# Mosby's HANDBOOK OF PHARMACOLOGY

BRUCE D. CLAYTON

FOURTH EDITION

# Mosby's HANDBOOK OF PHARMACOLOGY

BRUCE D. CLAYTON, Pharm. D.

Professor and Chairman
Department of Pharmacy Practice
College of Pharmacy
University of Arkansas for Medical Sciences
tle Rock, Arkansas

Printed by the United Butterson and

1839 Westine Industrial Dayer S

The Property answer Property Co

FOURTH EDITION

The C. V. Mosby Company

ST. LOUIS • WASHINGTON, D.C. • TORONTO



### A TRADITION OF PUBLISHING EXCELLENCE

Editor: Don Ladig

Assistant editors: June Heath, Robin Carter

Editing and production: Editing, Design & Production, Inc.

Design: John Rokusek

### **FOURTH EDITION**

Copyright © 1987 by The C.V. Mosby Company

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher.

Previous editions copyrighted 1977, 1980, 1984

Printed in the United States of America

The C.V. Mosby Company 11830 Westline Industrial Drive, St. Louis, Missouri 63146

# Library of Congress Cataloging-in-Publication Data

Clayton, Bruce D., 1947-Mosby's handbook of pharmacology.

Rev. ed. of: Mosby's handbook of pharmacology in nursing. 3rd ed. 1984.

Bibliography: p. Includes index.

1. Pharmacology—manubooks, manuals, etc.

2. Chemotherapy—Handbooks, manuals, etc. I. Clayton, Bruce D. Mosby's handbook of pharmacology in nursing. II. Title. [DNLM: 1. Drug Therapy—nurses' instruction.

2. Pharmacology—nurses instruction. QV 4 C622m] RM300.C514 1987 615'.1 86-23805

ISBN 0-8016-1406-6

# Mosby's Handbook of PHARMACOLOGY

Key Y = Yes companies

= Provisionally examples, use without 5 valuous of preparation

Bitat spaces in these that thing is no sualable date on opposition, the Trasel, L.A. Handbook of tajordole langs, while American Sectety of Hospital Praymaceus, 1909, Bellevia.

Thiopental	Sodium bicarbonate	Scopolamine	Promeinazine	Pentobarbital	Pentazocine	Oxymorphone	Nalbuphine	Morphine	Metoclopramide	Meperidine	Hydroxyzine	Hydromorphone	Glycopyrrolate	Diazepam	Codeine	Cimetidine	Butorphanol	Benzquinamide	Atropine	Alphaprodine	
													~	Z					Y	1	Alphaprodine
	Z	P	P	P	P		~	P	P	70	9	P	~	Z		~	~	~	1	4	Atropine
Z		~		Z	4			~		~	~		4	Z				1	~		Benzquinamide
		P	P	Z	7			P		P	~			Z			1		~	P	Butorphanol
				Z										Z		1			4		Cimetidine
	Z			Z							4		Y	Z	1						Codeine
Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	1	Z	Z	Z	Z	Z	Z	Diazepam
Z	Z	×	¥	Z	Z	4		4		4	4	~	1	Z	~			Y	Y	~	Glycopyrrolate
	Z	P	P	P	P						~	1	~	2					P		Hydromorphone
	Z	7	P	Z	P	~	~	P	P	4	1	4	~	Z	4		~	Y	P		Hydroxyzine
Z	Z	P	P	Z	P			Z	P	1	Y		~	Z			P	~	7		Meperidir .
	Z	P	P		P			P	1	P	9			Z					7		Metoclopramide
Z		P	P	Z	P			1	P	Z	P		~	Z			P	~	70		Morphine
		4	4	Z			1				~			Z					4		Nalbuphine
	tir.	P				1					~		~	Z							Oxymorphone
		P	7	Z	14				P	P	~	P	Z	Z			50	Y	2		Pentazocine
~	~	~	Z	1	Z		Z	Z		Z	Z	P	Z	Z	Z	Z	Z	2	3	5	Pentobarbital
~		P	1	Z	P		~	P	P				4				P		7	0	Promethazine
P	Z	1	P	~	P	P	~	P	P	P	P	P	4	Z			P	~	7		Scopolamine
Z	1	Z		~					Z	Z	Z	Z	Z	Z	Z				Z		Sodium bicarbonate
1	Z	7	Z	P				Z		Z			7	Z				Z			Thiopental

Key: Y = Yes, compatible.

N = No, not compatible.

P = Provisionally compatible, use within 15 minutes of preparation.

— indicates matching entries.

Blank spaces indicate that there is no available data on compatibility. Ref: Trissel, L.A., Handbook of Injectible Drugs, 4th ed. American Society of Hospital Pharmacists, 1986; Bethesda

# Preface to the fourth edition

The response to the third edition has been most gratifying. The support and suggestions offered by reviewers, colleagues, and students have indicated a need for a fourth edition of Mosby's Handbook of Pharmacology with expanded content.

Although those familiar with previous editions of this manual will recognize the format of the present edition, several sections have been added. Over 65 new drugs have been added, bringing the total to more than 500 single-entity agents and over 100 combination products. In an effort to assist Canadian practitioners, those agents that are available in Canada have been so designated.

Significant effort has been made to update and expand descriptions of therapeutic and adverse effects of drugs and the patient parameters that should be monitored to improve therapeutic effect and reduce the incidence of adverse activity. A new subdivision entitled "Pregnancy category" has been added to each of the monographs. This category refers to risk factors associated with the use of that particular agent in pregnant patients. Major updates have been made in the chapters on antibiotics, cardiovascular agents, antihypertensive agents, antidiabetic agents, oral contraceptive agents, and miscellaneous medicinal agents.

I wish to extend a word of thanks to the many students and colleagues who offered suggestions for improvement of this edition.

Special recognition must go to Francine E. Clayton for her patience, support, and excellent secretarial assistance in the preparation of the fourth edition. Special thanks is extended to the John D. Clayton family and the Francis H. Purdy family for their support and encouragement.

# Preface to the first edition

of the characteristics section represents a search of the

No single aspect of patient care demands greater accuracy than drug therapy. The continuing exchange of updated knowledge concerning the more than 7000 principal drugs in today's medical arsenal increases the need for accurate, readily available information. This practical, convenient pocket reference, a thorough compilation of information about the most commonly used single-entity drugs currently on the market, emphasizes the need for knowledge and understanding of precautions and potential drug interactions during administration.

Drugs discussed in the book are categorized in chapters according to their primary pharmacologic activity. Most chapters provide an introduction that briefly discusses pathologic conditions for which the agents are used, how treatment should be approached, and what adjunctive measures should be employed to provide patient comfort and

improve therapeutic effectiveness of the agent.

Monographs of drugs are arranged alphabetically by generic name within each chapter. More information about these monographs is contained in the Note to the reader. The individual monograph of each drug lists the generic name and a representative sample of trade names. Under each generic name is the *American Hospital Formulary Service* number that refers the reader to more detailed information about that drug. The category to which the drug belongs follows the AHFS number.

The first section of each monograph includes primary action and use. Knowledge of the mechanism of action is essential to ensure proper utilization of the drug. The actions discussed include the more important mechanisms sufficient for understanding uses and particular side effects, although the discussions in no way reflect the depth of a primary reference text. The most common and frequent

usages for each drug have been included, but no attempt has been made to list historical or investigational uses.

The characteristics section represents a search of the literature for physiologic parameters of the drug. These parameters provide a more complete understanding and thus more effective monitoring of both therapeutic activity and adverse effects. Such characteristics include half-life; extent of protein binding; rates of absorption; onset, peak, and duration of action; sites of metabolism and excretion; and requirements of dosage supplementation in patients undergoing dialysis.

The section on dosage administration in each monograph is more complete than in many other references. It discusses dosage adjustments for neonatal, pediatric, and adult patients in relation to sites of administration and indications for use, while placing emphasis on techniques and rates of administration. Flow rate charts are provided for those drugs administered by continuous infusion to provide accuracy in calculations and to allow closer correlation with

dosage and patient response.

One of the most valuable and important units of each monograph is that on special remarks and cautions. This section provides more clinically pertinent information about observation and interpretation of drug response. It does not belabor long lists of side effects that are experienced infrequently or that are based only on theoretical considerations. It includes reminders of information that the patient needs for improved understanding and compliance, warnings about interferences with laboratory tests, and use of the drug during pregnancy and lactation.

The concluding section of each monograph provides the health professional with information on significant interactions with other therapeutic agents. Drug interactions are a frequent cause of adverse effects, decreased compliance, and prolonged hospitalizations. Continual awareness of the possibility of interactions and observation for these complications are the responsibility of all health professionals.

No clinically oriented reference would be complete without charts that summarize frequently used data on administration, dosage adjustments, and monitoring. Hence, the appendixes include tables on mathematical conversions, correlation of body surface area with height and weight, pediatric dosage adjustment charts, and tables on excretion of drugs in breast milk and discoloration of excreta secondary to drug metabolism.

X

Safe monitoring of therapeutic agents carries enormous implications for every health professional. We believe that this book will serve as a review to help ensure the safe administration of medications. Students and practitioners in the health sciences will find this a useful and convenient source of accurate, readily applicable information.

Sheila A. Ryan Bruce D. Clayton

# **Acknowledgments**

Permission to use the pharmacologic-therapeutic classification of the American Hospital Formulary Service has been granted by the American Society of Hospital Pharmacists. The Society is not responsible for the accuracy of transpositions, or additions, or excerpts from the original context. For complete information concerning all drugs, consult the American Hospital Formulary Service. Permission to use excerpts from the American Hospital Formulary Service has been granted by the American Society of Hospital Pharmacists. The Society is not responsible for the accuracy of transpositions or excerpts from the original context. This material is copyrighted by the American Society of Hospital Pharmacists, Inc. All rights reserved.

# Note to the Reader

The seventy of the disease, as well as the age and state of

dialysis may still be beneficial in case of poisoning

# nous infusion to growate accuracy in calc amen abarT

The trade names represent an arbitrary selection and imply no preference for any brand name or manufacturer. Those brand names designated with a "\*" are available only in the United States, while those designated with a "C" are available only in Canada. Brand names without specific designation are available throughout North America.

This number directs the user to the American Hospital Formulary Service as a source of more complete information on the drug. The state of refer mello gueb and Action and use Deserve universal value of Value as Action

The mechanisms of action provide an overview and are not meant to include minor or proposed mechanisms. The uses are those generally accepted in medical practice today, however, the dosages and uses suggested do not necessarily have specific approval by the Food and Drug Administration. The manufacturer's product information should be consulted for approval.

# Characteristics

A wide degree of clinical variation may alter these parameters. Metabolic and excretory data are based on patients with normal renal and hepatic function. Therapeutic blood-level data may vary between laboratories and the specificity of the assay methods used. Toxic and lethal bloodlevel data are often based on a few cases, and toxic effects may be intensified by the ingestion of other drugs.

te committees (Federal Register

The qualitative effect of dialysis on drug removal is indicated by a no or a yes. A no indicates that dosage adjustment is not indicated after either peritoneal dialysis (P) or hemodialysis (H). A yes indicates that enough drug is removed in the dialysate to require an extra maintenance dose to ensure

nod studies), and no adequate and well-con-

adequate therapeutic blood levels. It must be emphasized that even though dosage adjustment may not be required, dialysis may still be beneficial in case of poisoning.

# Administration and dosage

Dosages given are for adults, children, and neonates. The severity of the disease, as well as the age and state of health of the patient, may alter the dosages. Administration charts are provided for those drugs administered by continuous infusion to provide accuracy in calculations and to allow closer correlation with dosage and patient response. The "notes" contain particular warnings that relate to administration.

### Patient considerations

Information provided in these sections include:

The more clinically pertinent side effects. Other sources should be consulted for a complete list of adverse effects.

Advice that should be given to help promote patient understanding and compliance, and to prevent complications in therapy. Data provided on laboratory test interferences. The data often refer to tests run by specific methods, many of which are infrequently used. Consult your laboratory for their methods of assay.

Use of drugs during pregnancy and lactation. Most drugs are not approved for use in pregnancy, and many have restrictions concerning pediatric use resulting from a lack of studies in these patient populations. Consult appropriate texts for use if the benefits of therapy outweigh the risks incurred by such therapy.

# **Pregnancy category**

The definitions (Federal Register 1980; 40:37434-67) of the risk factor categories (A, B, C, D, X) are:

Category A—Drugs for which adequate and well-controlled human studies have failed to demonstrate a risk to the fetus.

Category B—Drugs for which human fetal risk is relatively unlikely based upon either negative animal studies and no adequate and well-controlled human studies, or positive animal studies and negative, adequate and well-controlled human studies.

Category C—Drugs for which human fetal risk is unknown based upon positive animal studies (or no animal studies), and no adequate and well-con-

trolled human studies. Drugs should be given only if the potential benefit justifies the potential risk to the fetus.

Category D—Drugs for which there is positive human evidence of fetal risk available, but the benefits from use in pregnant women may be acceptable despite the risk.

Category X—Drugs for which positive animal studies or positive human evidence of fetal risk is available, and whose use in a pregnant woman is contraindicated.

These categories have been assigned based on the level of risk the drug poses to the fetus. Regardless of the category assigned, a drug should not be used in pregnancy unless clearly needed. The pregnancy categories do not refer to risk associated with breast feeding. A general rule to follow is that if the drug can safely be given directly to the infant, it is generally safe to give to the mother during lactation.

Pregnancy categories for combination products have not been listed. Refer to the monographs on the single entities for the classification. Products for topical application with minimal systemic absorption are generally not

classified.

# **Drug interactions**

Those listed are the more common, potentially significant interactions. If a reaction is suspected, consult texts that provide more complete information.

# Contents

1	Antimicrobial	agents,	1

- 2 Cardiovascular agents, 158
- 3 Antihypertensive agents, 237
- 4 Diuretic agents, 300
- 5 Anticoagulant and hemorrheologic agents, 320
- 6 Respiratory agents, 329
- 7 Antihistaminic agents, 361
- 8 Analgesic agents, 368
- 9 Sedative-hypnotic agents, 420
- 10 Tranquilizing agents, 439
- 11 Anticonvulsant agents, 494
- 12 Antiemetic agents, 509
- 13 Antidiabetic agents, 514
- 14 Corticosteroids, 539
- 15 Antineoplastic agents, 546
- 16 Thyroactive agents, 563
- 17 Agents used in the treatment of gout, 580
- 18 Oral contraceptives, 590
- 19 Agents used in obstetrics, 606
- 20 Local anesthetics, 622
- 21 Skeletal muscle relaxants, 628
- Agents used in the treatment of parkinsonism, 651
- 23 Biologic agents, 667

### xx Contents

- 24 Antihyperlipidemic agents, 687
- 25 Miscellaneous agents, 698

# **Appendix**

- A Administration techniques for eye, ear, nose, rectal, and parenteral products, 743
- B Common medical abbreviations, 757
- C Derivatives of medical terminology, 764
- D Prescription abbreviations, 766
- E Mathematic conversions, 767
- **F** Formulas for the calculation of infants' and children's dosages, 772
- G Pediatric emergency drug dosages, 773
- H Drugs excreted in human milk, 781
- Agents that discolor the feces, 785
- J Agents that discolor the urine, 786
- K Contents of general emergency cart, 787
- L Emergency tray contents, 789
- M Nomogram for calculating the body surface area of adults and children, 790

# Bibliography, 792

### **Tables**

- 1-1 Penicillin derivatives, 4
- 1-2 Comparison of penicillinase-resistant penicillins, 5
- **1-3** Comparison of the cephalosporins, 36
- 1-4 Gentamicin dosage in renal failure, 66
- 1-5 Tobramycin administration, 72
- **1-6** Comparison of the tetracyclines, 98
- **2-1** Dobutamine administration, 168
- 2-2 Dopamine administration, 171

2-3	Isoproterenol administration for cardiac standstilland arrhythmias in adults, 176
2-4	Isoxsuprine administration for premature labor, 178
2-5	Levarterenol administration, 181
2-6	Phenylephrine administration, 186
2-7	Bretylium administration, 193
2-8	Bretylium administration: patients with restricte fluid intake, 194
2-9	Routine lidocaine administration, 201
2-10	Lidocaine administration: patients with restricte fluid intake, 202
2-11	Procainamide administration, 211
2-12	Preparations of nitrites and organic nitrates, 227
2-13	Amrinone administration, 234
3-1	Ingredients of antihypertensive combination products, 240
3-2	Nitroprusside administration, 272
4-1	Indications of electrolyte imbalance, 302
4-2	Comparison of thiazide diuretics, 304
4-3	Comparison of other diuretics, 304
4-4	Diuretic combination products, 305
5-1	Heparin infusion, 322
6-1	Terbutaline administration in premature labor, 343
6-2	Theophylline content of theophylline salts, 346
6-3	Xanthine-derivative products, 350
6-4	Aminophylline infusion, 355
8-1	Nonsteroidal antiinflammatory agents, 411
10-1	Benzodiazepine derivatives, 441
10-2	Tricyclic antidepressants, 476
13-1	National Diabetes Data Group classification of glucose intolerance, 516
13-2	Commercially available forms of insulin, 521

xxii	Contents
13-3	Compatibility of insulin combinations, 527
13-4	Comparison of the values of urine glucose tests, 534
13-5	Drugs that may alter urine glucose determinations as a result of interference with the test procedure, 534
13-6	Comparison of the sulfonylureas, 536
14-1	Comparison chart of corticosteroid preparations, 544
15-1	Cancer chemotherapeutic agents, 548
16-1	Comparison of Thyrolar and Euthroid, 574
18-1	Pill side effects: a time framework, 592
18-2	Pill side effects: hormone etiology, 594
18-3	Oral contraceptives, 598
19-1	Ritodrine administration, 619
20-1	Comparison of local anesthetics, 624
22-1	Anticholinergic agents used to treat parkinsonism, 663
22-2	Antihistamines used to treat parkinsonism, 664
23-1	Recommended schedule for active immunization of normal infants and children, 669
23-2	Recommended immunization schedule for infants and children up to seventh birthday not immunized at the recommended time in early infancy, 670
23-3	Recommended immunization schedule for persons 7 years of age or older, 671
25-1	Laxative active ingredients, 741
	6-3 Xan chine derivative products, 350

Aminophylling inflision, 355