

OXFORD SPECIALIST HANDBOOKS IN SURGERY

VASCULAR SURGERY

Linda Hands

Matt Thompson

SECOND EDITION



SURGERY

Oxford Specialist Handbooks in Surgery Vascular Surgery

Second Edition

Linda Hands

Associate Professor in Surgery
Nuffield Department of Surgery
University of Oxford, John Radcliffe Hospital
Oxford, UK

Matt Thompson

Professor of Vascular Surgery, St Georges Vascular
Institute, St George's Hospital, London, UK

OXFORD
UNIVERSITY PRESS

OXFORD

UNIVERSITY PRESS

Great Clarendon Street, Oxford, OX2 6DP,
United Kingdom

Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide. Oxford is a registered trade mark of
Oxford University Press in the UK and in certain other countries

© Oxford University Press 2015

The moral rights of the author have been asserted

First Edition published 2007

Second Edition published 2015

Impression 1

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, without the
prior permission in writing of Oxford University Press, or as expressly permitted
by law, by licence or under terms agreed with the appropriate reprographics
rights organization. Enquiries concerning reproduction outside the scope of the
above should be sent to the Rights Department, Oxford University Press, at the
address above

You must not circulate this work in any other form
and you must impose this same condition on any acquirer

Published in the United States of America by Oxford University Press
198 Madison Avenue, New York, NY 10016, United States of America

British Library Cataloguing in Publication Data
Data available

Library of Congress Control Number: 2014960133

ISBN 978-0-19-968629-2

Printed in Great Britain by
Ashford Colour Press Ltd, Gosport, Hampshire

Oxford University Press makes no representation, express or implied, that the
drug dosages in this book are correct. Readers must therefore always check
the product information and clinical procedures with the most up-to-date
published product information and data sheets provided by the manufacturers
and the most recent codes of conduct and safety regulations. The authors and
the publishers do not accept responsibility or legal liability for any errors in the
text or for the misuse or misapplication of material in this work. Except where
otherwise stated, drug dosages and recommendations are for the non-pregnant
adult who is not breast-feeding

Links to third party websites are provided by Oxford in good faith and
for information only. Oxford disclaims any responsibility for the materials
contained in any third party website referenced in this work.

Preface

Vascular surgery is an evolving specialty which has to embrace the current developments in endovascular surgery while looking to future changes in training that may encompass more of the 'medical' aspects of vascular disease. Nevertheless, open surgical techniques still play a large role in the management of the vascular patient and will do so for some time to come. The vascular surgeon needs to be a physician who can operate but who also knows when to operate.

This book is designed to give detailed guidance on the work-up, peri-operative management, and operative details for patients undergoing vascular surgery. These details reflect the practice of the chapter authors; they are not intended as the only possible approach, and, in many cases, there are alternatives. The book includes both endovascular and open procedures for each condition where they are available and gives advice on the use of each. OPCS 4.7 (2014) codes are included for each procedure so that they become familiar to the surgical team in an environment where an accurate recording of activity is becoming essential.

The book is designed primarily for the training grade doctor to carry in their pocket on the ward, in clinic, and in the operating theatre. It is designed for quick reference and rapid reading and will help resolve uncertainties on the ward and prepare the trainee for their role in theatre, whether as prime operator or as assistant. It should also be helpful to F1 and F2 doctors involved in the care of vascular patients by providing background on the disease, details of ward management, and an idea of what happens in theatre. The trainee vascular anaesthetist will find useful detail of anaesthetic management but also of what is going on at the other end of the table. Similarly, trainee interventional radiologists, vascular nurses, and vascular technologists will all find that a broader appreciation of vascular patient management can be obtained from this book.

Contributors

Mr Paddy Coughlin

Consultant Vascular Surgeon
Addenbrooke's Hospital
Cambridge, UK

*Chapter 15: Infrainguinal
revascularization*

*Chapter 18: Surgical revasculariza-
tion of kidneys*

*Chapter 19: Revascularization of
the gut*

Chapter 21: Vascular trauma

Professor Ashok Handa

Associate Professor
Nuffield Department of Surgery
University of Oxford
John Radcliffe Hospital
Oxford, UK

*Chapter 5: Non-operative treat-
ment of arterial and venous
disease*

Professor Peter Karlheinz

Baker IDI Heart and Diabetes
Institute
Melbourne, Victoria, Australia

*Chapter 9: Managing coagulation
and bleeding*

Dr Andrew Kelion

Consultant Cardiologist
John Radcliffe Hospital
Oxford, UK

*Chapter 7: Perioperative manage-
ment of ischaemic heart disease*

Dr Htun Nay Min

Baker IDI Heart and Diabetes
Institute

Melbourne, Victoria, Australia

*Chapter 9: Managing coagulation
and bleeding*

Mr Ian Nordon

St. George's Vascular Institute
St. George's Hospital
London, UK

Chapter 13: Aortic surgery

Dr Mark Stoneham

Consultant Anaesthetist
John Radcliffe Hospital
Oxford, UK

*Chapter 8: Anaesthesia for vascular
surgery*

Mr John Thompson

Consultant Vascular Surgeon
Royal Devon and Exeter Hospital
Devon, UK

*Chapter 17: Vascular surgery of
head and arm*

Dr Flierl Ulrike

Baker IDI Heart and Diabetes
Institute

Melbourne, Victoria, Australia

*Chapter 9: Managing coagulation
and bleeding*

Symbols and abbreviations

~	approximately
β	beta
°	degree
°C	degree Celsius
\approx	equal to
\geq	equal to or greater than
\leq	equal to or less than
♀	female
>	greater than
↑	increased
→	leads to
<	less than
♂	male
%	per cent
+	plus
±	plus or minus
£	pound sterling
1°	primary
®	registered trademark
2°	secondary
AAA	abdominal aortic aneurysm
ABPI	ankle–brachial pressure index
ACE	angiotensin-converting enzyme
A & E	accident and emergency
AF	atrial fibrillation
ANH	acute normovolaemic haemodilution
AP	anteroposterior
APTT	activated partial thromboplastin time
ASIS	anterior superior iliac spine
AT	anterior tibial or antithrombin
A-TOS	arterial thoracic outlet syndrome
AV	arteriovenous
bd	<i>bis in die</i> (twice daily)
B-EVAR	branched endovascular aneurysm repair
BMI	body mass index
BMS	bare-metal stent

BP	blood pressure
bpm	beat per minute
CABG	coronary artery bypass graft
CCA	common carotid artery
CCF	congestive cardiac failure
CCT	cardiovascular computerized tomography
CEA	carotid endarterectomy
CEAP	Clinical, Etiological, Anatomical, and Pathophysiological
CFA	common femoral artery
CI	confidence interval
CIA	common iliac artery
cm	centimetre
CMR	cardiac magnetic resonance
CNS	central nervous system
CO ₂	carbon dioxide
COPD	chronic obstructive pulmonary disease
CPET	cardiopulmonary exercise testing
CRP	C-reactive protein
CS	compensatory sweating
CSE	combined spinal and epidural
CSF	cerebrospinal fluid
CT	computerized tomography
CTA	computerized tomographic arteriography/angiography
CVP	central venous pressure
CXR	chest X-ray
DES	drug-eluting stent
dL	decilitre
DMSA	dimercaptosuccinic acid
DMSO	dimethyl sulfoxide
DSE	dobutamine stress echocardiography
DVT	deep venous thrombosis
ECA	external carotid artery
ECG	electrocardiogram
echo	echocardiography
ED	emergency department
EEG	electroencephalogram
EIA	external iliac artery
ELISA	enzyme-linked immunosorbent assay
EMG	electromyography
EPO	erythropoietin

ePTFE	expanded polytetrafluoroethylene
ESR	erythrocyte sedimentation rate
ETCO ₂	end-tidal carbon dioxide
ETS	endoscopic transthoracic sympathectomy
ETT	endotracheal tube
EU	European Union
EVAR	endovascular aneurysm repair
FBC	full blood count
FDP	fibrin degradation product
F-EVAR	fenestrated endovascular aneurysm repair
FFP	fresh frozen plasma
Fr	French
g	gram
G	gauge
GA	general anaesthesia
GCS	Glasgow coma score
GFR	glomerular filtration rate
GI	gastrointestinal
GSV	greater saphenous vein
GTN	glyceryl trinitrate
h	hour
Hb	haemoglobin
HbA1c	glycosylated haemoglobin
HDL	high-density lipoprotein
HDL-C	high-density lipoprotein cholesterol
HDU	high-dependency unit
HIPA	heparin-induced platelet activation
HIT	heparin-induced thrombocytopenia
HIV	human immunodeficiency virus
Hz	hertz
ICA	internal carotid artery
ICU	intensive care unit
IFU	instructions for use
II	image intensifier
IIA	internal iliac artery
IMA	inferior mesenteric artery
in	inch
INR	international normalized ratio
IPPV	intermittent positive pressure ventilation
IU	international unit

IV	intravenous
IVC	inferior vena cava
IVDU	intravenous drug use
IVI	intravenous infusion
JVP	jugular venous pressure
kg	kilogram
kph	kilometre per hour
L	litre
LA	local anaesthetic
LDL	low-density lipoprotein
LDL-C	low-density lipoprotein cholesterol
LMA	laryngeal mask airway
LMWH	low-molecular-weight heparin
LSA	left subclavian artery
LSV	lesser saphenous vein
m	metre
MAG	mercaptoacetyltriglycine
MAP	mean arterial pressure
MEP	motor evoked potential
mEq	milli equivalent
MET	metabolic equivalent
mg	milligram
MI	myocardial infarction
micromol	micromole
min	minute
mL	millilitre
mmHg	millimetre of mercury
mmol	millimole
mph	mile per hour
MPS	myocardial perfusion scintigraphy
MRA	magnetic resonance arteriography
MRSA	methicillin-resistant <i>Staphylococcus aureus</i>
MRV	magnetic resonance venography
ng	nanogram
NG	nasogastric
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
NIHR	National Institute for Health Research
NS	not significant
N-TOS	neurological thoracic outlet syndrome

O ₂	oxygen
OCP	oral contraceptive pill
od	<i>omni die</i> (once daily)
OPCS	Office of Population Censuses and Surveys (code)
OR	odds ratio
P	probability
PA	posteroanterior
PABD	preoperative autologous blood donation
PACU	post-anaesthesia care unit
PAD	peripheral arterial disease
PAOD	peripheral arterial occlusive disease
PCA	patient-controlled analgesia
PCI	percutaneous coronary intervention
PE	pulmonary embolus/embolism
PET	positron emission tomography
PF4	platelet factor 4
PICC	peripherally introduced central catheter
PO	<i>per os</i> (orally, by mouth)
POBA	plain old balloon angioplasty
PSV	peak systolic velocity
PT	posterior tibial or prothrombin time
PTFE	polytetrafluoroethylene
PTT	partial thromboplastin time
qds	<i>quater die sumendus</i> (four times daily)
RCC	red cell concentrate
RCT	randomized controlled trial
RFA	radiofrequency ablation
rFVIIa	recombinant activated factor VII
rpm	revolution per minute
rtPA	recombinant tissue plasminogen activator
s	second
SC	subcutaneous
SFA	superficial femoral artery
SFJ	sapheno-femoral junction
SHOT	Serious Hazards of Transfusion
SMA	superior mesenteric artery
SPECT	single-photon emission computerized tomography
SPJ	sapheno-popliteal junction
SpO ₂	oxygen saturation measured by pulse oximetry
SRA	serotonin release assay

STD	sodium tetradecylsulfate
SVC	superior vena cava
SVR	systemic vascular resistance
TAA	thoracic aortic aneurysm
TAAA	thoraco-abdominal aortic aneurysm
TAD	thoracic aortic dissection
TAP	transversus abdominis plane
tds	<i>ter die sumendum</i> (three times daily)
TEG	thromboelastography
TENS	transcutaneous electrical nerve stimulation
TEVAR	thoracic endovascular aneurysm repair
TFA	transfemoral angiography
TIA	transient ischaemic attack
TKA	through-knee amputation
TOE	transoesophageal echocardiography
TOS	thoracic outlet syndrome
tPA	tissue plasminogen activator
U	unit
U & E	urea and electrolytes
UFH	unfractionated heparin
UK	United Kingdom
USA	United States of America
VKA	vitamin K antagonist
vs	versus
vWF	von Willebrand factor
W	watt
WCC	white cell count
y	year

Contents

Preface **v**

Detailed contents **viii**

Contributors **xiv**

Symbols and abbreviations **xv**

- 1 Arterial and venous disease
- 2 Arterial history and examination
- 3 Venous history and examination
- 4 Investigation of arterial and venous disease
- 5 Non-operative treatment: arterial and venous disease
- 6 Management of complex leg ulcers
- 7 Perioperative management of ischaemic heart disease
- 8 Anaesthesia for vascular surgery
- 9 Managing coagulation and bleeding
- 10 Infection prophylaxis and treatment
- 11 Graft material in bypass grafting
- 12 Techniques of open vascular surgery
- 13 Abdominal aortic surgery
- 14 Thoracic aortic surgery
- 15 Infrainguinal revascularization
- 16 Lower limb amputations
- 17 Vascular surgery of head and arm
- 18 Surgical revascularization of kidneys

19	Revascularization of the gut	325
20	Extra-anatomic bypass grafts	339
21	Vascular trauma	357
22	Venous surgery	371

Index	389
-------	-----

Detailed contents

Contributors *xiv*

Symbols and abbreviations *xv*

1	Arterial and venous disease	1
	Arterial disease: atherosclerosis	2
	Thromboembolic arterial disease	5
	Aneurysmal disease	6
	Large vessel arteritis	9
	Other arterial disorders	11
	Venous disease: introduction	13
	Varicose veins	15
	Chronic venous insufficiency	16
	Thromboembolic venous disease	17
	Uncommon venous disorders	19
2	Arterial history and examination	21
	History	22
	Examination	26
	Differential diagnosis on examination	30
3	Venous history and examination	31
	History	32
	Examination	36
4	Investigation of arterial and venous disease	39
	Overview to investigating arterial and venous disease	40
	The non-invasive vascular laboratory	41
	Radiological investigations	45
	Blood tests	47
	Reference	47
5	Non-operative treatment: arterial and venous disease	49
	Arterial disease	50
	Venous disease	53
	References	54

10	Infection prophylaxis and treatment	123
	Introduction to infection prophylaxis	124
	Prophylactic antibiotics	125
	Treatment of infection	126
	Vascular surgery and prosthetics	128
	Mycotic aneurysms	129
	Complications of antibiotic treatment	130
11	Graft material in bypass grafting	131
	Types of graft material	132
	Graft patency rates	136
	Graft infection	137
	Graft surveillance	138
12	Techniques of open vascular surgery	139
	Exposure of the aorta	140
	Exposure of iliac arteries	144
	Exposure of the common femoral artery	146
	Exposure of the popliteal artery	148
	Exposure of calf and foot arteries	151
	Exposure of the carotid artery	155
	Exposure of the subclavian artery	157
	Exposure of the axillary artery	159
	Exposure of the brachial artery	161
	Techniques for vascular anastomoses	162
	Techniques for haemostasis	169
13	Abdominal aortic surgery	173
	Abdominal aortic aneurysms	174
	Aorto-iliac occlusive disease	178
	Surgery for aorto-iliac aneurysmal and occlusive disease	179
	Aortic stent graft (endovascular aneurysm repair)	181
	Elective tube graft for aortic aneurysms	185
	Aorto-iliac bypass graft	189
	Open aortic surgery for ruptured aortic aneurysms	194
	Endovascular aneurysm repair for ruptured aortic aneurysms	197
	Complex endovascular solutions	198

Aorto-bifemoral bypass graft	200
Open surgery for suprarenal aortic aneurysms	204
Open repair of suprarenal aortic aneurysms with re-implantation of visceral arteries	205
Ilio-femoral bypass graft	209
Iliac endarterectomy	211
Treatment of aorto-enteric fistula	212
References	216

14 Thoracic aortic surgery	217
Thoracic aortic aneurysms	218
Thoracic aortic dissection	222

15 Infrainguinal revascularization	227
Infrainguinal revascularization for chronic ischaemia	228
Common femoral endarterectomy	233
Femoro-popliteal bypass graft above knee	236
Femoro-popliteal bypass graft below knee	240
Femoro-distal bypass graft: introduction	241
Femoro-distal bypass graft using vein	242
Femoro-distal sequential bypass graft using PTFE and vein	246
Composite femoro-distal bypass graft using PTFE and vein	248
Femoro-distal bypass graft using PTFE and a vein cuff	250
Popliteal aneurysm	252
Posterior approach for popliteal aneurysm bypass	253
Medial approach for popliteal aneurysm bypass	255
Femoral embolectomy	258
Popliteal embolectomy	262
Fasciotomy	263
Fasciotomy for compartment decompression	264
Release of popliteal entrapment	266
Infrainguinal angioplasty/stent insertion	268
Iliac angioplasty and stent insertion	270

16 Lower limb amputations	271
Overview of lower limb amputations	272
Above-knee amputation	274
Below-knee amputation	277

Aorto-bifemoral bypass graft	200
Open surgery for suprarenal aortic aneurysms	204
Open repair of suprarenal aortic aneurysms with re-implantation of visceral arteries	205
Ilio-femoral bypass graft	209
Iliac endarterectomy	211
Treatment of aorto-enteric fistula	212
References	216

14 Thoracic aortic surgery	217
Thoracic aortic aneurysms	218
Thoracic aortic dissection	222

15 Infrainguinal revascularization	227
Infrainguinal revascularization for chronic ischaemia	228
Common femoral endarterectomy	233
Femoro-popliteal bypass graft above knee	236
Femoro-popliteal bypass graft below knee	240
Femoro-distal bypass graft: introduction	241
Femoro-distal bypass graft using vein	242
Femoro-distal sequential bypass graft using PTFE and vein	246
Composite femoro-distal bypass graft using PTFE and vein	248
Femoro-distal bypass graft using PTFE and a vein cuff	250
Popliteal aneurysm	252
Posterior approach for popliteal aneurysm bypass	253
Medial approach for popliteal aneurysm bypass	255
Femoral embolectomy	258
Popliteal embolectomy	262
Fasciotomy	263
Fasciotomy for compartment decompression	264
Release of popliteal entrapment	266
Infrainguinal angioplasty/stent insertion	268
Iliac angioplasty and stent insertion	270

16 Lower limb amputations	271
Overview of lower limb amputations	272
Above-knee amputation	274
Below-knee amputation	277