Pharmacology from A to Z

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重庆医科大学第一医院
图书室

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Manchester University Press
Manchester and New York

Distributed exclusively in the USA and Canada
by St. Martin's Press

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Published by Manchester University Press
Oxford Road, Manchester M13 9PL, UK
and Room 400, 175 Fifth Avenue, New York, NY 10100, USA

Distributed exclusively in the USA and Canada
by St. Martin's Press, Inc.,
175 Fifth Avenue, New York, NY 10100, USA

British Library cataloguing in publication data
Carpenter, John
Pharmacology from A to Z.
1. Drugs – Encyclopaedias
I. Title
615'.1'0321

Library of Congress cataloging in publication data
Carpenter, John, 1943–
Pharmacology from A to Z / John Carpenter
p. cm. ISBN 0-7190-2988-0 : $35.00 (U.S. : est.). ISBN 0-7190-2692 (pbk.) :
$15.00 (U.S. : est.). 1. Pharmacology—Outlines, syllabi, etc. 2. Drugs—Dictionaries.
I. Title.
[DNLM: 1. Drugs. QV 55 Cd295p]
RM301.14.C37 1988
615'.1.—dc19
DNLM/DLC

ISBN 0 7190 2988 0 *hardback*
ISBN 0 7190 2692 X *paperback*

Typeset by Koinonia Ltd, Manchester

Printed in Great Britain
by Hartnolls Ltd, Bodmin, Cornwall

PREFACE

Many students find when they begin to study Pharmacology for the first time that the subject seems to require that they learn an enormous number of seemingly unrelated facts. After a period of time many find that connections begin to appear between these facts, although for too many students, the experience is that many of the facts they have learned to pass their examinations remain firmly unconnected to anything at all. This could either be because the connections have not yet been made, or that the facts are indeed isolated from the rest of the discipline. In this case, it could well be argued that these particular items of information are worthless. The purpose of this little book is to make it easier for you (the student) to distinguish the essentials of Pharmacology from the details – to tell the wood from the trees, if you like. If the objectives of this book are met, you will begin to grasp the important central concepts about drugs more easily – you might then find that some of those facts are in fact not quite so isolated and some will prove to be so fascinating that you will develop a burning urge to find out why those particular drugs have those unusual properties. When that happens you will have taken the first step towards becoming a pharmacologist.

Into *Pharmacology from A to Z* has been distilled, not the wisdom of 20 years of undergraduates, but their problems, for this is a book for the average and below average student – if you are a high flier, you may find it gives you a useful start, but you will soon be immersed in thick textbooks with copious references – well before the average undergraduate has mastered this A-Z!

If you like this book, please let me know. If it irritates you or you believe it can be improved, please also let me know how and I will do my best to incorporate your suggestions into any revised impressions that are are made.

John Carpenter
January 1988

INTRODUCTION

The book is arranged in two parts; an alphabetical listing of drugs and their properties forms the first of these and a rapid reference section, in which the drugs are arranged in groups according to a simple classification system, forms the second – what might be referred to as an "anti-index".

There are essentially three types of drug included in this book. Firstly there are those that are typical of all the drugs in that group – these are the prototypes and are given a full entry in the alphabetical section and appear in **CAPITALS** in the **RAPID REFERENCE** section. Secondly, there are other members of these groups which are to all intents and purposes identical to the prototypes in their main properties. These are not given full entries in the alphabetical section, but are described simply as being "As **PROTOTYPE**", although important differences are summarised. The third group comprises those drugs which are not much like anything else and are not important enough to be included in the beginner student's core of essential information. They are there to amuse, to interest and to stimulate.

HOW TO USE THIS BOOK

It is assumed that you already have another, primary textbook of Pharmacology and that you will be attending lectures from which you will be producing your own notes. What is intended is that you use the alphabetical section of this book to look up all the drugs mentioned in your lectures. This will summarise for you the important properties of these drugs. What you will not find is a list of the effects these drugs produce. To determine the effects drugs produce you will need to refer to your Pharmacology textbook and your lecture notes. You will also need to consult your textbooks and notes for the foundation subjects, such as Physiology, Biochemistry, Chemistry, etc. What should emerge is a framework of the essential properties of drugs and a central core to which you can keep referring in order to deduce the effects of particular drugs.

When the time comes for you to revise for your examinations, you can use the **RAPID REFERENCE** section. You will be able to see at a glance those drugs that are worth studying in detail (**PROTOTYPES**) and those that are worth only glancing at because they have the same profile as the **PROTOTYPES**. You should also be able to identify those drugs that are really such "small print" as to require an electron microscope!

You will probably find that my selection of **PROTOTYPES** does not coincide exactly with that of your lecturers. In this case, make the necessary annotations to the **RAPID REFERENCE** section yourself. (The basis on which the **PROTOTYPES** have been chosen is that they are usually those described in the *British National Formulary* (BNF) as being the most appropriate therapeutically. For drugs that have no therapeutic value but are of interest from a theoretical point of view, I have used my own judgement wherever I have not been able to find a consensus opinion in the commoner Pharmacology textbooks. I have relied quite heavily upon *Basic Pharmacology*, edited by R. W. Foster and published by Butterworths).

The naming of drugs is always a thorny issue. Throughout this book, *British Pharmacopœia* (BP) approved names are used, although a few common *United States Pharmacopeia* (USP) names are listed in the alphabetic section, though without full entries. For these USP names, cross references are given to the appropriate BP name. Trade names are avoided.

ABBREVIATIONS

Some abbreviations (e.g. ACTH) are listed as alphabetic entries. However, some are not and these are listed and defined below:–

ACE	Angiotensin converting enzyme
ACh	Acetylcholine
AChE	Acetylcholinesterase (true cholinesterase)
BNF	*British National Formulary*
BP	*British Pharmacopœia*
ChE	Butyrylcholinesterase (cholinesterase, pseudo-cholinesterase)
COMT	Catechol-O-methyl transferase
CNS	Central nervous system
CSF	Cerebrospinal fluid
CTZ	Chemosensitive trigger zone
DHF	Dihydrofolate
GI	Gastro-intestinal
IgE	Immunoglubulin type E
MAO	Monoamine oxidase
MFO	Mixed function oxidase
OTC	Over the counter, i.e. without prescription
PG	Prostaglandin
POM	Prescription only medicine
SER	Smooth endoplasmic reticulum
USP	*United States Pharmacopeia*

CONTENTS

ACEBUTALOL

As **PROPRANOLOL** but some cardioselectivity (β_1–adrenoceptors) and some intrinsic activity.

ACENOCOUMAROL

See **NICOUMAROL**.

ACETAMINOPHEN (USP)

See **PARACETAMOL**.

ACETANALID

As **ASPIRIN**, but too toxic for use in man.

ACETAZOLAMIDE

Carbonic anhydrase inhibitor.

Uses:– i) glaucoma
ii) may be of use in epilepsy (Grand Mal & Focal seizures; cf. ketogenic diet).

Precautions:– adverse effects common, especially in the elderly; augments K^+ excretion and may cause depression.

ACETOHEXIMIDE

As **TOLBUTAMIDE** but longer half-life (approximately 45 h including active metabolites).

ACETYLCHOLINE

Agonist at muscarinic and nicotinic cholinoceptors (normal transmitter in cholinergic neurones).

Readily hydrolysed, spontaneously or enzymically. Substrate for:–
i) acetylcholinesterase (true cholinesterase; AChE) at cholinergic neuro-effector junctions and in erythrocytes
ii) butyrylcholinesterase (cholinesterase; pseudocholinesterase; ChE) in solution in plasma and in liver.

Uses:– as experimental tool.

See also:– bethanechol, carbachol, DMPP, furtrethonium, methacholine, muscarine, nicotine, oxotremorine, pilocarpine, suxamethonium.

ACETYLCYSTEINE

Replenishes hepatic stores of glutathione depleted by overdoses of **PARACETAMOL**. Also lowers viscosity of mucus by breaking disulphide bonds.

Uses:– i) treatment of overdosing with **PARACETAMOL**.
ii) as aerosol to help respiration by facilitating expectoration – benefit unsubstantiated.

2-(ACETOXY)-BENZOIC ACID

See **ASPIRIN**.

ACETYLSALICYLIC ACID

See **ASPIRIN**.

ACETYLTRIETHYLCHOLINE

False transmitter in cholinergic nerves. Structural analogue of **ACETYLCHOLINE**. Much less potent at cholinoceptors than **ACETYLCHOLINE**.

Formed in cholinergic nerves by acetylation of **TRIETHYLCHOLINE**

ACONITINE

Delays inactivation of Na^+ channels – hence repetitive firing and failure of transmission.

Naturally occurring in the common aconite or monkshood *(Aconitum napellus)*.

Uses:– i) experimental tool.
ii) at one time used as tincture to relieve inflammatory pain.

See also:– batrachotoxin, dicophane, pyrethrin, veratridine.

ACTH (ADRENOCORTICOTROPHIC HORMONE; CORTICOTROPHIN)

Trophic hormone released from the anterior pituitary in response to low circulating levels of adrenocorticosteroids. Effect is to stimulate production of adrenocorticosteroids – mainly **CORTICOSTERONE** and **HYDROCORTISONE**.

Polypeptide with 39 residues.

See also:– tetracosactrin.

ACTINOMYCIN D

Cytotoxic antibiotic – inhibits transcription (mRNA synthesis) by binding in minor groove of DNA.
Poorly lipid soluble – hence must be injected.

Uses:– i) to treat paediatric cancers esp. rhabdomyosarcoma and Wilm's tumour.
ii) as experimental tool – inhibits protein synthesis at very early stage.

Precautions:– damages all rapidly dividing cell types.

See also:– bleomycin, cycloheximide, doxorubicin.

ACYCLOVIR

Anti-viral agent (herpes). Metabolised in infected cells to acyclo-GTP which inhibits viral polymerase. Also incorporated into viral DNA; transcription stops when this modified base encountered.

Uses:– i) treatment of herpes simplex
ii) palliative in herpes zoster (does not eradicate virus from root ganglia).

Precautions:– may depress liver function and haemopoeisis.

See also:– amantadine, zidovudine.

ADH (ANTIDIURETIC HORMONE; VASOPRESSIN)

Hormone of posterior pituitary. Enhances water reabsorption in distal tubules and collecting ducts. In pharmacological doses constricts resistance vessels via action at vasopressin receptors.

Nonapeptide therefore only effective after injection (or nasal insufflation).

Uses:– replacement therapy in diabetes insipidus.

See also:– desmopressin, felypressin, lypressin, oxytocin.

ADRENALINE

Agonist at α- and β-adrenoceptors (normal transmitter released from adrenal medulla and some neurones in CNS).

Inactivated by:– i) uptake
ii) N-oxidation (MonoAmine Oxidase; MAO)
iii) O-methylation (Catechol-O-Methyl Transferase; COMT).

Uses:– i) to treat allergic emergencies esp. anaphylaxis (dilates airways via β-adrenoceptors & constricts blood vessels via α-adrenoceptors)
ii) as vasoconstrictor a) prolongs action of local anaesthetics
b) in bloodless field surgery
c) nasal decongestant
d) slows bleeding from boxing wounds.

Precautions:– once popular use to elevate blood pressure in traumatic shock now considered inadvisable as impairs blood flow to vital organs.

ADRENOCORTICOTROPHIC HORMONE

See ACTH.

ALDOSTERONE

Steroid hormone of the adrenal cortex released in response to ANGIOTENSIN II; stimulates re-uptake of Na^+ (and hence water) and secretion of K^+ by distal tubules in kidney.

See also:– spironolactone.

ALLOPURINOL

Xanthine-oxidase inhibitor – reduces rate of formation of uric acid from purines.

Uses:– Prophylaxis of gout.

Precautions: i) may cause rashes or gastro-intestinal disorders.
ii) occasional hypersensitivity reactions occur.
iii) may interfere with cytotoxic chemotherapy in neoplasic disease.

See also:– colchicine.

ALLOXAN

Selectively destroys B-cells in pancreatic Islets of Langerhans.

Uses:– experimental tool only.

ALPROSTADIL (PROSTAGLANDIN E_1)

Agonist at prostaglandin E-type receptors.

Uses:– maintainance of ductus arteriosus patency in neonates before surgery to correct congenital heart defects.

See also:– dinoprost, dinoprostone.

AMANTADINE

Antiviral agent – inhibits entry of some RNA- or DNA-containing virions into host cells.

Also found to be agonist at dopamine receptors.

Uses:– i) treatment of viral diseases (A-strain influenza and herpes zoster).
ii) treatment of Parkinson's disease.

Precautions:– unwanted effects generally extension of drug's action at dopamine receptors.

AMETHOCAINE

As LIGNOCAINE but ester and more lipid soluble.

Uses:– as eyedrops to anaesthetise cornea for tonometry, etc.

AMIDOPYRINE

As **ASPIRIN**, but too toxic for use in man.

AMILORIDE

"Potassium-sparing" diuretic. Inhibits Na^+ reabsorption in collecting duct by blocking Na^+ channels. Hence Na^+/K^+ exchange inhibited.

Uses:– to limit K^+ loss during treatment with other diuretics (e.g. **BENDROFLUAZIDE** or **FRUSEMIDE**).

Precautions:– avoid use if plasma K^+ already elevated.

See also:– triamterene.

AMINOBENZOIC ACID

Absorbs solar radiation in the range 290-320 nm.

Uses:– in sun-screen creams and lotions.

p-AMINOBENZOATE

Precursor (with pteridine) of dihydrofolate in bacterial cells. Sulphonamides (e.g. **SULPHAMETHIZOLE**) are structural analogues.

γ-AMINO BUTYRIC ACID

See **GABA**.

AMINOCAPROIC ACID

Inhibits activation of fibrinolysinogen (plasminogen).

Uses:– i) helps staunch bleeding in haemophiliacs after dental extractions
ii) limits fibrinolysis after excessive doses of fibrinolysinogen activators (e.g. **STREPTOKINASE**) in attempts to dissolve fresh thrombi.

Precautions:– may precipitate clot formation in individuals with history of thromboembolic disorders and in pregnancy.

See also:– tranexamic acid.

AMINOGLUTETHIMIDE

Inhibitor of formation of pregnenolone from cholesterol. Hence inhibits production of all steroid hormones. Also inhibits peripheral formation of oestrogen.

Uses:– i) to reduce secretion from autonomously secreting adrenal tumours.
ii) in treatment of post-menopausal breast cancer (**DEXAMETHA-**

SONE also given as replacement for endogenous corticosteroids).

Precautions:– i) signs of adrenal insufficiency predictable untoward effect – hence replacement therapy with glucocorticoid and possibly mineralocorticoid essential
ii) induces hepatic enzymes.

See also:– cyproterone acetate.

AMINO-OXYACETIC ACID

Inhibitor of GABA-transaminase.

Uses:– experimental tool.

AMINOPHYLLINE

As **THEOPHYLLINE**.

Chemically, a complex between **THEOPHYLLINE** and **ETHYLENEDIAMINE**. Much more soluble than **THEOPHYLLINE**.

AMINOPYRINE (USP)

See **AMIDOPYRINE**.

5-AMINOSALICYLATE

As **ASPIRIN**; released by bacterial action in gut lumen from **SULPHASALAZINE**. Not well absorbed hence anti-inflammatory action exerted on gut.

AMIODARONE

Antidysrhythmic drug with complex action (Group 3); prolongs refractory period of cardiac cells (possibly by blocking K^+ channels). Also blocks Na^+ channels.

Unusual pharmacokinetics; may take weeks to reach therapeutic concentrations in plasma and microcrystalline deposits often occur in cornea, skin and other sites – these considerably delay fall of plasma levels once drug is withdrawn. Molecule contains iodine which may be released during metabolism.

Uses:– treatment of supraventricular tachycardias, especially Wolff-Parkinson-White syndrome.

Precautions:– i) released iodine may cause disturbed thyroid function (hypo- or hyper-)
ii) commonly causes photosensitivity of the skin – keep skin covered and use sun-screen ointment (see **AMINOBENZOIC ACID**).

AMITRIPTYLINE

As **IMIPRAMINE**.

AMOXYCILLIN

As **AMPICILLIN** but more lipid soluble therefore absorption after oral administration more reliable.

AMPHETAMINE

See **DEXAMPHETAMINE**.

AMPHONELIC ACID

As **DEXAMPHETAMINE**, but exclusively central action (possibly because selective for dopaminergic neurones).

Uses:– experimental tool.

AMPHOTERICIN

As **NYSTATIN** but lower toxicity allows it to be used by intravenous infusion for the treatment of systemic fungal infections.

Precautions:– i) commonly causes thrombophlebitis at site of infusion.
ii) dose related, renal toxicity occurs in about 80% of patients; reversible at low doses.
iii) nausea, vomiting, tinnitus & vision disturbances common.

AMPICILLIN

As **BENZYLPENICILLIN** but wider spectrum. Resistant to gastric acid but sensitive to β-lactamase.

AMYLOBARBITONE

As **DIAZEPAM**, but shorter duration of action (half life ca. 18 h). Chemically a **BARBITURATE**.

ANCROD

Anticoagulant. Enzymic constituent (glycoprotein) of the venom of the Malayan pit viper *(Agkistroden rhodostoma)*. Catalyses the conversion of fibrinogen into an unstable form of fibrin – forms micro-emboli which are dealt with by the reticuloendothelial system (action similar but not identical to thrombin). This depletes fibrinogen levels – hence lower clotting capacity.

Broken down in GI tract therefore must be given by intravenous infusion.

Uses:– treatment of deep-vein thrombosis and prevention of thrombus formation after surgery.

Precautions:– i) haemorrhage extension of desired pharmacological action

ii) formation of thrombo-embolus – extension of desired pharmacological action

iii) anaphylaxis (antigenic as glycoprotein).

ANDROSTENEDIONE

Intermediate in the synthesis of 17-β-**OESTRADIOL** and **TESTOSTERONE** in the ovary and testis.

Uses:– experimental tool only.

ANGIOTENSIN I

Essentially inactive decapeptide formed from inactive **ANGIOTENSINOGEN** (plasma α_2-globulin) by **RENIN**.

Substrate for ACE (Angiotensin Converting Enzyme) – product is **ANGIOTENSIN II**.

Uses:– experimental tool only.

ANGIOTENSIN II

Contracts vascular smooth muscle via angiotensin receptors; most potent pressor agent known. Stimulates **ALDOSTERONE** production and hence Na^+ and water retention.

Nonapeptide formed from **ANGIOTENSIN I** by ACE (Angiotensin Converting Enzyme). Broken down by plasma and tissue aminopeptidases to inactive peptide fragments.

Uses:– experimental tool only.

See also:– angiotensin I, bradykinin, captopril.

ANTHRALIN (USP)

See **DITHRANOL**.

ANTI-DIURETIC HORMONE

See **ADH**.

ANTIPYRINE (USP)

See **PHENAZONE**.

APAMIN

Blocks K^+ channels in cell membranes. Constituent of bee venom.

Uses:– experimental tool.

See also:– cromokalim, TEA.

APAZONE (USP)

See **AZAPROPAZONE**.

APOMORPHINE

Agonist at dopamine receptors especially those of the chemosensitive trigger zone (CTZ).

Chemically related to **MORPHINE**, but devoid of activity at opioid receptors.

Uses:– experimental tool only.

See also:– bromocryptine, levodopa.

APROTININ

Inhibitor of proteolytic enzymes, e.g. **KALLIKREIN**, **PLASMIN**. Low specificity.

Polypeptide – hence active only after injection.

Uses:– i) treatment of disseminated intravascular coagulation – effectiveness unproven
ii) treatment of acute pancreatitis – effectiveness unproven.

ARACHIDONIC ACID

Precursor of **PROSTAGLANDINS**.

ARGININE VASOPRESSIN

See **ADH**.

ASPIRIN

Inhibits cyclo-oxygenase and therefore reduces formation of prostaglandins. Anti-pyretic action central and may be due to suppression of prostaglandin formation in the brain. Analgesic action may involve central component not due to cyclo-oxygenase inhibition.

Weak acid; non-ionised, lipid-soluble form favoured by acid environment of stomach, but bulk of aspirin absorbed from ileum (alkaline) because of large surface area. Filtered at glomerulus and reabsorption hindered