Reflexology**

Acupuncture

Definition

Acupuncture is one of the main forms of treatment in **traditional Chinese medicine**. It involves the use of sharp, thin needles that are inserted in the body at very specific points. This process is believed to adjust and alter the body's energy flow into healthier patterns, and is used to treat a wide variety of illnesses and health conditions.

Purpose

The World Health Organization (WHO) recommends acupuncture as an effective treatment for over forty medical problems, including **allergies**, respiratory conditions, gastrointestinal disorders, gynecological problems, nervous conditions, and disorders of the eyes, nose and throat, and childhood illnesses, among others. Acupuncture has been used in the treatment of **alcoholism** and substance abuse. It is an effective and low-cost treatment



Woman undergoing facial acupuncture. (Photograph by Yoav Levy. Phototake NYC. Reproduced by permission.)

for headaches and chronic **pain**, associated with problems like back injuries and arthritis. It has also been used to supplement invasive Western treatments like **chemotherapy** and surgery. Acupuncture is generally most effective when used as prevention or before a health condition becomes acute, but it has been used to help patients suffering from **cancer** and **AIDS**. Acupuncture is limited in treating conditions or traumas that require surgery or emergency care (such as for broken bones).

Description

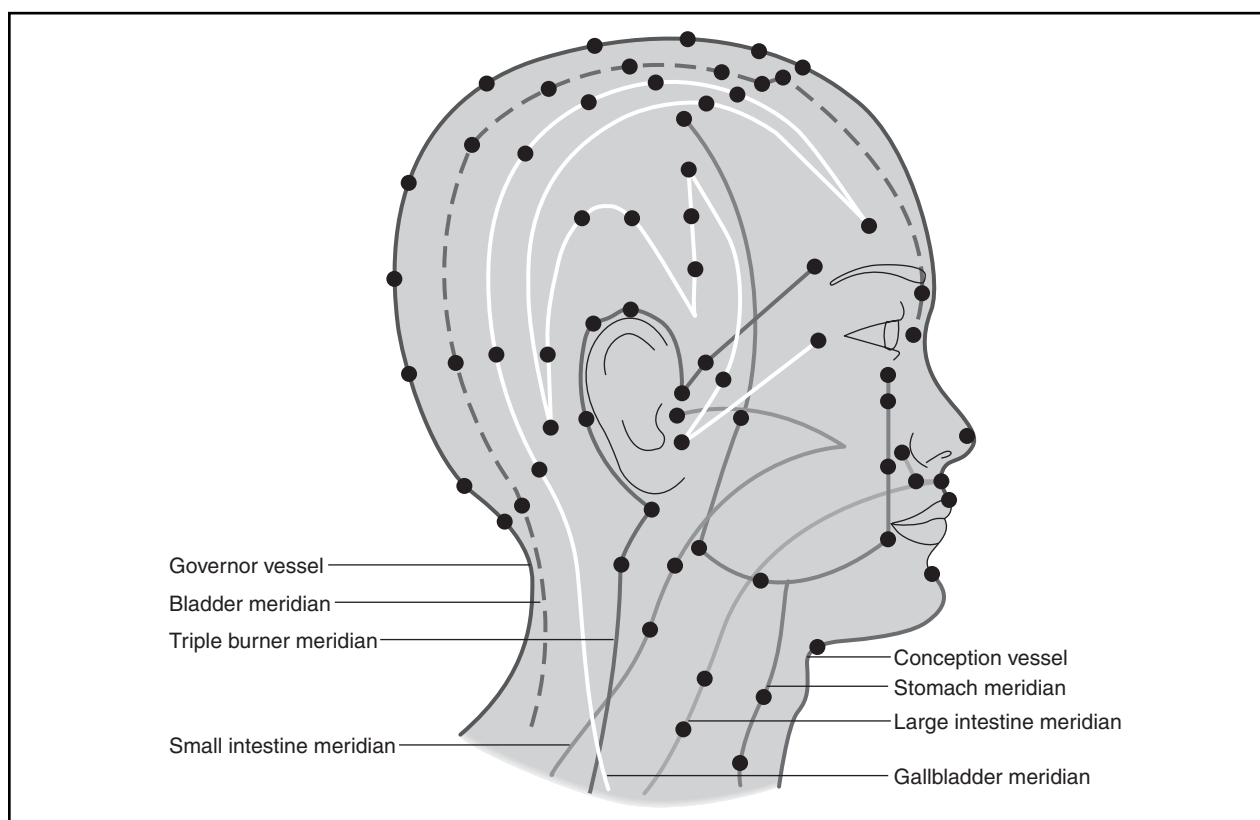
Origins

The original text of Chinese medicine is the *Nei Ching, The Yellow Emperor's Classic of Internal Medicine*, which is estimated to be at least 2,500 years old. Thousands of books since then have been written on the subject of Chinese healing, and its basic philosophies spread long ago to other Asian civilizations. Nearly all of the forms of Oriental medicine which are used in the West today, including acupuncture, **shiatsu**, **acupressure** massage, and macrobiotics, are part of or have their roots in Chinese medicine. Legend has it that acupuncture developed when early Chinese physicians observed unpredict-

ed effects of puncture **wounds** in Chinese warriors. The oldest known text on acupuncture, the *Systematic Classic of Acupuncture*, dates back to 282 A.D. Although acupuncture is its best known technique, Chinese medicine traditionally utilizes herbal remedies, dietary therapy, lifestyle changes and other means to treat patients.

In the early 1900s, only a few Western physicians who had visited China were fascinated by acupuncture, but outside of Asian-American communities it remained virtually unknown until the 1970s, when Richard Nixon became the first U.S. president to visit China. On Nixon's trip, journalists were amazed to observe major operations being performed on patients without the use of anesthetics. Instead, wide-awake patients were being operated on with only acupuncture needles inserted into them to control pain. During that time, a famous columnist for the *New York Times*, James Reston, had to undergo surgery and elected to use acupuncture instead of pain medication, and he wrote some convincing stories on its effectiveness.

Today acupuncture is being practiced in all 50 states by over 9,000 practitioners, with over 4,000 MDs including it in their practices. Acupuncture has shown notable success in treating many conditions, and over 15 million Americans have used it as a therapy. Acupuncture, how-



Acupuncture sites and meridians on the face and neck. (Illustration by Hans & Cassady.)

ever, remains largely unsupported by the medical establishment. The American Medical Association has been resistant to researching it, as it is based on concepts very different from the Western scientific model.

Several forms of acupuncture are being used today in America. Japanese acupuncture uses extremely thin needles and does not incorporate herbal medicine in its practice. Auricular acupuncture uses acupuncture points only on the ear, which are believed to stimulate and balance internal organs. In France, where acupuncture is very popular and more accepted by the medical establishment, neurologist Paul Nogier developed a system of acupuncture based on neuroendocrine theory rather than on traditional Chinese concepts, which is gaining some use in America.

Basic ideas of Chinese medicine

Chinese medicine views the body as a small part of the universe, and subject to universal laws and principles of harmony and balance. Chinese medicine does not draw a sharp line, as Western medicine does, between mind and body. The Chinese system believes that emotions and mental states are every bit as influential on disease as purely physical mechanisms, and considers fac-

tors like work, environment, lifestyle and relationships as fundamental to the overall picture of a patient's health. Chinese medicine also uses very different symbols and ideas to discuss the body and health. While Western medicine typically describes health in terms of measurable physical processes made up of chemical reactions, the Chinese use ideas like yin and yang, chi, the organ system, and the five elements to describe health and the body. To understand the ideas behind acupuncture, it is worthwhile to introduce some of these basic terms.

YIN AND YANG. According to Chinese philosophy, the universe and the body can be described by two separate but complementary principles, that of yin and yang. For example, in temperature, yin is cold and yang is hot. In gender, yin is female and yang is male. In activity, yin is passive and yang is active. In light, yin is dark and yang is bright; in direction yin is inward and downward and yang is outward and up, and so on. Nothing is ever completely yin or yang, but a combination of the two. These two principles are always interacting, opposing, and influencing each other. The goal of Chinese medicine is not to eliminate either yin or yang, but to allow the two to balance each other and exist harmoniously together. For instance, if a person suffers from symptoms

KEY TERMS

Acupressure—Form of massage using acupuncture points.

Auricular acupuncture—Acupuncture using only points found on the ears.

Chi—Basic life energy.

Meridian—Channel through which chi travels in the body.

Moxibustion—Acupuncture technique which burns the herb moxa or mugwort.

Tonification—Acupuncture technique for strengthening the body.

Yin/Yang—Universal characteristics used to describe aspects of the natural world.

of high blood pressure, the Chinese system would say that the heart organ might have too much yang, and would recommend methods either to reduce the yang or to increase the yin of the heart, depending on the other symptoms and organs in the body. Thus, acupuncture therapies seek to either increase or reduce yang, or increase or reduce yin in particular regions of the body.

CHI. Another fundamental concept of Chinese medicine is that of chi (pronounced *chee*, also spelled *qi*). Chi is the fundamental life energy of the universe. It is invisible and is found in the environment in the air, water, food and sunlight. In the body, it is the invisible vital force that creates and animates life. We are all born with inherited amounts of chi, and we also get acquired chi from the food we eat and the air we breathe. The level and quality of a person's chi also depends on the state of physical, mental and emotional balance. Chi travels through the body along channels called *meridians*.

THE ORGAN SYSTEM. In the Chinese system, there are twelve main organs: the lung, large intestine, stomach, spleen, heart, small intestine, urinary bladder, kidney, liver, gallbladder, pericardium, and the “triple warmer,” which represents the entire torso region. Each organ has chi energy associated with it, and each organ interacts with particular emotions on the mental level. As there are twelve organs, there are twelve types of chi which can move through the body, and these move through twelve main channels or meridians. Chinese doctors connect symptoms to organs. That is, symptoms are caused by yin/yang imbalances in one or more organs, or by an unhealthy flow of chi to or from one

organ to another. Each organ has a different profile of symptoms it can manifest.

THE FIVE ELEMENTS. Another basis of Chinese theory is that the world and body are made up of five main elements: wood, fire, earth, metal, and water. These elements are all interconnected, and each element either generates or controls another element. For instance, water controls fire and earth generates metal. Each organ is associated with one of the five elements. The Chinese system uses elements and organs to describe and treat conditions. For instance, the kidney is associated with water and the heart is associated with fire, and the two organs are related as water and fire are related. If the kidney is weak, then there might be a corresponding fire problem in the heart, so treatment might be made by acupuncture or herbs to cool the heart system and/or increase energy in the kidney system.

The Chinese have developed an intricate system of how organs and elements are related to physical and mental symptoms, and the above example is a very simple one. Although this system sounds suspect to Western scientists, some interesting parallels have been observed. For instance, Western medicine has observed that with severe heart problems, kidney failure often follows, but it still does not know exactly why. In Chinese medicine, this connection between the two organs has long been established.

MEDICAL PROBLEMS AND ACUPUNCTURE. In Chinese medicine, disease as seen as imbalances in the organ system or chi meridians, and the goal of any remedy or treatment is to assist the body in reestablishing its innate harmony. Disease can be caused by internal factors like emotions, external factors like the environment and weather, and other factors like injuries, trauma, diet, and germs. However, infection is seen not as primarily a problem with germs and viruses, but as a weakness in the energy of the body which is allowing a sickness to occur. In Chinese medicine, no two illnesses are ever the same, as each body has its own characteristics of symptoms and balance. Acupuncture is used to open or adjust the flow of chi throughout the organ system, which will strengthen the body and prompt it to heal itself.

A VISIT TO THE ACUPUNCTURIST. The first thing an acupuncturist will do is get a thorough idea of a patient's medical history and symptoms, both physical and emotional. This is done with a long questionnaire and interview. Then the acupuncturist will examine the patient to find further symptoms, looking closely at the tongue, the pulse at various points in the body, the complexion, general behavior, and other signs like coughs or pains. From this, the practitioner will be able to determine patterns of symptoms which indicate which organs and areas are

imbalanced. Depending on the problem, the acupuncturist will insert needles to manipulate chi on one or more of the twelve organ meridians. On these twelve meridians, there are nearly 2,000 points which can be used in acupuncture, with around 200 points being most frequently used by traditional acupuncturists. During an individual treatment, one to twenty needles may be used, depending on which meridian points are chosen.

Acupuncture needles are always sterilized and acupuncture is a very safe procedure. The depth of insertion of needles varies, depending on which chi channels are being treated. Some points barely go beyond superficial layers of skin, while some acupuncture points require a depth of 1-3 in (2.5-7.5 cm) of needle. The needles generally do not cause pain. Patients sometimes report pinching sensations and often pleasant sensations, as the body experiences healing. Depending on the problem, the acupuncturist might spin or move the needles, or even pass a slight electrical current through some of them. *Moxibustion* may be sometimes used, in which an herbal mixture (moxa or mugwort) is either burned like incense on the acupuncture point or on the end of the needle, which is believed to stimulate chi in a particular way. Also, acupuncturists sometimes use *cupping*, during which small suction cups are placed on meridian points to stimulate them.

How long the needles are inserted also varies. Some patients only require a quick in and out insertion to clear problems and provide *tonification* (strengthening of health), while some other conditions might require needles inserted up to an hour or more. The average visit to an acupuncturist takes about thirty minutes. The number of visits to the acupuncturist varies as well, with some conditions improved in one or two sessions and others requiring a series of six or more visits over the course of weeks or months.

Costs for acupuncture can vary, depending on whether the practitioner is an MD. Initial visits with non-MD acupuncturists can run from \$50-\$100, with follow-up visits usually costing less. Insurance reimbursement also varies widely, depending on the company and state. Regulations have been changing often. Some states authorize Medicaid to cover acupuncture for certain conditions, and some states have mandated that general coverage pay for acupuncture. Consumers should be aware of the provisions for acupuncture in their individual policies.

Precautions

Acupuncture is generally a very safe procedure. If a patient is in doubt about a medical condition, more than one physician should be consulted. Also, a patient should always feel comfortable and confident that their acupuncturist is knowledgeable and properly trained.

Research and general acceptance

Mainstream medicine has been slow to accept acupuncture; although more MDs are using it, the American Medical Association does not recognize it as a specialty. The reason for this is that the mechanism of acupuncture is difficult to scientifically understand or measure, such as the invisible energy of chi in the body. Western medicine, admitting that acupuncture works in many cases, has theorized that the energy meridians are actually part of the nervous system and that acupuncture relieves pain by releasing endorphins, or natural pain killers, into the bloodstream. Despite the ambiguity in the biochemistry involved, acupuncture continues to show effectiveness in clinical tests, from reducing pain to alleviating the symptoms of chronic illnesses, and research in acupuncture is currently growing. The Office of Alternative Medicine of the National Institute of Health is currently funding research in the use of acupuncture for treating depression and attention-deficit disorder.

Resources

BOOKS

- Fleischman, Dr. Gary F. *Acupuncture: Everything You Ever Wanted To Know*. New York: Barrytown, 1998.
Kakptchuk, Ted. *The Web That Has No Weaver: Understanding Chinese Medicine*. New York: Congdon and Weed, 1983.
Requena, Yves, MD. *Terrains and Pathology in Acupuncture*. Massachusetts: Paradigm, 1986.

PERIODICALS

- American Journal of Acupuncture*. 1840 41st Ave., Suite 102, P.O. Box 610, Capitola, CA 95010.

OTHER

- American Association of Oriental Medicine. <<http://www.aaom.org/>> (December 28, 2000).
North American Society of Acupuncture and Alternative Medicine. <<http://www.nasa-altmed.com/>> (December 28, 2000).

Douglas Dupler

Acute glomerulonephritis see **Acute poststreptococcal glomerulonephritis**

Acute homeopathic remedies see **Homeopathic remedies, acute prescribing**

Acute kidney failure

Definition

Acute kidney failure occurs when illness, infection, or injury damages the kidneys. Temporarily, the kidneys

cannot adequately remove fluids and wastes from the body or maintain the proper level of certain kidney-regulated chemicals in the bloodstream.

Description

The kidneys are the body's natural filtration system. They perform the critical task of processing approximately 200 quarts of fluid in the bloodstream every 24 hours. Waste products like urea and toxins, along with excess fluids, are removed from the bloodstream in the form of urine. Kidney (or renal) failure occurs when kidney functioning becomes impaired. Fluids and toxins begin to accumulate in the bloodstream. As fluids build up in the bloodstream, the patient with acute kidney failure may become puffy and swollen (edematous) in the face, hands, and feet. Their blood pressure typically begins to rise, and they may experience **fatigue** and nausea.

Unlike **chronic kidney failure**, which is long term and irreversible, acute kidney failure is a temporary condition. With proper and timely treatment, it can typically be reversed. Often there is no permanent damage to the kidneys. Acute kidney failure appears most frequently as a complication of serious illness, like **heart failure**, liver failure, **dehydration**, severe **burns**, and excessive bleeding (hemorrhage). It may also be caused by an obstruction to the urinary tract or as a direct result of kidney disease, injury, or an adverse reaction to a medicine.

Causes and symptoms

Acute kidney failure can be caused by many different illnesses, injuries, and infections. These conditions fall into three main categories: *prerenal*, *postrenal*, and *intrarenal* conditions.

Prerenal conditions do not damage the kidney, but can cause diminished kidney function. They are the most common cause of acute renal failure, and include:

- dehydration
- hemorrhage
- septicemia, or **sepsis**
- heart failure
- liver failure
- burns

Postrenal conditions cause kidney failure by obstructing the urinary tract. These conditions include:

- inflammation of the prostate gland in men (prostatitis)
- enlargement of the prostate gland (benign prostatic hypertrophy)
- bladder or pelvic tumors
- **kidney stones** (calculi)

Intrarenal conditions involve kidney disease or direct injury to the kidneys. These conditions include:

- lack of blood supply to the kidneys (ischemia)
- use of radiocontrast agents in patients with kidney problems
- drug abuse or overdose
- long-term use of nephrotoxic medications, like certain **pain** medicines
- acute inflammation of the glomeruli, or filters, of the kidney (**glomerulonephritis**)
- kidney infections (pyelitis or pyelonephritis)

Common symptoms of acute kidney failure include:

- anemia. The kidneys are responsible for producing erythropoietin (EPO), a hormone that stimulates red blood cell production. If kidney disease causes shrinking of the kidney, red blood cell production is reduced, leading to anemia.
- bad breath or bad taste in mouth. Urea in the saliva may cause an ammonia-like taste in the mouth.
- bone and joint problems. The kidneys produce vitamin D, which helps the body absorb calcium and keeps bones strong. For patients with kidney failure, bones may become brittle. In children, normal growth may be stunted. Joint pain may also occur as a result of high phosphate levels in the blood. Retention of uric acid may cause **gout**.
- edema. Puffiness or swelling in the arms, hands, feet, and around the eyes.
- frequent urination.
- foamy or bloody urine. Protein in the urine may cause it to foam significantly. Blood in the urine may indicate bleeding from diseased or obstructed kidneys, bladder, or ureters.
- headaches. High blood pressure may trigger headaches.
- hypertension, or high blood pressure. The retention of fluids and wastes causes blood volume to increase. This makes blood pressure rise.
- increased fatigue. Toxic substances in the blood and the presence of anemia may cause the patient to feel exhausted.
- itching. Phosphorus, normally eliminated in the urine, accumulates in the blood of patients with kidney failure. An increased phosphorus level may cause the skin to itch.
- lower back pain. Patients suffering from certain kidney problems (like kidney stones and other obstructions) may have pain where the kidneys are located, in the small of the back below the ribs.
- nausea. Urea in the gastric juices may cause upset stomach.

Diagnosis

Kidney failure is diagnosed by a doctor. A nephrologist, a doctor that specializes in the kidney, may be consulted to confirm the diagnosis and recommend treatment options. The patient that is suspected of having acute kidney failure will have blood and urine tests to determine the level of kidney function. A blood test will assess the levels of creatinine, blood urea nitrogen (BUN), uric acid, phosphate, sodium, and potassium. The kidney regulates these agents in the blood. Urine samples will also be collected, usually over a 24-hour period, to assess protein loss and/or creatinine clearance.

Determining the cause of kidney failure is critical to proper treatment. A full assessment of the kidneys is necessary to determine if the underlying disease is treatable and if the kidney failure is chronic or acute. X rays, **magnetic resonance imaging** (MRI), computed tomography scan (CT), ultrasound, renal biopsy, and/or arteriogram of the kidneys may be used to determine the cause of kidney failure and level of remaining kidney function. X rays and ultrasound of the bladder and/or ureters may also be needed.

Treatment

Treatment for acute kidney failure varies. Treatment is directed to the underlying, primary medical condition that has triggered kidney failure. Prerenal conditions may be treated with replacement fluids given through a vein, **diuretics**, blood **transfusion**, or medications. Postrenal conditions and intrarenal conditions may require surgery and/or medication.

Frequently, patients in acute kidney failure require *hemodialysis*, *hemofiltration*, or *peritoneal dialysis* to filter fluids and wastes from the bloodstream until the primary medical condition can be controlled.

Hemodialysis

Hemodialysis involves circulating the patient's blood outside of the body through an extracorporeal circuit (ECC), or dialysis circuit. The ECC is made up of plastic blood tubing, a filter known as a dialyzer (or artificial kidney), and a dialysis machine that monitors and maintains blood flow and administers dialysate. Dialysate is a sterile chemical solution that is used to draw waste products out of the blood. The patient's blood leaves the body through the vein and travels through the ECC and the dialyzer, where fluid removal takes place.

During dialysis, waste products in the bloodstream are carried out of the body. At the same time, electrolytes and other chemicals are added to the blood. The purified, chemically-balanced blood is then returned to the body.

KEY TERMS

Blood urea nitrogen (BUN)—A waste product that is formed in the liver and collects in the bloodstream; patients with kidney failure have high BUN levels.

Creatinine—A protein produced by muscle that healthy kidneys filter out.

Extracorporeal—Outside of, or unrelated to, the body.

Ischemia—A lack of blood supply to an organ or tissue.

Nephrotoxic—Toxic, or damaging, to the kidney.

Radiocontrast agents—Dyes administered to a patient for the purposes of a radiologic study.

Sepsis—A bacterial infection of the bloodstream.

Vasopressors—Medications that constrict the blood vessels.

A dialysis “run” typically lasts three to four hours, depending on the type of dialyzer used and the physical condition of the patient. Dialysis is used several times a week until acute kidney failure is reversed.

Blood pressure changes associated with hemodialysis may pose a risk for patients with heart problems. Peritoneal dialysis may be the preferred treatment option in these cases.

Hemofiltration

Hemofiltration, also called continuous renal replacement therapy (CRRT), is a slow, continuous blood filtration therapy used to control acute kidney failure in critically ill patients. These patients are typically very sick and may have heart problems or circulatory problems. They cannot handle the rapid filtration rates of hemodialysis. They also frequently need **antibiotics**, **nutrition**, **vasopressors**, and other fluids given through a vein to treat their primary condition. Because hemofiltration is continuous, prescription fluids can be given to patients in kidney failure without the risk of fluid overload.

Like hemodialysis, hemofiltration uses an ECC. A hollow fiber hemofilter is used instead of a dialyzer to remove fluids and toxins. Instead of a dialysis machine, a blood pump makes the blood flow through the ECC. The volume of blood circulating through the ECC in hemofiltration is less than that in hemodialysis. Filtration rates are slower and gentler on the circulatory system.

Hemofiltration treatment will generally be used until kidney failure is reversed.

Peritoneal dialysis

Peritoneal dialysis may be used if an acute kidney failure patient is stable and not in immediate crisis. In peritoneal dialysis (PD), the lining of the patient's abdomen, the peritoneum, acts as a blood filter. A flexible tube-like instrument (catheter) is surgically inserted into the patient's abdomen. During treatment, the catheter is used to fill the abdominal cavity with dialysate. Waste products and excess fluids move from the patient's bloodstream into the dialysate solution. After a certain time period, the waste-filled dialysate is drained from the abdomen, and replaced with clean dialysate. There are three type of peritoneal dialysis, which vary according to treatment time and administration method.

Peritoneal dialysis is often the best treatment option for infants and children. Their small size can make vein access difficult to maintain. It is not recommended for patients with abdominal adhesions or other abdominal defects (like a **hernia**) that might reduce the efficiency of the treatment. It is also not recommended for patients who suffer frequent bouts of an inflammation of the small pouches in the intestinal tract (diverticulitis).

Prognosis

Because many of the illnesses and underlying conditions that often trigger acute kidney failure are critical, the prognosis for these patients many times is not good. Studies have estimated overall **death** rates for acute kidney failure at 42-88%. Many people, however, die because of the primary disease that has caused the kidney failure. These figures may also be misleading because patients who experience kidney failure as a result of less serious illnesses (like kidney stones or dehydration) have an excellent chance of complete recovery. Early recognition and prompt, appropriate treatment are key to patient recovery.

Up to 10% of patients who experience acute kidney failure will suffer irreversible kidney damage. They will eventually go on to develop chronic kidney failure or end-stage renal disease. These patients will require long-term dialysis or **kidney transplantation** to replace their lost renal functioning.

Prevention

Since acute kidney failure can be caused by many things, prevention is difficult. Medications that may impair kidney function should be given cautiously. Patients with pre-existing kidney conditions who are

hospitalized for other illnesses or injuries should be carefully monitored for kidney failure complications. Treatments and procedures that may put them at risk for kidney failure (like diagnostic tests requiring radiocontrast agents or dyes) should be used with extreme caution.

Resources

BOOKS

- Bock, G. H., E. J. Ruley, and M. P. Moore. *A Parent's Guide to Kidney Disorders*. Minneapolis: University of Minnesota Press, 1993.
- Brenner, Barry M., and Floyd C. Rector Jr., eds. *The Kidney*. Philadelphia: W. B. Saunders Co., 1991.
- Cameron, J. Stewart. *Kidney Failure: The Facts*. New York: Oxford University Press, 1996.
- Ross, Linda M., ed. *Kidney and Urinary Tract Diseases and Disorders Sourcebook*. Vol. 21. Detroit: Omnigraphics, Inc., 1997.

PERIODICALS

- Stark, June. "Dialysis Choices: Turning the Tide in Acute Renal Failure." *Nursing* 27, no. 2 (Feb. 1997): 41-8.

ORGANIZATIONS

- National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). Building 31, Room 9A04, 31 Center Drive, MSC 2560, Bethesda, MD 20879-2560. (301) 496-3583. <<http://www.niddk.nih.gov>>.
- National Kidney Foundation. 30 East 33rd St., New York, NY 10016. (800) 622-9010. <<http://www.kidney.org>>.

Paula Anne Ford-Martin

Acute leukemias see **Leukemias, acute**

Acute lymphangitis

Definition

Acute lymphangitis is a bacterial infection in the lymphatic vessels which is characterized by painful, red streaks below the skin surface. This is a potentially serious infection which can rapidly spread to the bloodstream and be fatal.

Description

Acute lymphangitis affects a critical member of the immune system—the lymphatic system. Waste materials from nearly every organ in the body drain into the lymphatic vessels and are filtered in small organs called lymph nodes. Foreign bodies, such as bacteria or viruses, are processed in the lymph nodes to generate an immune response to fight an infection.

In acute lymphangitis, bacteria enter the body through a cut, scratch, insect bite, surgical wound, or other skin injury. Once the bacteria enter the lymphatic system, they multiply rapidly and follow the lymphatic vessel like a highway. The infected lymphatic vessel becomes inflamed, causing red streaks that are visible below the skin surface. The growth of the bacteria occurs so rapidly that the immune system does not respond fast enough to stop the infection.

If left untreated, the bacteria can cause tissue destruction in the area of the infection. A pus-filled, painful lump called an **abscess** may be formed in the infected area. **Cellulitis**, a generalized infection of the lower skin layers, may also occur. In addition, the bacteria may invade the bloodstream and cause septicemia. Lay people, for that reason, often call the red streaks seen in the skin “blood poisoning.” Septicemia is a very serious illness and may be fatal.

Causes and symptoms

Acute lymphangitis is most often caused by the bacterium *Streptococcus pyogenes*. This potentially dangerous bacterium also causes **strep throat**, infections of the heart, spinal cord, and lungs, and in the 1990s has been called the “flesh-eating bacterium.” Staphylococci bacteria may also cause lymphangitis.

Although anyone can develop lymphangitis, some people are more at risk. People who have had radical **mastectomy** (removal of a breast and nearby lymph nodes), a leg vein removed for coronary bypass surgery, or recurrent lymphangitis caused by tinea pedis (a fungal infection on the foot) are at an increased risk for lymphangitis.

The characteristic symptoms of acute lymphangitis are the wide, red streaks which travel from the site of infection to the armpit or groin. The affected areas are red, swollen, and painful. Blistering of the affected skin may occur. The bacterial infection causes a **fever** of 100–104°F (38°–40°C). In addition, a general ill feeling, muscle aches, **headache**, chills, and loss of appetite may be felt.

Diagnosis

If lymphangitis is suspected, the person should call his or her doctor immediately or go to an emergency room. Acute lymphangitis could be diagnosed by the family doctor, infectious disease specialist, or an emergency room doctor. The painful, red streaks just below the skin surface and the high fever are diagnostic of acute lymphangitis. A sample of blood would be taken for culture to determine whether the bacteria have entered the bloodstream. A biopsy (removal of a piece of infected tissue) sample may be taken for culture to identify which

KEY TERMS

Biopsy—The process which removes a sample of diseased or infected tissue for microscopic examination to aid in diagnosis.

Lymphatic system—A component of the immune system consisting of vessels and nodes. Waste materials from organs drain into the lymphatic vessels and are filtered by the lymph nodes.

Septicemia—Disease caused by the presence and growth of bacteria in the bloodstream.

type of bacteria is causing the infection. Diagnosis is immediate because it is based primarily on the symptoms. Most insurance policies should cover the expenses for the diagnosis and treatment of acute lymphangitis.

Treatment

Because of the serious nature of this infection, treatment would begin immediately even before the bacterial culture results were available. The only treatment for acute lymphangitis is to give very large doses of an antibiotic, usually penicillin, through the vein. Growing streptococcal bacteria are usually eliminated rapidly and easily by penicillin. The antibiotic clindamycin may be included in the treatment to kill any streptococci which are not growing and are in a resting state. Alternatively, a “broad spectrum” antibiotic may be used which would kill many different kinds of bacteria.

Aspirin or other medications which reduce the **pain** and the fever may also be given. Medications which reduce any inflammation of the infected region may also be provided. The patient is likely to be hospitalized to administer the antibiotic and other medications and to closely monitor his or her condition. Surgical drainage of an abscess may be necessary.

Prognosis

Complete recovery is expected if antibiotic treatment is begun at an early stage of the infection. However, if untreated, acute lymphangitis can be a very serious and even deadly disease. Acute lymphangitis that goes untreated can spread, causing tissue damage. Extensive tissue damage would need to be repaired by plastic surgery. Spread of the infection into the bloodstream could be fatal.

Prevention

Although acute lymphangitis can occur in anyone, good hygiene and general health may help to prevent infections.

Resources

PERIODICALS

Dajer, Tony. "A Lethal Scratch." *Discover* (Feb. 1998): 34-7.

Belinda Rowland, PhD

Acute pericarditis see **Pericarditis**

Acute poststreptococcal glomerulonephritis

Definition

Acute poststreptococcal **glomerulonephritis** (APSGN) is an inflammation of the kidney tubules (glomeruli) that filter waste products from the blood, following a streptococcal infection such as **strep throat**. APSGN is also called postinfectious glomerulonephritis.

Description

APSGN develops after certain streptococcal bacteria (group A beta-hemolytic streptococci) have infected the skin or throat. Antigens from the dead streptococci clump together with the antibodies that killed them. These clumps are trapped in the kidney tubules, cause the tubules to become inflamed, and impair that organs' ability to filter and eliminate body wastes. The onset of APSGN usually occurs one to six weeks (average two weeks) after the streptococcal infection.

APSGN is a relatively uncommon disease affecting about one of every 10,000 people, although four or five times that many may actually be affected by it but show no symptoms. APSGN is most prevalent among boys between the ages of 3 and 7, but it can occur at any age.

Causes and symptoms

Frequent sore throats and a history of streptococcal infection increase the risk of acquiring APSGN. Symptoms of APSGN include:

- fluid accumulation and tissue swelling (**edema**) initially in the face and around the eyes, later in the legs
- low urine output (oliguria)
- blood in the urine (hematuria)
- protein in the urine (proteinuria)
- high blood pressure
- joint **pain** or stiffness

KEY TERMS

Streptococcus—A gram-positive, round or oval bacteria in the genus *Streptococcus*. Group A streptococci cause a number of human diseases including strep throat, impetigo, and APSGN.

Diagnosis

Diagnosis of APSGN is made by taking the patient's history, assessing his/her symptoms, and performing certain laboratory tests. **Urinalysis** usually shows blood and protein in the urine. Concentrations of urea and creatinine (two waste products normally filtered out of the blood by the kidneys) in the blood are often high, indicating impaired kidney function. A reliable, inexpensive blood test called the anti-streptolysin-O test can confirm that a patient has or has had a streptococcal infection. A **throat culture** may also show the presence of group A beta-hemolytic streptococci.

Treatment

Treatment of APSGN is designed to relieve the symptoms and prevent complications. Some patients are advised to stay in bed until they feel better and to restrict fluid and salt intake. **Antibiotics** may be prescribed to kill any lingering streptococcal bacteria, if their presence is confirmed. Antihypertensives may be given to help control high blood pressure and **diuretics** may be used to reduce fluid retention and swelling. **Kidney dialysis** is rarely needed.

Prognosis

Most children (up to 95%) fully recover from APSGN in a matter of weeks or months. Most adults (up to 70%) also recover fully. In those who do not recover fully, chronic or progressive problems of kidney function may occur. Kidney failure may result in some patients.

Prevention

Receiving prompt treatment for **streptococcal infections** may prevent APSGN.

Resources

BOOKS

- Harrison's Principles of Internal Medicine*. Ed. Anthony S. Fauci, et al. New York: McGraw-Hill, 1997.
- Professional Guide to Diseases*. 5th ed. Springhouse, PA: Springhouse Corporation, 1995.

ORGANIZATIONS

American Kidney Fund. 6110 Executive Boulevard, Rockville, MD 20852. (800) 638-8299. <<http://216.248.130.102/Default.htm>>.

National Kidney Foundation. 30 East 33rd St., New York, NY 10016. (800) 622-9010. <<http://www.kidney.org>>.

Maureen Haggerty

Acute respiratory distress syndrome see
Adult respiratory distress syndrome

Acute stress disorder

Definition

Acute **stress** disorder (ASD) is an **anxiety** disorder characterized by a cluster of dissociative and anxiety symptoms occurring within one month of a traumatic event. (Dissociation is a psychological reaction to trauma in which the mind tries to cope by “sealing off” some features of the trauma from conscious awareness).

Description

Acute stress disorder is a new diagnostic category that was introduced in 1994 to differentiate time-limited reactions to trauma from **post-traumatic stress disorder** (PTSD).

Causes and symptoms

Acute stress disorder is caused by exposure to trauma, which is defined as a stressor that causes intense fear and, usually, involves threats to life or serious injury to oneself or others. Examples are rape, mugging, combat, natural disasters, etc.

The symptoms of stress disorder include a combining of one or more dissociative and anxiety symptoms with the avoidance of reminders of the traumatic event. Dissociative symptoms include emotional detachment, temporary loss of memory, depersonalization, and derealization.

Anxiety symptoms connected with acute stress disorder include irritability, physical restlessness, sleep problems, inability to concentrate, and being easily startled.

Diagnosis

Diagnosis of acute stress disorder is based on a combination of the patient’s history and a **physical examination** to rule out diseases that can cause anxiety. The

KEY TERMS

Depersonalization—A dissociative symptom in which the patient feels that his or her body is unreal, is changing, or is dissolving.

Derealization—A dissociative symptom in which the external environment is perceived as unreal.

Dissociation—A reaction to trauma in which the mind splits off certain aspects of the trauma from conscious awareness. Dissociation can affect the patient’s memory, sense of reality, and sense of identity.

Trauma—In the context of ASD, a disastrous or life-threatening event.

essential feature is a traumatic event within one month of the onset of symptoms. Other diagnostic criteria include:

- The symptoms significantly interfere with normal social or vocational functioning
- The symptoms last between two days and four weeks.

Treatment

Treatment for acute stress disorder usually includes a combination of antidepressant medications and short-term psychotherapy.

Alternative treatment

Acupuncture has been recommended as a treatment for acute stress disorder. Some other alternative approaches, including **meditation**, breathing exercises, and **yoga**, may be helpful when combined with short-term psychotherapy. Homeopathic treatment and the use of herbal medicine and flower essences also can help the person with acute stress disorder rebalance on the physical, mental, and emotional levels.

Prognosis

The prognosis for recovery is influenced by the severity and duration of the trauma, the patient’s closeness to it, and the patient’s previous level of functioning. Favorable signs include a short time period between the trauma and onset of symptoms, immediate treatment, and appropriate social support. If the patient’s symptoms are severe enough to interfere with normal life and have lasted longer than one month, the diagnosis may be changed to PTSD. If the symptoms have lasted longer than one month but are

not severe enough to meet the definition of PTSD, the diagnosis may be changed to adjustment disorder.

Patients who do not receive treatment for acute stress disorder are at increased risk for substance abuse or major **depressive disorders**.

Prevention

Traumatic events cannot usually be foreseen and, thus, cannot be prevented. However, in theory, professional intervention soon after a major trauma might reduce the likelihood or severity of ASD. In addition, some symptoms of acute stress disorder result from biochemical changes in the central nervous system, muscles, and digestive tract that are not subject to conscious control.

Resources

BOOKS

"Acute Stress Disorder." In *Diagnostic and Statistical Manual of Mental Disorders*. 4th ed. Washington, DC: American Psychiatric Association, 1994.

Corbman, Gene R. "Anxiety Disorders." In *Current Diagnosis*. Vol. 9. Ed. Rex B. Conn, et al. Philadelphia: W. B. Saunders Co., 1997.

Eisendrath, Stuart J. "Psychiatric Disorders." In *Current Medical Diagnosis and Treatment*, 1998. 37th ed. Ed. Stephen McPhee, et al. Stamford: Appleton & Lange, 1997.

Kabat-Zinn, Jon. *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain, and Illness*. New York: Bantam Doubleday Dell Publishing Group, Inc., 1990.

"On-Call Problems: Insomnia." In *Surgery On Call*, ed. Leonard G. Gomella and Alan T. Lefor. Stamford: Appleton & Lange, 1996.

Rebecca J. Frey

Acute stress gastritis see **Gastritis**

Acute transverse myelitis see **Transverse myelitis**

Acyclovir see **Antiviral drugs**

Addiction

Definition

Addiction is a dependence on a behavior or substance that a person is powerless to stop. The term has been partially replaced by the word *dependence* for substance abuse. Addiction has been extended, however, to

include mood-altering behaviors or activities. Some researchers speak of two types of addictions: substance addictions (for example, **alcoholism**, drug abuse, and **smoking**); and process addictions (for example, gambling, spending, shopping, eating, and sexual activity). There is a growing recognition that many addicts, such as polydrug abusers, are addicted to more than one substance or process.

Description

Addiction is one of the most costly public health problems in the United States. It is a progressive syndrome, which means that it increases in severity over time unless it is treated. Substance abuse is characterized by frequent relapse, or return to the abused substance. Substance abusers often make repeated attempts to quit before they are successful.

In 1995 the economic cost of substance abuse in the United States exceeded \$414 billion, with health care costs attributed to substance abuse estimated at more than \$114 billion.

By eighth grade, 52% of adolescents have consumed alcohol, 41% have smoked tobacco, and 20% have smoked marijuana. Compared to females, males are almost four times as likely to be heavy drinkers, nearly one and a half more likely to smoke a pack or more of cigarettes daily, and twice as likely to smoke marijuana weekly. However, among adolescents these gender differences are decreasing. Although frequent use of tobacco, **cocaine** and heavy drinking appears to have remained stable in the 1990s, marijuana use increased.

In 1999, an estimated four million Americans over the age of 12 used prescription **pain** relievers, sedatives, and stimulants for "nonmedical" reasons during one month.

In the United States, 25% of the population regularly uses tobacco. Tobacco use reportedly kills 2.5 times as many people each year as alcohol and drug abuse combined. According to 1998 data from the World Health Organization, there were 1.1 billion smokers worldwide and 10,000 tobacco-related deaths per day. Furthermore, in the United States, 43% of children aged 2-11 years are exposed to environmental tobacco smoke, which has been implicated in **sudden infant death syndrome**, low birth weight, **asthma**, middle ear disease, **pneumonia**, **cough**, and upper respiratory infection.

Eating disorders, such as **anorexia nervosa**, **bulimia nervosa**, and binge eating, affect over five million American women and men. Fifteen percent of young women have substantially disordered attitudes toward eating and eating behaviors. More than 1,000 women die each year from anorexia nervosa.

A 1997 Harvard study found that an estimated 15.4 million Americans suffered from a gambling addiction. Over half that number (7.9 million) were adolescents.

Causes and symptoms

Addiction to substances results from the interaction of several factors:

Drug chemistry

Some substances are more addictive than others, either because they produce a rapid and intense change in mood; or because they produce painful withdrawal symptoms when stopped suddenly.

Genetic factor

Some people appear to be more vulnerable to addiction because their body chemistry increases their sensitivity to drugs. Some forms of **substance abuse and dependence** seem to run in families; and this may be the result of a genetic predisposition, environmental influences, or a combination of both.

Brain structure and function

Using drugs repeatedly over time changes brain structure and function in fundamental and long-lasting ways. Addiction comes about through an array of changes in the brain and the strengthening of new memory connections. Evidence suggests that those long-lasting brain changes are responsible for the distortions of cognitive and emotional functioning that characterize addicts, particularly the compulsion to use drugs. Although the causes of addiction remain the subject of ongoing debate and research, many experts now consider addiction to be a brain disease: a condition caused by persistent changes in brain structure and function. However, having this brain disease does not absolve the addict of responsibility for his or her behavior, but it does explain why many addicts cannot stop using drugs by sheer force of will alone.

Social learning

Social learning is considered the most important single factor. It includes patterns of use in the addict's family or subculture, peer pressure, and advertising or media influence.

Availability

Inexpensive or readily available tobacco, alcohol, or drugs produce marked increases in rates of addiction.



Crack users. Crack, a form of cocaine, is one of the most addictive drugs. (Photograph by Roy Marsch, *The Stock Market*. Reproduced by permission.)

Individual development

Before the 1980s, the so-called addictive personality was used to explain the development of addiction. The addictive personality was described as escapist, impulsive, dependent, devious, manipulative, and self-centered. Many doctors now believe that these character traits develop in addicts as a result of the addiction, rather than the traits being a cause of the addiction.

Diagnosis

In addition to a preoccupation with using and acquiring the abused substance, the diagnosis of addiction is based on five criteria:

- loss of willpower
- harmful consequences
- unmanageable lifestyle
- tolerance or escalation of use
- withdrawal symptoms upon quitting

Treatment

Treatment requires both medical and social approaches. Substance addicts may need hospital treatment to manage withdrawal symptoms. Individual or group psychotherapy is often helpful, but only after substance use has stopped. Anti-addiction medications, such as **methadone** and naltrexone, are also commonly used.

The most frequently recommended social form of outpatient treatment is the twelve-step program. Such programs are also frequently combined with psychotherapy. According to a recent study reported by the American Psychological Association (APA), anyone, regardless of his or her religious beliefs or lack of religious beliefs, can benefit from participation in 12-step programs such as Alcoholics Anonymous (AA) or Narcotics Anonymous (NA). The number of visits to 12-step self-help groups exceeds the number of visits to all mental health professionals combined. There are twelve-step groups for all major substance and process addictions.

The Twelve Steps are:

- Admit powerlessness over the addiction.
- Believe that a Power greater than oneself could restore sanity.
- Make a decision to turn your will and your life over to the care of God, as you understand him.
- Make a searching and fearless moral inventory of self.
- Admit to God, yourself, and another human being the exact nature of your wrongs.
- Become willing to have God remove all these defects from your character.
- Humbly ask God to remove shortcomings.
- Make a list of all persons harmed by your wrongs and become willing to make amends to them all.
- Make direct amends to such people, whenever possible except when to do so would injure them or others.
- Continue to take personal inventory and promptly admit any future wrongdoings.
- Seek to improve contact with a God of the individual's understanding through **meditation** and prayer.
- Carry the message of spiritual awakening to others and practice these principles in all your affairs.

Alternative treatment

Acupuncture and **homeopathy** have been used to treat withdrawal symptoms. Meditation, **yoga**, and **reiki** healing have been recommended for process addictions, however, the success of these programs has not been well documented through controlled studies.

KEY TERMS

Addiction—Dependence on a habit-forming substance or behavior that the person is powerless to stop.

Addictive personality—A concept that was formerly used to explain addiction as the result of pre-existing character defects in individuals.

Process addiction—Addiction to certain mood-altering behaviors, such as eating disorders, gambling, sexual activity, overwork, and shopping.

Tolerance—A condition in which an addict needs higher doses of a substance to achieve the same effect previously achieved with a lower dose.

Withdrawal—The unpleasant, sometimes life-threatening physiological changes that occur, due to the discontinuation of use of some drugs after prolonged, regular use.

Prognosis

The prognosis for recovery from any addiction depends on the substance or process, the individual's circumstances, and underlying personality structure. Poly-drug users have the worst prognosis for recovery.

Prevention

The most effective form of prevention appears to be a stable family that models responsible attitudes toward mood-altering substances and behaviors. Prevention education programs are also widely used to inform the public of the harmfulness of substance abuse.

Resources

BOOKS

"Psychiatric Disorders: Drug Dependence." In *The Merck Manual of Diagnosis and Therapy*. Vol. 1. Ed. Robert Berkow, et al. Rahway, N.J.: Merck Research Laboratories, 1992.

Robert Wood Johnson Foundation. *Substance Abuse: The Nation's #1 Problem*. Princeton, N.J., 2001.

PERIODICALS

Kalivas, Peter. "Drug Addiction: To the Cortex...and beyond" *The American Journal of Psychiatry* volume 158, issue 3, (March 2001).

Kelly, Timothy. "Addiction: A Booming \$800 Billion Industry." *The World and I* (July 1, 2000).

Leshner, Alan. "Addiction is a Brain Disease" *Issues in Science and Technology* volume 17, issue 3, (April 1, 2001).

Mattas-Curry, L. "12-step self-help programs proved successful regardless of participants' religious background, study

suggests." *APA Monitor Online*. volume 30, number 11, (December 1999). <<http://www.apa.org/monitor/>>.

ORGANIZATIONS

- Al-Anon Family Groups. Box 182, Madison Square Station, New York, NY 10159. <<http://www.Al-Anon Alateen.org>>.
- Alcoholics Anonymous World Services, Inc. Box 459, Grand Central Station, New York, NY 10163. <<http://www.alcoholics-anonymous.org>>.
- American Anorexia Bulimica Association. <<http://www.aabainc.org/>>.
- American Psychiatric Association. <<http://www.psych.org>>.
- Center for On-Line Addiction. <<http://www.netaddiction.com/>>.
- eGambling: Electronic Journal of Gambling Issues. <<http://www.camh.net/egambling/main.html>>.
- National Center on Addiction and Substance Abuse at Columbia University. <<http://www.casacolumbia.org/>>.
- National Alliance on Alcoholism and Drug Dependence, Inc. 12 West 21st St., New York, NY 10010. (212)206-6770.
- National Clearinghouse for Alcohol and Drug Information. <<http://www.health.org>>.
- National Institute on Alcohol Abuse and Alcoholism (NIAAA) 6000 Executive Boulevard, Bethesda, Maryland 20892-7003. <<http://www.niaaa.nih.gov>>.

Bill Asenjo, MS, CRC

Addison's disease

Definition

Addison's disease is a disorder involving disrupted functioning of the part of the adrenal gland called the cortex. This results in decreased production of two important chemicals (hormones) normally released by the adrenal cortex: cortisol and aldosterone.

Description

The adrenals are two glands, each perched on the upper part of the two kidneys. The outer part of the gland is known as the cortex; the inner part is known as the medulla. Each of these parts of the adrenal gland is responsible for producing different types of hormones.

Cortisol is a very potent hormone produced by the adrenal cortex. It is involved in regulating the functioning of nearly every type of organ and tissue throughout the body, and is considered to be one of the few hormones absolutely necessary for life. Cortisol is involved in:

- the very complex processing and utilization of many nutrients, including sugars (carbohydrates), fats, and proteins
- the normal functioning of the circulatory system and the heart

KEY TERMS

Gland—A collection of cells whose function is to release certain chemicals, or hormones, which are important to the functioning of other, sometimes distantly located, organs or body systems.

Hormone—A chemical produced in one part of the body, which travels to another part of the body in order to exert its effect.

- the functioning of muscles
- normal kidney function
- production of blood cells
- the normal processes involved in maintaining the skeletal system
- proper functioning of the brain and nerves
- the normal responses of the immune system

Aldosterone, also produced by the adrenal cortex, plays a central role in maintaining the appropriate proportions of water and salts in the body. When this balance is upset, the volume of blood circulating throughout the body will fall dangerously low, accompanied by a drop in blood pressure.

Addison's disease is also called primary adrenocortical insufficiency. In other words, some process interferes directly with the ability of the adrenal cortex to produce its hormones. Levels of both cortisol and aldosterone drop, and numerous functions throughout the body are disrupted.

Addison's disease occurs in about four in every 100,000 people. It strikes both men and women of all ages.

Causes and symptoms

The most common cause of Addison's disease is the destruction and/or shrinking (atrophy) of the adrenal cortex. In about 70% of all cases, this atrophy is believed to occur due to an autoimmune disorder. In an autoimmune disorder, the immune system of the body, responsible for identifying foreign invaders such as viruses or bacteria and killing them, accidentally begins to identify the cells of the adrenal cortex as foreign, and destroy them. In about 20% of all cases, destruction of the adrenal cortex is caused by **tuberculosis**. The remaining cases of Addison's disease may be caused by fungal infections, such as **histoplasmosis**, coccidiomycosis, and **cryptococcosis**, which affect the adrenal gland by producing destructive, tumor-like masses

called granulomas; a disease called **amyloidosis**, in which a starchy substance called amyloid is deposited in abnormal places throughout the body, interfering with the function of whatever structure it is present within; or invasion of the adrenal glands by **cancer**.

In about 75% of all patients, Addison's disease tends to be a very gradual, slowly developing disease. Significant symptoms are not noted until about 90% of the adrenal cortex has been destroyed. The most common symptoms include **fatigue** and loss of energy, decreased appetite, nausea, vomiting, **diarrhea**, abdominal **pain**, weight loss, muscle weakness, **dizziness** when standing, **dehydration**, unusual areas of darkened (pigmented) skin, and dark freckling. As the disease progresses, the patient may appear to have very tanned, or bronzed skin, with darkening of the lining of the mouth, vagina, and rectum, and dark pigmentation of the area around the nipples (areola). As dehydration becomes more severe, the blood pressure will continue to drop and the patient will feel increasingly weak and light-headed. Some patients have psychiatric symptoms, including depression and irritability. Women lose pubic and underarm hair, and stop having normal menstrual periods.

When a patient becomes ill with an infection, or stressed by an injury, the disease may suddenly and rapidly progress, becoming life-threatening. Symptoms of this "Addisonian crisis" include abnormal heart rhythms, severe pain in the back and abdomen, uncontrollable **nausea and vomiting**, a drastic drop in blood pressure, kidney failure, and unconsciousness. About 25% of all Addison's disease patients are identified due to the development of Addisonian crisis.

Diagnosis

Many patients do not recognize the slow progression of symptoms and the disease is ultimately identified when a physician notices the areas of increased pigmentation of the skin. Once suspected, a number of blood tests can lead to the diagnosis of Addison's disease. It is not sufficient to demonstrate low blood cortisol levels, as normal levels of cortisol vary quite widely. Instead, patients are given a testing dose of another hormone called corticotropin (ACTH). ACTH is produced in the body by the pituitary gland, and normally acts by promoting growth within the adrenal cortex and stimulating the production and release of cortisol. In Addison's disease, even a dose of synthetic ACTH does not increase cortisol levels.

To distinguish between primary adrenocortical insufficiency (Addison's disease) and secondary adrenocortical insufficiency (caused by failure of the

pituitary to produce enough ACTH), levels of ACTH in the blood are examined. Normal or high levels of ACTH indicate that the pituitary is working properly, but the adrenal cortex is not responding normally to the presence of ACTH. This confirms the diagnosis of Addison's disease.

Treatment

Treatment of Addison's disease involves replacing the missing or low levels of cortisol. In the case of Addisonian crisis, this will be achieved by injecting a potent form of steroid preparation through a needle placed in a vein (intravenous or IV). Dehydration and salt loss will also be treated by administering carefully balanced solutions through the IV. Dangerously low blood pressure may require special medications to safely elevate it until the steroids take effect.

Patients with Addison's disease will need to take a steroid preparation (hydrocortisone) and a replacement for aldosterone (fludrocortisone) by mouth for the rest of their lives. When a patient has an illness which causes nausea and vomiting (such that they cannot hold down their medications), he or she will need to enter a medical facility where IV medications can be administered. When a patient has any kind of infection or injury, the normal dose of hydrocortisone will need to be doubled.

Prognosis

Prognosis for patients appropriately treated with hydrocortisone and aldosterone is excellent. These patients can expect to enjoy a normal lifespan. Without treatment, or with substandard treatment, patients are always at risk of developing Addisonian crisis.

Resources

BOOKS

Williams, Gordon H., and Robert G. Dluhy. "Hypofunction of the Adrenal Cortex." In *Harrison's Principles of Internal Medicine*, ed. Anthony S. Fauci, et al. New York: McGraw-Hill, 1997.

PERIODICALS

Brosnan, C. M., and N. F. C. Gowing. "Addison's Disease." *British Medical Journal* 312, no. 7038 (27 Apr. 1996): 1085+.

Oelkers, Wolfgang. "Adrenal Insufficiency." *New England Journal of Medicine* 335, no. 16 (17 Oct. 1996): 1206+.

ORGANIZATIONS

National Adrenal Disease Foundation. 505 Northern Boulevard, Suite 200, Great Neck, NY 11021. (516) 487-4992.

Rosalyn Carson-DeWitt, MD