

A Practice of Cardiothoracic Surgery

M. P. Holden

A Practice of Cardiothoracic Surgery

M. P. Holden

*Consultant Cardiothoracic Surgeon, The Freeman Hospital
The University of Newcastle upon Tyne*

with a Foreword by

M. I. Ionescu

WRIGHT · PSG

Bristol London Boston

1982

© **Mr. M. P. Holden**, Regional Cardiothoracic Centre, The Freeman Hospital, Freeman Road, High Heaton, Newcastle upon Tyne. 1982

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 the prior permission of the copyright owner.

Published by:

John Wright & Sons Ltd, 42-44 Triangle West, Bristol BS8 1EX, England.

John Wright PSG Inc., 545 Great Road, Littleton, Massachusetts 01460, USA.

British Library Cataloguing in Publication Data

Holden, M. P.

A practice of cardiothoracic surgery.

1. Chest—Surgery

I. Title

617.54059

RD536

ISBN 0 7236 0626 9

Library of Congress Catalog Card Number: 82-70098

Printed in Great Britain by John Wright & Sons (Printing) Ltd, at the Stonebridge Press, Bristol BS4 5NU

Preface

The explosion of knowledge and capabilities in cardiothoracic surgery during the past four decades has been phenomenal. For those surgeons of my generation who entered this discipline in the mid-sixties, the achievements of our senior colleagues have been breathtaking and exhausting. There are few cardiac abnormalities for which absolutely nothing can be done and, consequently, the surgeon can offer most referred patients an improved quality of life. Along with the development of an extensive range of surgical procedures, much clinical and laboratory research has been, and continues to be, undertaken. The number of learned journals weekly reporting these advances in our discipline creates a daunting prospect for us all, but especially for those clinicians currently embarking upon a career in cardiothoracic surgery, or those who are taking higher examinations which require a certain knowledge of this branch of surgery.

Most of the available textbooks covering cardiothoracic surgery are vast encyclopaedic tomes, written by the high priests of our profession, which have become the necessary daily reference works for all of us. However, for doctors who are beginning their training or who are preparing for higher examinations a shorter, more condensed book is desirable to prepare a quick foundation.

It was with the special need of residents and registrars in mind that I accepted the invitation of the publishers to prepare such a book on the subject of the 'current state of cardiac surgery'. I respectfully argued that thoracic surgery must be included in an attempt to prevent the further fragmentation of cardiothoracic surgery. In a short work such as this not every subject can be covered, and those that appear may not be emphasized as some readers would wish. I accept such criticism in advance, because many subjects are still controversial, and also the spectrum of work varies, as I have observed from the various departments in which I have worked or which I have visited. I have presented subjects that are particularly important, for whatever reason, in the practice in which I have worked as a consultant cardiothoracic surgeon for the past 7 years. Thus, I have little doubt that some senior readers or book reviewers may be sorely displeased by the layout, emphasis, omissions and some of the points of view. Having the great good fortune to work in a large department with five other cardiothoracic surgeons, I am daily reminded by observation that there are many opinions and methods different from mine, all of which achieve

similar success. Consequently, in the text I have presented alternative views where time and space would allow, but necessarily not all opinion can be presented and discussed, otherwise we would end up with another extensive, daunting volume.

In some sections where I considered that a member of our department has special international expertise I invited him to prepare the appropriate chapter, for example pulmonary embolism, the surgical treatment of tachyarrhythmias, cardiopulmonary bypass and intensive care.

Some chapters are of considerable length, but I make no apology for this, because I believe that, as an example, the subject of pulmonary embolism is one with which all clinicians must be familiar even though they will, fortunately, not have to deal very often with a patient so afflicted. Yet so catastrophic can be the outcome of this pathology that all doctors must be prepared to consider the diagnosis and to support the patient until ready for referral to a centre of excellence, where appropriate, if this should be necessary. A second example is that of intensive care. I believe that all doctors in training should spend part of their compulsory training in a cardiothoracic intensive care unit, for it is here that they will see, all day and every day, a wide spectrum of labile pathophysiology being manipulated, usually with great skill by the attendant clinicians, using an equally wide spectrum of pharmacological agents. Furthermore, all residents embarking upon a career in cardiothoracic surgery must quickly come to terms with the fact that the ability to establish the correct preoperative diagnosis and to maintain meticulous attention to detail in the intensive care unit are of equal importance to acquiring a successful operative technique. Unlike many other branches of surgery, in which if the surgeon has excelled in theatre the patient can merely be placed in a bed afterwards and all will be well in most instances, after cardiothoracic surgery, particularly after open heart surgery, the patient is in a fragile state mainly because we cannot 'rest the injured part'. For example, an orthopaedic surgeon would do so by enforcing rest with an encasing plaster-of-Paris cast. In our sphere two of the injured parts, namely the heart and the lungs, have to function as soon as surgery is completed in order to support life.

Becoming a consultant in cardiothoracic surgery is very similar to the experience in life when the traumatic realization dawns that one's parents do not know all the answers, and that life is not precisely black and white. As a result it comes as quite a shock to learn that there are no precise and accepted criteria for determining when we should operate for so many conditions: for example mitral stenosis and aortic regurgitation. I have attempted to make such suggestions in some chapters, if only to stimulate thought by the reader, and to emphasize the dilemma that faces a practising surgeon and cardiologist most of the time. None the less, I believe that the time is ripe for the international societies and colleges to elect a body that can select some criteria for deciding when to operate for most cardiothoracic conditions. After two complete decades of open heart surgery, and four

decades for the remainder of cardiothoracic surgery, there must be sufficient expertise and experience around the world to allow someone, somewhere to make a definite commitment. Such guidelines, if established, would resolve many dilemmas and remove many of the 'eyeballing' methods by which operative decisions are frequently made. They would also supplement the annual audit data that are accumulated and distributed by the British and Australian Cardiac Registers.

If cardiothoracic surgery is to avoid the same pitfalls as gastric surgery, which has remained almost stationary since the days of Billroth, only to be rendered largely impotent by the pharmaceutical industry, then we must submit to the rigours of our own annual audit and have more uniform and scientifically based indications for operations. Apart from being of enormous benefit to our patients, it will be of inestimable value in the training of young surgeons.

In conclusion, I am delighted to have had the cooperation of my three colleagues, Derek Pearson, Ronnie Campbell and Roger Hall, who have prepared four masterly chapters.

My apologies are extended to my family who have suffered even greater neglect than usual during the past eighteen months.

I wish to express my gratitude to John Wright & Sons Ltd for inviting me to prepare this book, in particular to Mr Roy Baker, the Managing Editor, for his patience, courtesy and continuing encouragement, and above all for his boundless diplomacy.

The skill, endurance and kindness of my secretary, Mrs Sheila Malpass, have triumphed once again; it has been apparent for a long time that her team effort can never adequately be repaid.

M. P. H.

Acknowledgements

No book of this type can be completed without the goodwill and cooperation of many of the world's leading authorities in this particular sphere, along with their respective sympathetic publishing houses.

I am most grateful to Professor A. S. Nadas and W. B. Saunders Co. for allowing me to insert an appreciable quotation relating to the value of steroids in the treatment of rheumatic fever from the textbook *Pediatric Cardiology*, 3rd ed., 1972.

Dr G. D. Buckberg kindly agreed to the use of his quotation, from 1979, 'I can find no evidence of the superiority of any one technique of producing cardioplegia in the clinical setting'. He hastened to add that now there is very good evidence that cold blood should be used as the vehicle for delivering the cardioplegic agents.

I was delighted to have the permission of C. V. Mosby Co. and Dr J. W. Kirklin to reproduce his predictive formulae concerning the repair of Fallot's tetralogy with and without pulmonary atresia. Dr D. C. McGoon and C. V. Mosby Co. graciously consented to the use of a quotation by the former in a debate with Dr S. H. Rahimtoola on the subject of valve replacement in patients with aortic incompetence.

Professor S. S. Gellis was 'delighted' to be quoted at the beginning of the chapter on Pectus Excavatum. Similarly, Professor G. M. Folger allowed us to use his statement, 'Currently there is no non-invasive study that allows for accurate determination of the degree of aortic stenosis nor the anatomic configuration of the valve as it relates to surgical treatment', which appeared in the journal *Angiology*, in November 1980.

Dr Delafresnaye, of the International Union against Cancer, not only gave permission to quote extensively from the TMN Classification, but very thoughtfully pointed out that T₂ should now read, 'Tumour more than 3 cm in its greatest dimension, or tumour of any size which either invades the visceral pleura or has associated atelectasis or obstructive pneumonitis extending to the hilar region'.

Permission to use the quotation 'Injuries to the thorax have been all too frequently synonymous with death', was willingly provided by Dr K. W. Jones and W. B. Saunders Co.

The quotation 'If education is so important, why don't they teach it at school' was gladly provided by Mr Doyle of ITV Books, London, from their very successful book entitled *Kidstuff*.

List of Contributors

R. J. C. Hall MD, MRCP

*Consultant Physician and Cardiologist
Royal Victoria Infirmary, Newcastle upon Tyne*

Chapter 13: The Prevention and Treatment of Pulmonary Embolism

R. W. F. Campbell BSc, MRCP

*Honorary Consultant Cardiologist and
Senior Lecturer, Academic Department of Cardiology
The Freeman Hospital, Newcastle upon Tyne*

Chapter 27: The Surgical Management of Tachycardias

D. T. Pearson FRCP FFA RCS

*Consultant Anaesthetist
The Freeman Hospital, Newcastle upon Tyne*

Chapter 51: Cardiopulmonary Bypass

Chapter 52: Intensive Care

Foreword

by **Marian I. Ionescu**

*Consultant Cardiothoracic Surgeon
The General Infirmary at Leeds*

The development and progress of cardio-thoracic surgery over the past 40 years represents a quantum in the growing process of medical sciences. These first 40 years have provided us with the text; the next 20 will supply the commentary. The text consists of a body of scientific papers, review articles, proceedings of meetings and a few encyclopedic but rapidly outdated treatises. The commentary is slowly emerging as the scientific dust settles and the mould of understanding cools down.

Young people are usually more given to admiring the exceptional rather than what is reasonable and, thus, the natural often has little chance to succeed. In writing this exceptional book, my friend and former associate Michael Holden has had to decide between the alternatives of Plinius: either of writing what deserves to be written or of writing what deserves to be read.

This book lies between disparate articles and heavy treatises. It is written for the resident, the young student of cardio-thoracic surgery who needs a solid but clear foundation in the specialty and who has not yet developed the ability and experience to select, digest and assimilate disparate segments of clinical science. The material in this book is put into perspective by a very experienced surgeon who, at the same time, is a clinical investigator and a basic scientist. The material has been distilled and filtered in a surprisingly balanced way and is presented with clarity and simplicity. Any type of communication, it is said, is a compromise with impossibilities, and therefore absolute answers to some problems may not be forthcoming, but the delineation of a 'controversy' will help sharpen the perception of the issue.

This book is unique as it clearly gives the reader the sense of the provisional and at the same time it helps one to think in generalities and to act in detail.

The book emphasizes repeatedly that 'both sides of a question do not belong to the poor old question at all, but to the opposing views which bedevil it', as Haskins put it. To settle controversial issues, the author combines formal logic with fact in order to help the reader to discover his own reasons for understanding.

The text is fluent, cohesive and highly readable. It is marked by a healthy, joyous distrust of dogma. 'Unmitigated seriousness is rather out of place in human affairs' Plato used to say in his solemn old age.

This book will have not exhausted all facets of cardiothoracic surgery and probably it will need, as many other things, upgrading and updating in the future, but for now it represents a work that will prove of inestimable value not only for the beginner but for many serious students of cardiothoracic surgery.

Contents

Foreword

xv

Part One: Pulmonary, Pleural and Chest Wall

1	Management of Intercostal Drainage Tubes	3
2	Management of Tracheostomy	7
3	Bronchoscopy	11
4	Preoperative Lung Function Predictors of Increased Risk during Major Surgery	15
5	Thoracic (non-cardiac) Infections	16
6	Bronchiectasis	23
7	Bronchial Carcinoma	26
8	Thoracic Tumours other than Bronchogenic Carcinomas	38
9	Malignant Pleural Mesothelioma	45
10	Malignant Pleural Effusions	48
11	Chylothorax Management	51
12	Shock Lung	54
13	The Prevention and Treatment of Pulmonary Embolism	57
14	Pectus Excavatum and Carrinatum	76

Part Two: Oesophageal

15	Oesophageal Investigations	81
16	Congenital Oesophageal Atresia and Tracheo-oesophageal Fistula	86
17	The Management of Gastro-oesophageal Reflux	91
18	Carcinoma of the Oesophagus	101
19	Achalasia	113
20	Diffuse Oesophageal Spasm	117

Part Three: Acquired Cardiac

21	Surgical Approach to Coronary Artery Disease	123
22	Myocardial Protection	141
23	Intra-Aortic Balloon Counterpulsation (IABP)	151
24	Heart Valve Surgery	157
25	Cardiovascular Infections	177
26	Cardiac Pacing	188
27	The Surgical Management of Tachycardias	203
28	Cardiothoracic Trauma	212
29	Traumatic Rupture of the Aorta	217
30	Thoracic Aortic Aneurysms	220
31	Dissection of the Thoracic Aorta	225
32	Cardiac Tumours	232
33	Heart Transplantation	234

Part Four: Congenital Cardiac

34	Atrial Septal Defects	241
35	Ventricular Septal Defects	247
36	Double Outlet Right Ventricle	255
37	The Patent Ductus Arteriosus	259
38	Total Anomalous Pulmonary Venous Drainage	264
39	Complete Atrioventricular Canal	270
40	Truncus Arteriosus	274
41	Congenital Aortic Stenosis	277
42	Coarctation of the Thoracic Aorta	281
43	Anomalous Left Coronary Artery	291
44	Pulmonary Artery Sling	293
45	Fallot's Tetralogy	296
46	Pulmonary Atresia with Ventricular Septal Defect	305
47	Pulmonary Atresia with Intact Ventricular Septum	310
48	Shunt Procedures	313
49	The Fontan Procedure	320
50	Transposition of the Great Arteries	327
51	Cardiopulmonary Bypass (Extracorporeal Circulation)	335
52	Intensive Care	368

Strongly Recommended Browsing	417
-------------------------------	-----

Index	423
-------	-----

PART ONE

Pulmonary, Pleural and Chest Wall

1 *Management of Intercostal Drainage Tubes*

The glamour of the operating theatre and the research laboratory, combined with the shorter working week and the lure of the committee room, have allowed the management of this fundamental aspect of cardiothoracic surgery to fall by the wayside. It is as important to our patients as oxygen and cardiopulmonary bypass.

Quite the best description of the procedure I have read is by Firmin and Welch (1980), two London senior registrars. The article has clear descriptions and splendid photographs and ought to be compulsory reading.

BASIC PRINCIPLES

If you are asked to insert an intercostal tube, and you have never done it before, and especially never seen it before, then say so and get help. This procedure is always being performed to help someone whose life is in jeopardy, and if it is not undertaken properly, the morbidity and mortality are considerable. Correct insertion does not distress patients, let alone harm them, and they will rapidly benefit from your precise and expert ministrations.

Tubes are inserted into the pleural cavities of patients to remove air and/or fluid (be it pleural effusion, blood, chyle or pus). Consequently, the tube should be placed in such a site that by recalling a few fundamental laws of physics (particularly that of gravity) both the forms of matter can enter the tube. Do remember that these fluids are heavier than air and will therefore gravitate to the most dependent part of the pleural cavity. The latter will depend on the position the patient adopts in bed depending on his or her clinical circumstances. Air will rise to the highest point in the pleural space and the tube must therefore reach the apex.

The *aims* of the tube are: (1) to remove the fluid and air, and (2) to approximate the visceral and parietal pleura to achieve physiological pleurodesis. Use of the 4th or 5th intercostal space in midaxillary line (there is minimal muscle here) is most comfortable for the patient and convenient for the nursing staff. The following list of *dos* and *do nots* will assist in minimizing the trauma to the patient.

Do

1. A lateral chest X-ray is essential to locate the fluid prior to intubation.

2. Sedate the patient unless it is a very urgent intubation for a tension pneumothorax.

3. Get the patient in a very comfortable position, because the whole procedure may take 5–10 minutes.

4. Insert local anaesthetic and wait for 5 minutes. This syringe and needle will also aspirate pleural contents to confirm the correct site.

5. During the 5 minutes waiting for optimum analgesia, check all the equipment:

a. Does the tube pass right through the trocar if a Malecot catheter is being used?

b. Do you have a connector that fits the intercostal tube and the tube leading to the drainage bottle?

c. Observe the nurse who is checking that the bottle, bung and underwater tubes are airtight and are the correct way round, and that the correct one is 'underwater'.

d. Have you got a knife, scissors, two clamps and a strong atraumatic skin stitch?

6. When all has been checked, make the skin incision and insert purse-string suture. The method of anchorage will depend on the personal or departmental preference.

7. Insert the scissor or a clamp through the wound to pleural space to facilitate passage of trocar and tube.

8. Insert the trocar and tube with an index finger 2 cm from end of sharp point: this prevents a sudden entry proceeding too far into dangerous territory.

9. When the pleural cavity is entered with the trocar, retract the sharp point and direct the tube towards apex of pleural cavity.

10. Withdraw the trocar completely and immediately clamp the tube until it is safely but rapidly connected to the underwater drain.

11. Make sure the tube does not move or fall out whilst completing 10.

12. Have a spare skin suture inserted to tie off the skin incision when the tube is removed.

13. Anchor the tube so that it will resist all forces that are applied to it during the daily life of the ward.

14. Place the tube so that patient does not lie on it.

15. Check the connectors again to ensure that they are air-tight.

16. Try to avoid expanding a completely collapsed lung immediately because pulmonary oedema may ensue.

17. Suction of 15–20 cm H₂O may be required, but remember that if air leaks into the pleural space from the lung faster than the pump can remove it, then the pump will be as dangerous as the application of a clamp to the tube.

18. Therefore, stay with the patient until a stable situation has been achieved.

19. Ensure that the nursing staff understand the management of such a patient.

20. Repeat the chest X-ray and examine it carefully.

Do Not

1. Parade all the instruments in front of the patient, who will be even more terrified.

2. Even if you are terrified, do not appear to be so.

3. Do not insert the tube through the 2nd intercostal space anteriorly, because the patient sees everything: it is a very dangerous site and it drains very badly.

4. Do not insert the tube posteriorly above the scapula: it is very dangerous and it has no advantages.

5. Do not delegate this procedure to juniors until you have seen them undertake it safely.

Remember

1. Remove the tube at least 24 hours after the final air leak has been observed—this way better pleurodesis will be achieved.

2. Give the patient an analgesic before the tube is removed—it is very painful.

3. It is a waste of time asking the patient to breathe in or out during the 'pulling out' phase, because they will all gasp anyway.

4. You require two pairs of hands. One pair ties the suture when the tube is removed. The other two hands have separate functions: one pulls the tube out rapidly and the second instantaneously compresses the hole. All this is an attempt to prevent air from re-entering.

5. Do this yourself with a senior nurse present to ensure that (a) it is done properly and (b) that it is an opportunity to instruct the nurses.

6. If it is done badly air re-enters and the lung collapses and it negates all the uncomfortable treatment which the patient has endured for the past week or longer.

7. So long as the tube is lying between two pleural surfaces fluid will flow down it, because the tube acts as a primary irritant which increases pleural fluid production, particularly if it is a Malecot catheter.

8. Malecot catheters kink very easily and cannot be inserted very far.

9. Argyle catheters are difficult to anchor.

10. Check the whole system at least twice daily.