Stahl's Illustrated

Attention Deficit Hyperactivity Disorder

Stephen M. Stahl
University of California, San Diego

Laurence Mignon
Neuroscience Education Institute, CA

Nancy Muntner
Illustrations

CAMBRIDGE UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS

Shaftesbury Road, Cambridge CB2 8EA, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of Cambridge University Press & Assessment, a department of the University of Cambridge.

We share the University's mission to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/9780521133159

First published 2009 (version 7, September 2022)

A catalogue record for this publication is available from the British Library

Library of Congress Cataloging-in-Publication data
Stahl, S. M.
Attention deficit hyperactivity disorder / Stephen M. Stahl, Laurence Mignon ; Nancy Muntner, illustrations.
p. cm. – (Stahl's illustrated series)
Includes bibliographical references and index.
ISBN 978-0-521-13315-9 (pbk.)
1. Attention-deficit hyperactivity disorder. I. Mignon, Laurence. II. Title.
RJ506.H9S67 2010
618.92′8589 – dc22 2009025166

ISBN 978-0-521-13315-9 Paperback

PREFACE

These books are designed to be fun. All concepts are illustrated by full-color images. The text can be used as a supplement to figures, images, and tables. The visual learner will find that this book makes psychopharmacology concepts easy to master, while the non-visual learner may enjoy a shortened text version of complex psychopharmacology concepts. Each chapter builds upon previous chapters, synthesizing information from basic biology and diagnostics to building treatment plans and dealing with complications and comorbidities.

Novices may want to approach this book by first looking through all the graphics, gaining a feel for the visual vocabulary on which our psychopharmacology concepts rely. After this once-over glance, we suggest going back through the book to incorporate the images with text from figure legends. Learning from visual concepts and textual supplements should reinforce one another, providing you with solid conceptual understanding at each step along the way.

Readers more familiar with these topics should find that going back and forth between images and text provides an interaction with which to vividly conceptualize complex psychopharmacology. You may find yourself using this book frequently to refresh your psychopharmacological knowledge. You may also find yourself referring your colleagues to this desk reference.

This book is intended as a conceptual overview of different topics; we provide you with a visual-based language to incorporate the rules of psychopharmacology at the sacrifice of discussing the exceptions to these rules. A Suggested Readings section at the end of this book gives you a good start for more in-depth learning about particular concepts presented here.

When you come across an abbreviation or figure you don't understand, you can refer to the Abbreviations and Visual Vocabulary legends. After referring to these several times you will begin to develop proficiency in the visual vocabulary of psychopharmacology. Stahl's Essential Psychopharmacology, 3rd Edition, and Stahl's Essential Psychopharmacology: The Prescriber's Guide, 3rd Edition, can be helpful supplementary tools for more in-depth information on particular topics in this book. Now you can also search topics in psychopharmacology on the Neuroscience Education Institute's website (www.neiglobal.com) for lectures, courses, slides, and related articles.

Whether you are a novice or an experienced psychopharmacologist, hopefully this book will lead you to think critically about the complexities involved in psychiatric disorders and their treatments.

Best wishes for your educational journey into the fascinating field of psychopharmacology!

Table of Contents

CME Information

Overview

This book aims to visually explain the underlying pathophysiology of attention deficit hyperactivity disorder (ADHD), give an overview of the evolution of symptoms and the comorbidities present with ADHD, and provide information on best treatment approaches for children, adolescents, and adults with ADHD. The book is divided into four chapters for ease of reading and referencing. Chapter 1, "Neurobiology, Circuits, and Genetics," focuses on the known and hypothetical causes underlying the pathophysiology of ADHD. Chapter 2, "ADHD Across the Ages," explains how the symptoms of ADHD can evolve over time and gives an overview of different rating scales for children, adolescents, and adults. Chapter 3, "Comorbidities of ADHD," examines the different comorbidities that can be present with patients of all ages with ADHD. Chapter 4, "ADHD Treatments," describes the different medications that are used for the treatment of ADHD and elaborates on their mechanisms of action. The visual component of this book is designed to allow the reader to easily grasp concepts.

Target Audience

This CME activity has been developed for MDs specializing in psychiatry. There are no prerequisites for this activity. Physicians in all specialties who are interested in psychopharmacology, as well as nurses, psychologists, and pharmacists, are welcome for advanced study.

Statement of Need

The following unmet needs regarding attention deficit hyperactivity disorder were revealed following a vigorous assessment of activity feedback, expert faculty assessment, literature review, and through new medical knowledge:

- Attention deficit hyperactivity disorder (ADHD) is a chronic disorder, which (1) does not fade away with time, (2) can remain undiagnosed until adulthood, or (3) can start in adulthood. Appropriate understanding of symptom evolution is required to make a proper diagnosis at any age.
- Patients with ADHD have comorbid psychiatric disorders as well as weight issues, all of which can have an important impact on treatment selection.
- The different rating scales available to aid diagnosis and tracking of symptoms of ADHD may not be used as often as they should be; at the same time, the diagnosis of adult ADHD may need a separate set of rating scales that reflect the differences in symptoms compared to childhood ADHD.
- A number of new formulations of current stimulant medications, as well as new non-stimulant treatments with different mechanisms of action, are being tested and integrated into the market; these, in conjunction with patient education and therapy, may help improve treatment adherence.

To help fill these unmet needs, quality improvement efforts need to increase understanding of the neurobiology of psychiatric disease states and the pharmacology of available, new, and in-development medications.

Learning Objectives

After completing this activity, participants should be better able to fulfill the following learning objectives:

- Explain the symptoms of ADHD and the circuits involved
- Compare and contrast the diagnosis of ADHD in children versus adolescents versus adults
- Understand the importance of dopamine and norepinephrine in the pathophysiology and treatment of ADHD, with emphasis on the symptom of executive dysfunction
- Recognize the difference between pulsatile versus tonic neuronal firing and the importance of it in ADHD
- Understand the difference in the mechanisms of action of stimulant versus non-stimulant drugs
- Identify comorbidities in children, adolescents, and adults with ADHD
- Individualize treatment strategies for ADHD in children versus adolescents versus adults

Accreditation and Credit Designation Statements

The Neuroscience Education Institute is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

The Neuroscience Education Institute designates this educational activity for a maximum of 3.0 *AMA PRA Category 1 Credits*™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Nurses in most states may claim full credit for activities approved for *AMA PRA Category 1 Credits*™ (for up to half of their recertification credit requirements). This activity is designated for 3.0 AMA PRA Category 1 Credits.

Also available will be a certificate of participation for completing this activity.

Activity Instructions

This CME activity is in the form of a printed monograph and incorporates instructional design to enhance your retention of the information and pharmacological concepts that are being presented. You are advised to go through the figures in this activity from beginning to end, followed by the text, and then complete the posttest and activity evaluation. The estimated time for completion of this activity is 3.0 hours.

Instructions for CME Credit

To receive your certificate of CME credit or participation, please complete the posttest (you must score at least 70% to receive credit) and activity evaluation found at the end of the book and mail or fax them to the address/number provided. Once received, your posttest will be graded and a certificate sent if a score of 70% or more was attained. Alternatively, **you may complete the posttest and activity evaluation online and immediately print your certificate**. There is a fee for the posttest (waived for NEI members).

NEI Disclosure Policy

It is the policy of the Neuroscience Education Institute to ensure balance, independence, objectivity, and scientific rigor in all its educational activities. Therefore, all individuals in a position to influence or control content development are required by NEI to disclose any financial relationships or apparent conflicts of interest that may have a direct bearing on the subject matter of the activity. Although potential conflicts of interest are identified and resolved prior to the activity being presented, it remains for the participant to determine whether outside interests reflect a possible bias in either the exposition or the conclusions presented.

These materials have been peer-reviewed to ensure the scientific accuracy and medical relevance of information presented and its independence from commercial bias. The Neuroscience Education Institute takes responsibility for the content, quality, and scientific integrity of this CME activity.

Individual Disclosure Statements

Authors

Stephen M. Stahl, MD, PhD

Adjunct Professor, Department of Psychiatry, University of California, San Diego School of Medicine, San Diego, CA

Grant/Research: Forest Laboratories, Inc.; Johnson & Johnson; Novartis; Organon; Pamlab, L.L.C.; Pfizer Inc; Sepracor Inc.; Shire Pharmaceuticals Inc.; Takeda Pharmaceuticals North America, Inc.; Vanda Pharmaceuticals Inc.; Wyeth Pharmaceuticals

Consultant/Advisor: Arena Pharmaceuticals, Inc.; Azur Pharma Inc; Bionevia Pharmaceuticals Inc.; Bristol-Myers Squibb Company; CeNeRx BioPharma, Inc.; Eli Lilly and Company; Endo Pharmaceuticals Inc.; Forest Pharmaceuticals, Inc.; Janssen Pharmaceutica Inc.; Jazz Pharmaceuticals, Inc.; Johnson & Johnson; Labopharm Inc.; Lundbeck Pharmaceuticals Ltd.; Marinus Pharmaceuticals, Inc.; Neuronetics, Inc.; Novartis; Noven Pharmaceuticals, Inc.; Pamlab, L.L.C.; Pfizer Inc; Pierre Fabre; Sanofi-Synthélabo Inc.; Sepracor Inc.; Servier Laboratories; Shire Pharmaceuticals Inc.; SK Corporation; Solvay Pharmaceuticals; Somaxon Pharmaceuticals, Inc.; Tetragenix Pharmaceuticals; Vanda Pharmaceuticals Inc.

Speakers Bureau: Pfizer Inc; Wyeth Pharmaceuticals

Laurence Mignon, PhD
Senior Medical Writer, Neuroscience Education Institute, Carlsbad, CA
Stockholder: Aspreva Pharmaceuticals Corporation; Vanda Pharmaceuticals Inc.; ViroPharma Incorporated.

Content Editor
Meghan Grady
Director, Content Development, Neuroscience Education Institute, Carlsbad, CA
No other financial relationships to disclose.

Peer Reviewer
Christopher J. Kratochvil, MD
Professor, Departments of Psychiatry and Pediatrics, University of Nebraska Medical Center, Omaha, NE
Grant/Research: Abbott Laboratories; Eli Lilly and Company; McNeil Consumer & Specialty Pharmaceuticals; Shire Pharmaceuticals Inc.
Consultant/Advisor: Abbott Laboratories; Eli Lilly and Company; Pfizer Inc (DSMB)

Design Staff
Nancy Muntner
Director, Medical Illustrations, Neuroscience Education Institute, Carlsbad, CA
No other financial relationships to disclose.

Disclosed financial relationships have been reviewed by the Neuroscience Education Institute CME Advisory Board to resolve any potential conflicts of interest. All faculty and planning committee members have attested that their financial relationships do not affect their ability to present well-balanced, evidence-based content for this activity.

Disclosure of Off-Label Use

This educational activity may include discussion of products or devices that are not currently labeled for such use by the FDA. Please consult the product prescribing information for full disclosure of labeled uses.

Disclaimer

The information presented in this educational activity is not meant to define a standard of care, nor is it intended to dictate an exclusive course of patient management. Any procedures, medications, or other courses of diagnosis or treatment discussed or suggested in this educational activity should not be used by clinicians without full evaluation of their patients' conditions and possible contraindications or dangers in use, review of any applicable manufacturer's product information, and comparison with recommendations of other authorities. Primary references and full prescribing information should be consulted.

Participants have an implied responsibility to use the newly acquired information from this activity to enhance patient outcomes and their own professional development. The participant should use his/her clinical judgment, knowledge, experience, and diagnostic decision-making before applying any information, whether provided here or by others, for any professional use.

Sponsorship Information
This activity is sponsored by Neuroscience Education Institute.

Support
This activity is supported solely by the sponsor, Neuroscience Education Institute. Neither the Neuroscience Education Institute nor the authors/illustrator have received any funds or grants in support of this educational activity.

Date of Release/Expiration
Release Date: April, 2009 CME Credit Expiration Date: March, 2012

Stahl's Illustrated

Visual Vocabulary Legend

 Cardiac Impairment	 Life-threatening or Dangerous Side Effects
 Children and Adolescents	 Norepinephrine
 Dopamine	 Pregnancy
 Dopamine Transporter	 Psychotherapy
 Drug Interactions	 Renal Impairment
 Hepatic Impairment	 Tips and Pearls

Objectives

- Explain the symptoms of attention deficit hyperactivity disorder (ADHD) and the circuits involved
- Compare and contrast the diagnosis of ADHD in children versus adolescents versus adults
- Understand the importance of dopamine and norepinephrine in the pathophysiology and treatment of ADHD, with emphasis on the symptom of executive dysfunction
- Recognize the difference between phasic versus tonic neuronal firing and the importance of it in ADHD
- Understand the difference in the mechanisms of action of stimulant versus non-stimulant drugs
- Identify comorbidities in children, adolescents, and adults with ADHD
- Individualize treatment strategies for ADHD in children versus adolescents versus adults