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FOR ANAESTHETISTS

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EDITED BY Keith G. Allman | Iain H. Wilson

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- Handbook of Surgical Consent
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# Oxford Handbook of Anaesthesia

FOURTH EDITION

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This book is dedicated to the memory of Henry Wallace Wilson (1923–2014) and Geoffrey Leslie Allman (1927–2014). Great men, much missed.

# Preface

Welcome to the fourth edition of the *Oxford Handbook of Anaesthesia*. We have been delighted with the success of the handbook and hope that this edition will be well received.

The fourth edition contains many changes to take account of the feedback obtained from readers and reviewers. We have involved new authors in different sections of the book, so that the material remains up-to-date and reflects a balanced set of views. In our opinion, each author is an established expert in their field and, more importantly, a good clinical anaesthetist.

The book describes the preparation of the patient for anaesthesia, the implications of concurrent diseases, and the general principles of anaesthetic practice for different subspecialties. A practical approach is suggested where appropriate. There are detailed chapters on obstetric and paediatric anaesthesia, and also emergencies. A comprehensive drug formulary is included. A new section on anaesthesia for weight reduction surgery has been added.

The *Oxford Handbook of Anaesthesia* remains a practical guide to anaesthesia written for those who have mastered basic anaesthetic techniques but need advice for the many common problems encountered in clinical practice.

The *Oxford Handbook of Anaesthesia* has proved popular in many countries throughout the world. A low-cost edition is available in India, Pakistan, and Bangladesh, and translations have been produced in Chinese, Italian, Polish, and Russian. An American edition was produced in 2008.

We are particularly grateful for the expert proofreading skills of Dr Aidan O'Donnell who has provided invaluable support during the preparation of this edition.

Despite all our efforts, it is possible that an occasional error exists; please be careful. We hope that you will enjoy this latest edition of the *Oxford Handbook of Anaesthesia*. Please email us your criticisms and suggestions, so that we can keep improving the book.

Many thanks to our understanding families and authors, and to the landlord and locals of the Bridford Inn during editorial meetings.

Keith and Iain  
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2015

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# Abbreviations

A&E	accident and emergency
AAA	abdominal aortic aneurysm
AADR	anaesthetic adverse drug reaction
AAGBI	Association of Anaesthetists of Great Britain and Ireland
AAS	atlantoaxial subluxation
ABC	airway, breathing, circulation
ABG	arterial blood gas
AC	alternating current
ACE	angiotensin-converting enzyme
ACF	antecubital fossa
ACoTS	acute coagulopathy of trauma shock
ACT	activated clotting time
ACTH	adrenocorticotrophic hormone
ADH	antidiuretic hormone
ADHD	attention-deficit/hyperactivity disorder
ADP	adenosine diphosphate
AEC	airway exchange catheter
AED	automated external defibrillator
AEP	auditory evoked response
AF	atrial fibrillation
AFE	amniotic fluid embolism
AFOI	awake fibreoptic intubation
AHI	apnoea-hypopnoea index
AICD	automatic implantable cardioverter-defibrillator
AIDS	acquired immunodeficiency syndrome
AIP	acute intermittent porphyria
ALF	acute liver failure
ALI	acute lung injury
ALP	alkaline phosphatase
ALS	advanced life support
ALT	alanine aminotransferase
a.m.	<i>ante meridiem</i> (before noon)
ANH	acute normovolaemic haemodilution

AP	anteroposterior
APL	adjustable pressure limiting
APTT	activated partial thromboplastin time
APUD	amine precursor uptake and decarboxylation
AR	aortic regurgitation
ARB	angiotensin receptor blocker
ARDS	acute respiratory distress syndrome
ARF	acute renal failure
art line	arterial line
AS	aortic stenosis
ASA	American Society of Anesthesiologists
ASAP	as soon as possible
ASD	atrial septal defect
ASIS	anterior superior iliac spine
ASRA	American Society of Regional Anesthesia and Pain Medicine
AST	aspartate transaminase
AT	anaerobic threshold
ATD	adult therapeutic dose
ATLS®	Advanced Trauma Life Support®
ATN	acute tubular necrosis
ATR	acute transfusion reaction
AV	atrioventricular
A–V	arteriovenous
AVM	arteriovenous malformation
AVR	aortic valve replacement
AVSD	atrioventricular septal defect
BAHA	bone-anchored hearing aid
BBV	blood-borne virus
BCIS	bone cement implantation syndrome
bd	<i>bis diem</i> (twice daily)
BiPAP	bilevel positive airway pressure
BIS	bispectral index
BLS	basic life support
BMHA	British Malignant Hyperthermia Association
BMI	body mass index
BMS	bare-metal stent
BNF	<i>British National Formulary</i>

BNFc	<i>British National Formulary for Children</i>
BP	blood pressure
bpm	beat per minute
BSE	bovine spongiform encephalopathy
BSS	balanced salt solution
BT	Blalock–Taussig (shunt)
BUN	blood urea nitrogen
BURP	backwards, upwards, and rightwards pressure
Ca <sup>2+</sup>	calcium ion
CABG	coronary artery bypass grafting
CAD	coronary artery disease
cAMP	cyclic adenosine monophosphate
CBF	coronary blood flow; cerebral blood flow
CC	creatinine clearance
CCD	central core disease
CCF	congestive cardiac failure
CEA	carotid endarterectomy; caudal extradural analgesia
CF	cystic fibrosis
CFTR	cystic fibrosis transmembrane regulator
Ch	Charrière (French) gauge (also FG or Fr)
CHD	congenital heart disease
CI	confidence interval
CICV	cannot intubate, cannot ventilate
CJD	Creutzfeldt–Jakob disease
CK	creatine kinase
Cl <sup>-</sup>	chloride ion
CLD	chronic liver disease
cLMA	classic laryngeal mask airway
cm	centimetre
CMACE	Centre for Maternal and Child Enquiries
CMT	combat medical technician
CMV	cytomegalovirus
CNS	central nervous system
CO	carbon monoxide
CO <sub>2</sub>	carbon dioxide
COETT	cuffed oral endotracheal tube
COHb	carboxyhaemoglobin



COPD	chronic obstructive pulmonary disease
COPRA	cuffed oropharyngeal airway
CORP	Committee on the Review of Porphyrinogenicity
COX	cyclo-oxygenase
CPAP	continuous positive airway pressure
CPB	cardiopulmonary bypass
CPET	cardiopulmonary exercise testing
CPP	cerebral perfusion pressure
CPR	cardiopulmonary resuscitation
CPSP	chronic post-surgical pain
CRA	continuous regional analgesia
CREST	calcinosis, Raynaud's, oesophageal dysfunction, sclerodactyly, and telangiectasia
CRF	chronic renal failure
CRP	C-reactive protein
CRTZ	chemoreceptor trigger zone
CSE	combined spinal/epidural
CSF	cerebrospinal fluid
CSM	Committee on Safety of Medicines
CT	computed tomography
CVA	cerebrovascular accident
CVC	central venous catheter
CVP	central venous pressure
CVS	cardiovascular system
CXR	chest X-ray
2D	two-dimensional
3D	three-dimensional
d	day
D&C	dilatation and curettage
D&E	dilatation and evacuation
Da	dalton
DAS	Difficult Airway Society
DBD	donor after brain death
DBS	double-burst stimulation
DC	direct current
DCR	dacrocystorhinostomy; damage control resuscitation
DCS	damage control surgery

DES	drug-eluting stent
DHCA	deep hypothermic circulatory arrest
DHPR	dihydropyridine receptor
DHS	dynamic hip screw
DHTR	delayed haemolytic transfusion reaction
DIC	disseminated intravascular coagulation
dL	decilitre
DLCO	diffusing capacity of the lungs for carbon monoxide
DLT	double-lumen (endobronchial) tube
DMARD	disease-modifying antirheumatoid drug
DNAR	Do Not Attempt Resuscitation
DND	delayed neurological deficit
DS	degree of substitution
DVT	deep vein thrombosis
dyn	dyne
EBM	evidence-based medicine
ECF	extracellular fluid
ECG	electrocardiogram
ECMO	extracorporeal membrane oxygenation
ECT	electroconvulsive therapy
ED	external diameter
EEG	electroencephalogram/electroencephalography
EF	ejection fraction
eGFR	estimated glomerular filtration rate
EMA	European Medicines Agency
EMG	electromyogram/electromyography
EMHG	European Malignant Hyperthermia Group
EMI	electromagnetic interference
EMLA <sup>®</sup>	Eutectic Mixture of Local Anaesthetics <sup>®</sup>
ENT	ear, nose, and throat
EO	external oblique
EPO	erythropoietin
EPP	exposure-prone procedure
ERAS	enhanced recovery after surgery
ERCP	endoscopic retrograde cholangiopancreatography
ERPC	evacuation of retained products of conception
ESR	erythrocyte sedimentation rate

ETCO <sub>2</sub>	end-tidal carbon dioxide
ETO <sub>2</sub>	end-tidal oxygen
ETT	endotracheal tube
EUA	examination under anaesthesia
EuroSCORE	European System for Cardiac Operative Risk Evaluation
EVD	external ventricular drain
FAST	focused assessment sonogram in trauma
FBC	full blood count
FDA	Food and Drug Administration
FES	fat embolism syndrome
FEV <sub>1</sub>	forced expiratory volume in 1 second
FFP	fresh frozen plasma
FG	French gauge (also Fr and Ch)
FGF	fresh gas flow
FHF	fulminant hepatic failure
FiO <sub>2</sub>	fractional inspired oxygen content
fLMA	flexible laryngeal mask airway
FPG	fasting plasma glucose
Fr	French gauge (also FG and Ch)
FRC	functional residual capacity
ft	foot (feet)
FTc	corrected flow time
FTSG	full-thickness skin graft
FVC	forced vital capacity
g	gram
G	Gauge (standard wire gauge)
G&S	group and screen
G6PD	glucose-6-phosphate dehydrogenase
GA	general anaesthetic/anaesthesia
GCS	Glasgow Coma Scale
GDC	Guglielmi detachable coil
GEB	gum elastic bougie
GFR	glomerular filtration rate
GI	gastrointestinal
GOLD	Global Initiative for Chronic Obstructive Lung Disease
GP	general practitioner
GT	greater trochanter

GTN	glyceryl trinitrate
GvHD	graft-versus-host disease
H <sup>+</sup>	hydrogen ion
HAS	human albumin solution
Hb	haemoglobin
HbA1c	glycosylated haemoglobin
HBV	hepatitis B virus
HCO <sub>3</sub> <sup>-</sup>	bicarbonate ion
HCP	hereditary coproporphyria
Hct	haematocrit
HCV	hepatitis C virus
HDL	high-density lipoprotein
HDU	high dependency unit
HELLP	haemolysis, elevated liver enzymes, low platelets
HES	Hospital Episode Statistics; hydroxyethyl starch
HFO	high-frequency oscillation
Hib	<i>Haemophilus influenzae</i> type b
HIT	heparin-induced thrombocytopenia
HIV	human immunodeficiency virus
HLA	human leucocyte antigen
HLHS	hypoplastic left heart syndrome
HME	heat and moisture exchanger
HOCM	hypertrophic obstructive cardiomyopathy
HPA	hypothalamic–pituitary–adrenal
hr	hour
HR	heart rate
HRS	Heart Rhythm Society
HRT	hormone replacement therapy
HRUK	Heart Rhythm UK
HTLV	human T cell lymphotropic virus
HVOD	hepatic veno-occlusive disease
Hz	hertz
I:E ratio	inspired:expired ratio
IABP	intra-aortic balloon pump
IBCT	incorrect blood component transfused
IBW	ideal body weight
ICD	implantable cardioverter–defibrillator

ICP	intracranial pressure
ICU	intensive care unit
ID	internal diameter
IDT	intra-dermal testing
IE	infective endocarditis
IED	improvized explosive device
IHD	ischaemic heart disease
IL	interleukin
ILMA	intubating laryngeal mask airway
IM	intramuscular
IMCAS	independent mental capacity advocacy service
in	inch
INR	international normalized ratio
IO	internal oblique
IOP	intraocular pressure
IP	in-plane
IPPV	intermittent positive pressure ventilation
IT	ischial tuberosity
ITP	idiopathic thrombocytopenic purpura
IU	international unit
IV	intravenous(ly)
IVC	inferior vena cava
IVCT	<i>in vitro</i> contracture test
IVI	intravenous infusion
IVRA	intravenous regional anaesthesia
J	joule
JVP	jugular venous pressure
K <sup>+</sup>	potassium ion
kcal	kilocalorie
KCl	potassium chloride
kg	kilogram
km	kilometre
kPa	kilopascal
L	litre
LA	lupus anticoagulant; local anaesthetic/anaesthesia
LACA	left atrial circumferential ablation
LAST	local anaesthetic systemic toxicity

LAVH	laparoscopically assisted vaginal hysterectomy
LBW	low birthweight
LCNT	lateral cutaneous nerve of thigh
LDH	lactate dehydrogenase
L-dopa	levodopa
LFT	liver function test
LMA	laryngeal mask airway
LMWH	low-molecular-weight heparin
LP	lumbar puncture
LRTI	lower respiratory tract infection
LSCS	lower-segment Caesarean section
LSD	lysergic acid diethylamide
LV	left ventricle/ventricular
LVEDP	left ventricular end-diastolic pressure
LVEF	left ventricular ejection fraction
LVH	left ventricular hypertrophy
m	metre
M	molar
mA	milliampere
MAC	minimum alveolar concentration
MAGPI	meatal advancement and glanuloplasty
MAO	monoamine oxidase
MAO-A	monoamine oxidase A
MAO-B	monoamine oxidase B
MAOI	monoamine oxidase inhibitor
MAP	mean arterial pressure
MCV	mean corpuscular volume
MDMA	3,4-methylenedioxymethamphetamine
MEAC	minimum effective analgesic concentration
MELD	model for end-stage liver disease
MEN	multiple endocrine neoplasia
MEOWS	Modified Early Obstetric Warning Scoring
MERT	medical emergency response team
MET	metabolic equivalents of task
mg	milligram
Mg <sup>2+</sup>	magnesium ion
MH	malignant hyperthermia

MHAUS	Malignant Hyperthermia Association of the United States
MHP	massive haemorrhage protocol
MHRA	Medicines and Healthcare Products Regulatory Agency
MHz	megahertz
MI	myocardial infarction
MIBG	<i>meta</i> -iodobenzylguanidine
MIC	minimum inhibitory concentration
MILNS	manual in-line neck stabilization
min	minute
mL	millilitre
mm	millimetre
mmHg	millimetre of mercury
mmol	millimole
MMS	masseter muscle spasm
mol	mole
mOsmol	milliosmole
mph	mile per hour
MR	mitral regurgitation
MRI	magnetic resonance imaging
MRSA	meticillin-resistant <i>Staphylococcus aureus</i>
ms	millisecond
MSBOS	maximum surgical blood ordering schedule
MSU	midstream urine
mT	millitesla
MTC	major trauma centre; minimum toxic concentration
MUA	manipulation under anaesthesia
MUGA	multigated acquisition scan
MW	molecular weight
6MWT	6-minute walk test
N	newton
Na <sup>+</sup>	sodium ion
NaCl	sodium chloride
NAP	National Audit Project
NCA	nurse-controlled analgesia
NCEP	National Cholesterol Education Program
NCEPOD	National Confidential Enquiry into Patient Outcome and Death

NDMR	non-depolarizing muscle relaxant
ng	nanogram
NG	nasogastric
NGT	nasogastric tube
NHS	National Health Service
NIBP	non-invasive blood pressure
NICE	National Institute for Health and Care Excellence
NIPPV	non-invasive positive pressure ventilation
NJR	National Joint Registry
nm	nanometre
NMB	neuromuscular blockade
NMDA	<i>N</i> -methyl- <i>D</i> -aspartate
nmol	nanomole
NNT	number needed to treat
NO	nitric oxide
N <sub>2</sub> O	nitrous oxide
NSAID	non-steroidal anti-inflammatory drug
NTS	nucleus tractus solitarius
O&D	oesophagoscopy and dilatation
O <sub>2</sub>	oxygen
OCP	oral contraceptive pill
OELM	optimal external laryngeal manipulation
OHS	obesity hypoventilation syndrome
OLV	one-lung ventilation
OMV	Oxford miniature vaporizer
OOP	out-of-plane
OPCAB	off-pump coronary artery bypass grafting
OR	odds ratio
ORIF	open reduction and internal fixation
OSA	obstructive sleep apnoea
OSD	ostial segmental disconnection
OSMRS	Obesity Surgery Mortality Risk Score
Pa	pascal
PA	posterior to anterior; pulmonary artery/arterial
PABA	para-aminobenzoic acid
PaCO <sub>2</sub>	arterial partial pressure of carbon dioxide
PAD	preoperative autologous donation



PAFC	pulmonary artery flotation catheter
PaO <sub>2</sub>	arterial partial pressure of oxygen
PAO <sub>2</sub>	alveolar partial pressure of oxygen
PAOP	pulmonary artery occlusion pressure
PAP	pulmonary artery pressure
P <sub>aw</sub>	airway pressure
PAOP	pulmonary artery occlusion pressure
PCA	patient-controlled analgesia
PCC	prothrombin complex concentrate
PCEA	patient-controlled epidural analgesia
PCI	percutaneous coronary intervention
PCR	protein:creatinine ratio; polymerase chain reaction
PCV	packed cell volume
PDA	persistent ductus arteriosus
PDE	phosphodiesterase
PDPH	post-dural puncture headache
PE	phenytoin equivalents; pulmonary embolism
PEA	pulseless electrical activity
PEEP	positive end-expiratory pressure
PEFR	peak expiratory flow rate
PEP	post-exposure prophylaxis
PFT	pulmonary function test
pg	picogram
PICC	peripherally inserted central catheter
PICU	paediatric intensive care unit
p.m.	<i>post meridiem</i> (after noon)
pmol	picomole
PNB	peripheral nerve block
PNS	peripheral nerve stimulator
PO	<i>per os</i> (oral)
POCD	post-operative cognitive dysfunction
POD	post-operative delirium
PONV	post-operative nausea and vomiting
POSSUM	physiological and operative severity score for enumeration of mortality and morbidity
PPI	proton pump inhibitor
ppo	predicted post-operative