An Introduction to Problem Solving in Surgery

P S Hunt, MS, FRACS

An Introduction to Problem Solving in Surgery

P S Hunt, MS, FRACS

Surgeon
Prince Henry's Hospital
Monash University Department of Surgery

PITMAN MEDICAL AUSTRALIA

First published
in Australia 1979

Pitman Publishing Pty Ltd
158 Bouverie Street
Carlton
Victoria 3053

National Library of Australia
Cataloguing in Publication data

Hunt, Philip S.
An introduction to problem solving in surgery.

Index
ISBN 0 85896 626 3

1. Diagnosis, Surgical. I. Title.

617.075

Designed by Peter Yates
Cover design by Guy Mirabella

The cover illustration shows *Operation in a field hospital New Guinea, February 1944* by Sir William Dargie. Reproduced by permission of the Trustees, Australian War Memorial

Text set in 10/11pt Caledonia
by The Dova Type Shop, Melbourne
Printed and bound by
Globe Press Pty Ltd, Melbourne

Associated companies

Pitman Publishing Ltd
London

Copp Clark Pitman
Toronto

Fearon Pitman Publishers, Inc
Belmont, California

Pitman Publishing New Zealand Ltd
Wellington

Preface

This book was developed from discussions about medical education with fifth-year Monash medical students. This experience revealed that students were not equipped to solve the everyday problems of clinical practice, a process learnt mainly by trial and error after graduation. Textbooks tend to assume that a diagnosis has already been made, as is usually the case in the teaching hospital setting. Books on diagnoses concentrate on routine history recording and common physical signs. This book is an attempt to link the need for a thorough history and physical examination with the identification and diagnosis of common clinical problems. These problems and their common causes are not necessarily treated by surgery, and this is one important point of emphasis.

My intention is to describe the process of diagnosis and treatment for medical and nursing students. The symptoms discussed are seen throughout the world but the common causes are those found in Australia. Acknowledgment must go to the patients who contributed to this experience and to medical education. I would also like to thank Dr Neil Williams and Professor Jim Watts. They have made important contributions in setting up a surgical unit based upon problem orientation, which is of great value in teaching and the review of standards. My thanks also to Mrs Marjorie Pressley and Mr Pat Smyth for their help in the preparation of this book.

P S Hunt

Contents

PART ONE
General Principles of Diagnosis 1

1 Introduction 3
2 General Principles of Wound Healing 7
3 Shock and Resuscitation 17
4 Nutrition 27

PART TWO
Analysis of Common Surgical Problems 36

5 Weight Loss 37
6 Dysphagia 39
7 Vomiting 42
8 Indigestion 44
9 Haematemesis and Melaena 47
10 Acute Abdomen 49
11 Acute Upper Abdominal Pain 52
12 Acute Right Iliac Fossa Pain 54
13 Chronic Left Iliac Fossa Pain 56
14 Constipation 58
15 Diarrhoea 61
16 Rectal Bleeding 63
17 Anal Pain 65
18 Anal Itch 67
19 Jaundice 68
20 Leg Ulceration 70
21 Lump in the Groin 73
22 Lump in the Scrotum 75
23 Lump in the Breast 77
24 Wounds 79
25 Multiple Trauma 81
26 Shock 83
27 Hand Infections 86
28 Obstructed Urinary Flow 88
29 Haematuria 89
30 Acute Back Pain 91
31 Lump in the Neck 93
32 Goitre 95
33 Skin Ulcers 97
34 Ingrown Toenail 99
35 Subcutaneous Swellings of the Hand 100
36 Mouth Ulcers 101

PART THREE
Appendixes 103

A A Problem-oriented System 105
B A Discharge Summary 111
C Problem-oriented Log Book for Student Use 114

Index 119

Contents

PART ONE
General Principles of Diagnosis 1

1 Introduction 3
2 General Principles of Wound Healing 7
3 Shock and Resuscitation 17
4 Nutrition 27

PART TWO
Analysis of Common Surgical Problems 36

5 Weight Loss 37
6 Dysphagia 39
7 Vomiting 42
8 Indigestion 44
9 Haematemesis and Melaena 47
10 Acute Abdomen 49
11 Acute Upper Abdominal Pain 52
12 Acute Right Iliac Fossa Pain 54
13 Chronic Left Iliac Fossa Pain 56
14 Constipation 58
15 Diarrhoea 61
16 Rectal Bleeding 63
17 Anal Pain 65
18 Anal Itch 67
19 Jaundice 68
20 Leg Ulceration 70
21 Lump in the Groin 73
22 Lump in the Scrotum 75
23 Lump in the Breast 77
24 Wounds 79
25 Multiple Trauma 81
26 Shock 83
27 Hand Infections 86
28 Obstructed Urinary Flow 88
29 Haematuria 89
30 Acute Back Pain 91
31 Lump in the Neck 93
32 Goitre 95
33 Skin Ulcers 97
34 Ingrown Toenail 99
35 Subcutaneous Swellings of the Hand 100
36 Mouth Ulcers 101

PART THREE
Appendixes 103

A A Problem-oriented System 105
B A Discharge Summary 111
C Problem-oriented Log Book for Student Use 114

Index 119

PART ONE

General Principles of Diagnosis

1

Introduction

It has proved difficult to define the objectives of medical education.[1] It is generally assumed that clinical medicine should be classified according to body systems and diseases. In practice, however, diagnosis is a process which starts with a problem of unknown cause. There is no clear classification according to problems, or their methods of solution, in clinical medicine. In an educational sense, the learning of medical practice is a question of method—the objectives of medical education are methodological.

The intention of this book is to define common surgical problems, and outline, for each one, a method of solution. Before this section there are three chapters which emphasise the history of basic subjects in an attempt to link the development of knowledge in that subject, with the day to day solution of 'surgical' problems.

The main objectives in clinical medicine are the means by which illness is understood, prevented, alleviated and cured. It is the solution of these problems which forms the basic structure of medical education and care. To educate in medicine means to teach reliable methods of solving medical problems. As Karl Popper[2] pointed out, it is not the accumulation of facts, but the solving of problems which increases knowledge. The old idea that science proceeds by accumulating observations and making inductions from observations does not correspond with the logic of scientific enquiry—sciences start from problems, not observations. The conscious task is always the solution of a problem through the construction of a theory which solves the problem.

Thus, the definition of objectives in medical education and care is generative and requires an explanation of clinical scientific method.

Review of most medical courses reveals that much of the time is spent learning vast quantities of biological facts. These facts are important, but the failure to link this material with clinical problems is a major barrier to their full inclusion in clinical practice.

Symptom Analysis

There are definite varieties of clinical problems. In all varieties the method of solution is the same. Here also the area of practice produces a bias in the sorts of problems which need to be solved. The siting of medical education in public hospitals means that there is an undue concentration on pathology, technology and iatrogenic problems. This tends to turn the student away from experience in the area of first contact between the patient and doctor. The objective of first-contact medical teaching is to learn about the analysis of symptoms. The definition and analysis of symptoms is the most important and neglected part of medical education.

The student in the normal medical course is encouraged to take a history and examine a patient but then finds himself ill-equipped, through lack of either guidance or experience, to make a diagnosis. Most formal teaching does not help much. When the student turns to a textbook he finds this also of little help. Most textbooks are written assuming that a diagnosis has already been made. They are set out according to pathological classification of disease and not to the usual symptoms which face the clinician when he first sees the patient. Thus, for example, a patient may complain of indigestion, the student finds that methods of solving the problem are hard to come by. When the student turns to his lecture notes or textbook he is forced to make a spot diagnosis of, for example, duodenal ulcer as the cause of the problem.

This basic principle, of medical practice by attention to symptoms, was set down by Thomas

Sydenham[3] in the 17th century. He wrote that all diseases should be described as objects of natural history. He went on to say 'That in writing about the natural history of disease, every mere philosophical hypothesis should be set aside and that the manifestations of natural phenomena, however minute, should be noted with the utmost accuracy. There cannot be a short, or indeed any other way of deriving morbific causes or discovering the curative indications than a perception of peculiar symptoms'.

It remains true today that clinical medicine is about the prevention, alleviation and cure of symptoms.

Sydenham made another vital point about the value of such an orientation in that symptoms reveal natural history; that is the process of disease development is seen as a consequence of failure to cope with the situation, thus countering the tendency to describe a disease as a result of otherworldly influences.

Symptoms and Pathology

MacKenzie[4] in his book *The Future of Medicine* written in 1919 showed clearly that an emphasis on learning about disease entities also hinders learning about the natural history of disease. The knowledge of disease entities has less meaning in practice than the logic of behaviour which directs such practice. This makes it hard for the student to learn how to handle the day-to-day problems in clinical medicine. Commonly, practice then becomes a trial-and-error process after graduation.

The incorrect idea which creates this difficulty is that a disease only exists when pathology is present. In fact, a study of natural history reveals that pathology is a late manifestation of disease.[4] It is much more common, taking the whole spectrum of illness, for symptoms to arise in the absence of pathology. The effect of assuming the identity of disease and pathology is to put the actual practice of medicine in conflict with the needs of the patient.

For example, weight loss* is a common problem seen especially in general practice. The most common cause is depression, with or without alcoholism, ie no actual pathology; but such a symptom may be a presenting problem in diabetes, gastrointestinal malignancy, thyrotoxicosis and other less common causes with pathological change. These diseases may also produce different symptom(s) at presentation. In these cases there are different spectrums of causes.

The recognition from a study of natural history that symptoms in the absence of pathology represent an early phase of disease is also fundamental to the development of preventive concepts. Almost invariably the history reveals conflict at varying levels between the host and environment. For example smoking and lung function, refined food and colonic function. Generally there is a background of constant tension or stress related to the problems of living which are difficult to solve. At one stage or another a trigger (eg smoking) may be located initiating symptoms (eg cough). These factors together with constitution make up the predisposition of that individual for a certain disease.

Problem Solving Method

The eliciting or isolation of the presenting or cardinal symptom is in itself a difficult process.[5] It is exceptional for only one symptom to be present and the choice of that symptom or group of symptoms requires both guidance by the teacher, and experience. It is essential that the symptom(s) chosen for consideration are fundamental, related in time, primary and worry the patient most, rather than secondary features which have developed as accompaniments.[6]

As indicated by Weed[7] 'the basic criterion of the physician is how well he can identify the patient's problems and organise them for solution'. With organisation of problems for solution, attention to the diagnostic reasoning process of experienced clinicians reveals that rarely do they just passively collect information and wait for enlightenment. The process is interpretive—there is an immediate construction of hypotheses about possible (common) causes and reasoning about the most likely cause from the observation of mainly historical features. So important is the history in diagnosis that for a long time the diagnostic process in medicine has been called the historical method.[4]

The basic work in the scientific analysis of symptoms was set down by Claude Bernard[8] in 1865 in his book *Introduction to the Study of Experimen-*

*Weight loss is here labelled surgical, though as a problem it can be seen that a number of causes are not treated surgically, but by medical means

tal Medicine. He described the analysis of symptoms as a synthesis of observation of the particular case and reason from previous experience to attain a diagnosis. A method of recording this process was introduced by Weed[9] and called problem formulation (Table 1.1). Such a record conforms to the requirements of science in that it represents a general principle of problem solving in clinical medicine. Furthermore, because it describes common practice it can become the basis of teaching clinical medicine and improve the general standards of practice.

A N Whitehead described this orientation as 'To see what is general in what is particular and what is permanent in what is transitory is the aim of scientific thought'. The permanent aspect of clinical medicine is the symptomatic expression of the transition from health to disease. Practice confirms that this is the basis of the learning of clinical medicine.

Table 1.1

A comparison of process in scientific experimentation and the problem-oriented medical record (POMR)

Scientific Experiment	*POMR*	
Problem	Problem	
↓	↓	
(Hypothesis)	(Hypothesis)	
↓	↓	
Experiment	Observation	S/O
↓	↓	
Results/Conclusions	Assessment	A
↓	↓	
Plan	Plan	P

S/O is subjective/objective and virtually the same as history/physical examination
A is assessment and **P** plan

Problem-oriented Medical Record

The objectives of medical education are to learn the following:

1 The taking of a complete and accurate history and physical examination, the data base
2 The definition of significant problems from the data base
3 The solution of problems using basically the history and physical examination but also technical and laboratory assistance—problem formulation

The learning of clinical medicine requires that there be some framework for a complete history and physical examination. For students the notes taken of such a structured interview is the data base from which the presenting complaints or significant problems are derived.[4,9,10] Thereafter the analysis of such problems is by a process which is similar to the observation and reason of scientific experimentation[5], called by Weed, *Problem Formulation*.[9] Here all the information obtained is directed toward solution of that problem[5] and not dispersed into simply a description of the status of organs or systems.

With experience, clinical problem solving becomes more consistently interpretive and less descriptive.

These objectives are the basis of most types of problem-oriented record, first devised by Weed.[9] Appendix A shows one system of learning by recording, used for four years now by students in the Monash University Department of Surgery at Prince Henry's Hospital.

The derivation of the significance of past and present problems as a problem list is often the way natural history of disease is revealed and students learn about the development of disease. It also helps in choosing more socially desirable forms of treatment and in the educative aspects of treatment and rehabilitation.

Educational Audit

The prerequisite for audit is scientific method. A logical system of problem solving which represents clinical practice is readily checked both for errors and as a guide to learning. The record of the reasoning process, on paper about actual problems, displays proficiency.

Students can perform the problem-orientated medical record within a clinical service provided that the staff understand, practise and are prepared to supervise the process.[11] In this way audit can act as a means of cumulative learning if it is incorporated in the day-to-day practice of the unit.

There are two main ways of formal audit which include the following:

1 Verbal presentation of progress and results of management[12] (Table 1.2)
2 Assessment of the medical record, especially the discharge summary (Table 1.3) (Appendix B)

It is also useful for the students to audit their own experience. Possibly the best way to do this is to carry a log book of problems. Appendix C is one log book of common surgical problems.

Finally it should be pointed out that diagnosis is only the first phase in the process of clinical medicine. Treatment also raises problems which can be solved in a similar manner.

Table 1.2
POMR presentation—'Be critical'

1 Put up the major problem list
2 Nominate the major problem (establish priorities)
3 Present the patient profile
4 Analyse:
  (a) The major problem **S:** History
  O: Physical examination and investigations
  A: Interpretation
  P: Plan
  (b) Interrelation of this problem with others
  (c) Other problems you consider significant in a little more detail
  (d) Rehabilitation
5 Critical summary

Table 1.3
Evaluation of medical records

Student:
Patient:
Evaluator:

	Grade	Notes
1 Has a complete *Data base* been collected?		
2 Is the *Problem list* complete and current?		
3 Are the *Plans* for each active problem appropriate?		
4 *Progress notes* satisfactory?		
5 *Discharge summary*—does it give a clear account of the illness and future plans (including what the patient was told about illness)?		

Further comments
Degree of difficulty of record—Easy/Average/Difficult
Grading scores: 1 Poor
2 Average
3 Good

References

1 Editorial—'Objectives in medical education', *Medical Education*, vol 11, 1977, pp 241–3
2 K Popper, *Conjectures and Refutations*, Routledge & Kegan Paul, London, 1963, p 222
3 W Osler, *Aequanemitas*, H K Lewis, London, 1935
4 J MacKenzie, *The Future of Medicine*, Oxford University Press, London, 1919
5 W L Morgan and G L Engel, *The Clinical Approach to the Patient*, W B Saunders, Philadelphia, 1969, p 17
6 A Feinstein, *Clinical Judgement*, Krieger, New York, 1967
7 L L Weed, 'Medical records that guide and teach', *New Eng J Med*, vol 278, 1968, p 593
8 C Bernard, *An Introduction to the Study of Experimental Medicine*, trans by H C Greene, Dover Publications, New York, 1957, p 28
9 L L Weed, *Medical Records, Medical Education and Patient Care*, Press of Case Western Reserve University, Cleveland, 1971
10 C Seward, *Bedside Diagnosis*, E & S Livingstone, Edinburgh, 1952
11 L L Weed, 'Quality control and the medical record', *Arch Int Med*, vol 127, 1971, p 101
12 J W Hurst, 'The art and science of presenting a patient's problem', *Arch Int Med*, vol 128, 1971, p 463

2

*General Principles of Wound Healing**

A working knowledge of wound healing is the basic objective of surgical education. Full understanding requires that the practice of wound treatment be backed by sound theory. Together, theory and practice form the science of surgery.

The history of the study of wounds is indeed the history of surgery itself. An understanding of current practice and future development depends upon appreciation of the history of progress in wound management.

A review of the history of wound healing shows that there has been steady uneven progress, both in the treatment of wounds and the general application of principles of wound management. More recently, there has been an acceleration in progress both in response to community need (especially in wars) and because of advances in other areas such as anaesthetics and resuscitation.

Historically, uneven development and stagnation in practice have gone hand in hand. Proper wound management depends upon the incorporation of advances into a general framework of both practice and teaching. For centuries there have been excellent individual pus evacuators but little system for either teaching the art or providing such a service for the ordinary soldier; in marked contrast to, for example, the service provided in the modern US armed forces.

The role of the surgeon as a pus evacuator has also changed rapidly, with the introduction of lessons from elective surgery. There has, however, been a tendency to over-emphasise environmental and bacteriological factors to the exclusion of surgical technique.[1,2] Thus, the significant advances of antisepsis, germ theory of infection and antibiotics have for varying times distorted and hindered the general understanding of the best approach to wound management. The correct place and emphasis of these advances in the creation and treatment of wounds has only become a matter of general surgical knowledge in the past decade or so.

Taken overall, it has been the gradual introduction of scientific method to the study of wounds which has initiated advance. In all situations there have been problems which have caused the working out of solutions.[3] Observations of natural history and the results of various forms of treatment have, through reason, led to the selection of more rational management. This method has been applied to experiments in animals—the intention being to reduce the variables of the actual clinical situation to the point where generalisations can be deduced from controlled observations.[4] Often undue credence has been given to the results of *in vivo* or *in vitro* animal experiments, not remembering that their validity must be tested by observations made on man. An example of this problem was seen recently with the widespread use of antibiotics, without clear indications, with attendant sensitivity reactions, toxicity, development of resistant organisms and neglect of sound surgical technique.[5,23]

When generalisations are found to be true about natural history and treatment, that is they explain or predict accurately and are consistent over time, then such principles become part of general surgical knowledge. This is the first step, for such measures also need to be institutionalised. An institutional system is vital for continuing education—the way skill is amplified in each generation. Thus, it is not just discovery which is important but also the scientific inclusion of discoveries in general surgical practice which then constitutes valid theory (Figure 2.1).

There has been a tendency in writing about wounds to separate wound healing as a subject from wound infection. In practice, this is incorrect

*See Chapter 24 'Wounds', Part Two, p 79 and Chapter 25 'Multiple Trauma', Part Two, p 81

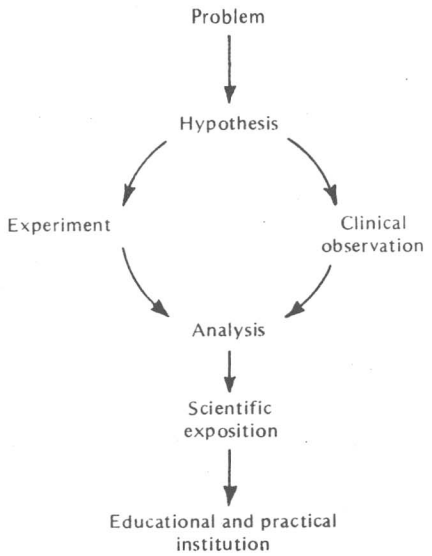

Figure 2.1 The development of scientific knowledge

for almost invariably the failure of wounds to heal is due to infection. For many centuries wound management was that of the treatment of infection. In the past 100 years, with the more controlled experience of elective wounds, rapid wound healing without infection has become the rule. Nevertheless, the scientific objective remains the promotion of the healing of wounds, the prevention and treatment of infection, with the development of facilities making these skills available to the whole community. At the present time, the prevention of wounds is assuming prime importance.

It is difficult to select figures who have led in the science of wound management. Taking both discovery and scientific exposition as criteria, three individuals are very important; Ambrose Paré (1510–1590)[6] who started the liberation of surgery from mediaeval dogma; Joseph Lister (1827–1910)[7], in the words of Zachary Cope (1953)[8], 'during the last seventy years, surgery has become a new art which differs from that of preceding times in that it is based upon a surer scientific basis. This speedy advance has been due to several causes. First and foremost, was the avoidance of infection which became possible owing to discoveries of Pasteur and their application by Lister.' Finally, William S Halsted (1852–1922)[9] who defined correct surgical techniques and the institutional and educational requirements of learning in surgery.

The intention in this chapter is to give a brief outline of the history of wound healing. This has been a continuum, but for clarity it is divided into a number of sections of special significance. Finally a summary will be given of the general principles of wound healing as presently understood.

Ambrose Paré (1510–1590)

Coming at the time of the renaissance, Paré expressed in his writings the enlightenment of that era, demonstrating the superiority of independent observation over blind acceptance of feudal dogma. Consistently in his work, he built up a picture of his wide experience in wounds, demonstrating that his methods of treatment produced consistent and reproducible results. He used the French language to record his work (for which he was criticised as an ignorant charlatan) for the very good reason that the work was only accessible to learning surgeons when in the local vernacular.

Thus, Paré's contribution to surgery was more than his well-known discoveries, many of which had been long practised. His writings, however, convince by their accurate observation, recorded from many instances, that his practice could be generally applied and was indeed scientific.

To Ambrose Paré is generally attributed the first rational statement on the harmfulness of treating gunshot wounds with boiling oil, the use of ligature for haemostasis after amputation and the need for immediate dilatation of gunshot wounds; accompanied by extraction of all lodged foreign bodies including wood, clothing, armour, bone splinters, bullets, and bruised or lacerated muscle and blood clots (debridement), together with provision for drainage.[6]

When describing his methods, such as the use of ligature for haemostasis, he cited many previous authorities such as Hippocrates, Galen and Celius, to support his contentions. Together with this, he describes the beneficial effects on healing and the dramatic reduction in morbidity and pain when compared with the previous method of cautery control of haemorrhage. His description of the use of a bland dressing of digested egg yolk, oil of roses and turpentine when the boiling oil ran out, is reminiscent of the discovery of penicillin.

These principles remain the clearest and most scientific of his recommendations; more confused are his statements about the dressing of infected wounds. He was, no doubt, an expert in this area but little can be gathered of principles, for his methods remain obscured by a great variety of empirical applications.

Antisepsis to Asepsis—Joseph Lister (1827–1910)

The origins of antiseptic wound management can be traced back to antiquity.[10] For centuries, antisepsis—empirical and ill-understood—was the basis of wound management. This approach receded, initially by reduction in toxicity, for example when boiling oil was discarded by Paré. Towards the end of the 19th century, free use of antiseptics was replaced by preventive antisepsis or asepsis of the environment. The use of antiseptics persists in such areas as the preparation of skin for elective surgery, the irrigation of wounds, dressings for granulating wounds, and the surgical scrub.

Semmelweis established the value of hypochlorite in his preventive antiseptic programme.[10] He concentrated its use on the hands of accoucheurs and equipment which might be the source of contaminants causing puerperal sepsis. The essential concept that Semmelweis introduced was that of preventive, rather than treatment, antisepsis—that is asepsis; these are measures to reduce contamination of wounds and thus prevent infection. Subsequently, where possible, thermal rather than chemical antisepsis is used together with rubber gloves, face masks and so on.

There has been some discussion of priority between Semmelweis and Lister; really, the question is irrelevant. The discovery may have been made first by Semmelweis but the consistent scientific work, which established the place of antisepsis and asepsis against strong opposition, was due to Lister. The effect of Lister's work upon surgical practice was by far the greater.[10] It must be remembered that there were centuries of antiseptic practice to contend with. With clear scientific exposition, Lister started with the use of undiluted carbolic acid into the wounds of compound fractures; he then reduced concentration, and ended by adopting complete preventive antiseptic practices; all the time relating his work to experience. There could be no answer from those tied to the past, and quickly asepsis was accepted throughout the world (Figure 2.2).

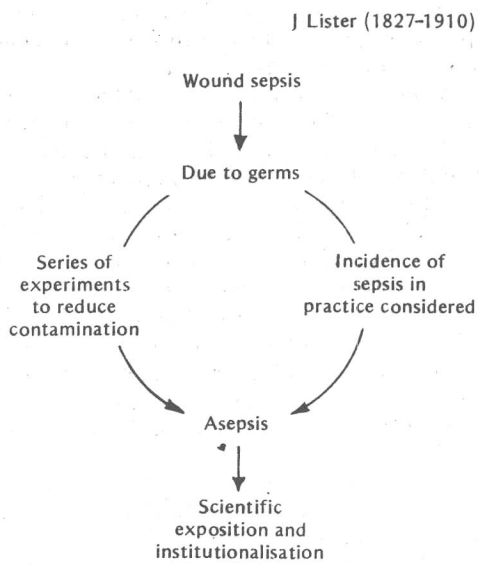

Figure 2.2 The development of the principles of asepsis

In the words of Wangensteen:[10]

> Lister will be remembered as the surgeon scientist who brought the meaningful work of Pasteur to the attention of surgeons, and whose patient and thoughtful clinical observations led to the control of surgical wound infection, and to the extension of surgery as an important agency in the management of many diseases previously believed to be beyond relief by any therapeutic agency.

Technique and Experience—William S Halsted (1852–1922)[9]

Stimulated by the needs of a community facing hospitalisation as a death sentence and opposed by surgeons who looked for causes in the environment, rather than themselves, for their operative deaths, Lister established that infection arose from incorrect methods of practice. Preventive antisepsis (and anaesthesia) set the stage for a close look at surgical technique. 'Bad air' dominated the thinking of surgeons during the 19th century; because of this the essence of practice was speed, with rapid covering of the wound to lessen the time of exposure.[11] Initially, Kocher and then Halsted[9],

in a series of papers, established the general principles of surgical technique which are (and remain) the basis of wound management.

He emphasised in his studies that the right operation as well as the right technique were important for the best results, initiating the scientific study of clinical judgement in surgical practice. Technically, his practice and writings confirmed the importance of a deliberate approach and strict asepsis, aided by the introduction of rubber gloves. He recommended gentleness in the handling of tissues; sharp dissection using the minimal number of fine non-absorbable sutures to minimise inflammatory response and ensure careful and complete haemostasis. Ligation and suturing should involve small portions of tissue and optimal tension to avoid undue tension, ischaemia and strangulation of tissue. Tissue must be correctly opposed so that dead space can be eliminated and haematoma formation avoided. Subsequent studies[12] have confirmed again and again his work, illustrating its basic importance. Indeed, the experienced practice of these principles is more important than contamination—sound surgical technique is the basis of the prevention of wound infection.

Probably Halsted's most significant contribution to surgery was in the field of education. Throughout his work, he emphasised the importance of guided experience. He devised the surgical training programme and through his influence on the Flexnor report[13], ensured a widespread raising of standards in wound management for medical education and practice.

Debridement and Secondary Closure of Wounds

For centuries, infection was considered to be a normal consequence of wounding. At times it was considered laudable—which is partly true because pus does represent developing host response. It appears that the situation had never been as bad as during the industrial revolution, with a population demoralised by their working conditions and malnutrition widespread throughout the community. In this situation it was firmly established by Koch[14], that wound infection was due to direct transfer of bacteria. This information was surgically applied by Lister in his scientific evolution to preventive antisepsis. Subsequent research has confirmed that airborne infection is unimportant in surgical practice.[15,16,17,18] With modern asepsis the majority of infections are by intestinal (usually the patient's) organisms.

It was obvious, however, that asepsis did not solve the problems of infection in war wounds or in elective operations, particularly on the intestine where controversy as to approach actively continues to the present day. Secondary principles have arisen from the problems of healing contaminated wounds. These principles were designed as general guidelines in the treatment of wounds that are contaminated with dead and devitalised tissue, foreign material and bacteria.

Initially, the problem related to war and civilian wounds. It was realised that removal of foreign material and excision of dead and devitalised tissue (debridement) was clearly described by Ambrose Paré[6] in the 16th century. It was Wangensteen[10] who first pointed out to English readers the importance of the work of Reyher in wound revision and debridement. Reyher, in the Russo–Turkish wars of 1876–78, showed in prospective studies that a combination of wound antisepsis with early debridement succeeded in significantly lowering the mortality of gunshot injuries of the extremities. He was the first to perform debridement under reasonably well-controlled antiseptic conditions.[10]

It was not until 1917[19] that debridement with subsequent secondary closure of the wound was accepted generally, in the management of war wounds. This important principle needed to be re-emphasised during the Second World War[20] and now is a routinely practised secondary principle of wound healing.[21]

Bacterial contamination is encountered mainly in elective surgery, particularly colonic. In cases of gross contamination, wounds may be left open and closed later with much improved results[22], or drained, especially with moderate contamination or inadequate haemostasis.[15] The use of prophylactic antibiotics remains at issue.[15]

The Treatment of Infection

Surgeons have been described, with some truth in the past, as simply pus evacuators. However, the management of infection has always required the greatest skill. Drainage still rémains the basis of treatment for infection, but more than this, it is the proper timing of drainage which is crucial.

Primary and secondary principles of wound

healing have reduced the incidence of abscesses, but when they occur, drainage becomes a rule. The natural history of infection is such that there is a period of cellulitis before the formation of pus; it is the latter which needs to be drained, neither too early nor too late for the best chance of survival.

Antibiotics have had a marked effect upon the results of wound infection, not, however, without side effects. Antibiotics are no substitute for correct application of the principles of primary wound care and debridement.[5,23] In general, one can say that morbidity and mortality from cellulitis and septicaemia are much reduced by antibiotics in individual cases.[23] In general, the deleterious effects of antibiotics are supra-infection by resistant organisms, and the tendency to neglect the principles of surgical technique.[23]

The article which most clearly described the treatment of infection during the antibiotic era, is that of Brock in 1946-47.[24] His paper was on empyema, which he described as a mature abscess, the end result of an acute suppurative process. The stages of this process comprise an acute pleurisy, proceeding to a sero-purulent effusion which matures by the formation of thickening pus, and a limiting fibrous tissue encapsulation to the formation of an abscess; this is the pathological process seen in all body infections, and the assessment of the stage reached is vital in treatment. Brock then pointed out how penicillin had influenced this evolutionary process. Use in the cellulitic phase is more likely to be followed by successful abortion of the process, than in the later phase, when penicillin is ineffective. It is in the mature phase where surgical drainage remains the basis of treatment.

He goes on to describe the fundamentals of treatment of pleural (or any) infection; these are worth enumerating.

1 The correct time for drainage is when the abscess is mature, early drainage is unnecessary and dangerous. He lists clinical criteria which must be considered in the timing of drainage, such as the time since onset, temperature characteristics and so on
2 The provision of adequate drainage
3 Physical treatment, both general and respiratory, to maintain function, tone and stamina
4 When to stop drainage→when there is no longer clinical evidence of systemic infection, or demonstrable abscess cavity

Here is clearly summarised, both the place and dangers of antibiotics and drainage in the treatment of infection, wound or otherwise, anywhere in the body.

General Principles of Wound Healing

The study of wound healing has entered the era of attention more to host factors, particularly with regard to nutrition, morale, and rehabilitation. Surgeons are also developing, with the community, an investigation of the most difficult problem of wounds, that is, their prevention.

As it stands, the study of wounds is somewhat unclassified, and is piecemeal and static in its presentation. It is intended in this section to derive a classification of the process of wound healing. The problems presented in practice will be described within a framework which predicts the behaviour and response to treatment of most wounds. Generally, wound healing is presented as being of three varieties: First intention—primary union; Second intention—healing by granulation and Third intention—healing by secondary suture.[25] This classification does not show how to apply these principles; the scheme used here will be that wounds heal by what is called primary, secondary and tertiary principles.

1 Primary principles

Basic to wound healing are the three inter-related factors of the health of the host, the experience of the surgeon and sound management of the wound. Usually, experience is not included but it is vital and dependent upon a reliable system of training. The host factors of most importance are nutritional state and morale. A definitive study of general patient factors[26] showed that, in elective wound healing, the risk of infection increased with age, obesity and malnutrition, and especially with the degree of bacterial contamination of the wound.

Management consists of three main requirements. One is the presence of reliable aseptic methods. These are measures to reduce bacterial count and bacterial transfer to the wound, by thermal and chemical antisepsis of instruments, garments, dressings, drapes, skin at operation site, and so on, together with other barriers to bacterial transfer, including masks, gloves and wound

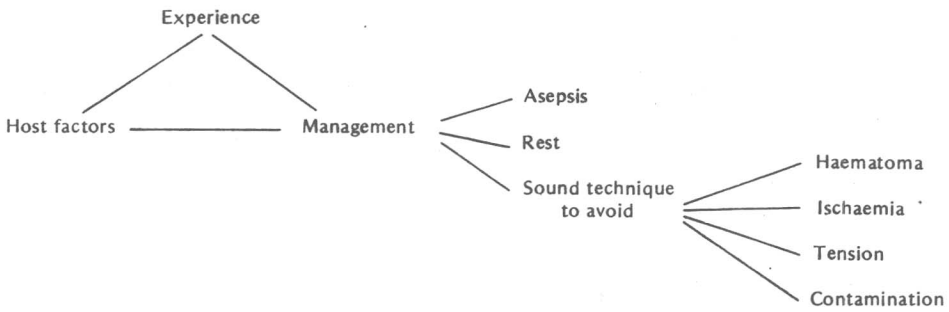

Figure 2.3 Primary principles of wound healing

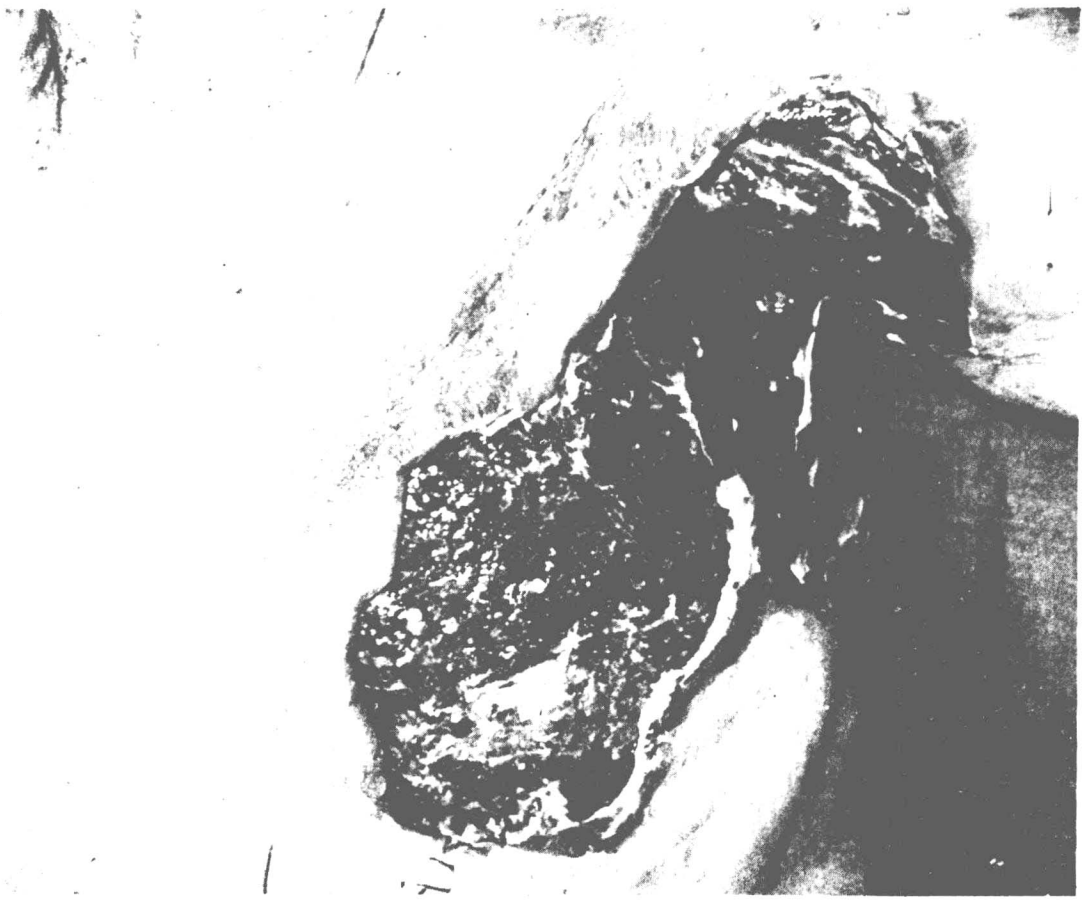

Figure 2.4 Failure of wound healing of radical mastectomy, 1960. This photograph illustrates, by negative example, the occasional consequences of failure to adhere to the principles of primary wound care. It was the custom to make every effort to excise widely and carefully, to the point of obsession, primary carcinoma of the breast. In the process, skin flaps were devascularised and sewn together under tension. There was a large dead space difficult to drain and, in this case, wound healing failed