Handbook of Intensive Care

Edited by

W. H. Bain

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Preface

We believe that this is an appropriate time to produce a handbook of intensive therapy practice. The initial phase of development in intensive therapy, as with all developing specialties, has brought with it a variety of opinion and practice and a somewhat alarming rate of growth. Most authorities would agree that the pioneering phase of intensive therapy has now given way to a longer period in which a broad consensus has appeared. This is not to say that controversy has ceased to flourish, for there is more than a grain of truth in the idea that when an issue ceases to be controversial it ceases to be interesting. Rather, the picture now is of continual refinement of well-established techniques and lines of therapy, in which increasing inroads are being made not only in terms of mortality figures but even more so in terms of reducing the morbidity associated with life-threatening illness.

No textbook may claim to be sufficiently comprehensive or authoritative in the vast area of intensive therapy practice. However, the multi-disciplinary approach to intensive therapy is reflected in the choice of authors in this handbook. They have been selected not only for their expertise and knowledge of a particular aspect of intensive therapy, but because their experience has been gained over many years as clinicians actively involved in general intensive therapy units.

The handbook has been compiled with an emphasis on practical patient care. Where management régimes are proposed, details of the author's preference and dosage are included as well as a discussion of alternative management régimes. Each author has been encouraged to discuss in some detail the broad principles of pathophysiology and of therapy, since an appreciation of these foundation stones of intensive therapy practice allows for the assimilation and integration of future developments.

The editors are grateful to the contributing authors for their efforts to keep to the systematic style suggested to them.

Mr Roy Baker has, on behalf of the publishers, maintained a keen and valued interest in the textbook as it has materialised. Mrs Jane Sugarman's expertise in reviewing and organising the original manuscripts has been invaluable.

The editors wish to thank Mrs Jean Kennedy for secretarial assistance, and the medical photographic departments in the Royal and Western Infirmaries, Glasgow, for their help with the illustrations.

Finally, our thanks must go to our medical, nursing and technical colleagues, with whose help and in whose company intensive therapy practice continues to progress.

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Chapter 1

Principles of Intensive Therapy

W. H. Bain and K. M. Taylor

The word 'intensive' implies a concentration of effort. This emphasizes the important point that intensive therapy is not an alternative type of medical care, but merely a concentration of existing techniques of diagnosis, measurement and treatment, in the presence of life-threatening, but potentially curable, pathology.

Intensive therapy units have evolved over the past 30 years as the logical result of the concept of 'progressive patient care'. Even before this label was applied, progressive care was seen, in practice, in the 'Nightingale' wards. Those patients requiring most care, either as a result of their illness itself or of necessary therapeutic intervention, would be sited nearest to the nurses' station. The degree of recovery could be traced accurately thereafter, progress up the ward being directly proportional to improving health. In the 1960s, patient care areas within a ward became designated as Intensive, Intermediate or Convalescent. Also at this time, certain specialties, e.g. cardiac surgery, cardiology and renal medicine, found it more efficient and expedient to train their staff to apply newly available techniques in purpose-built units.

Recognition of the value of such concentration of expertise and necessary equipment, both in terms of patient care and of economics, led to the inclusion of the provision of specially designated Intensive Therapy Units in the Department of Health and Social Security's 1970 recommendations for new hospital buildings.

We have previously indicated that intensive therapy units are primarily concerned with patients suffering from life-threatening, but potentially curable, pathology. The life-threatening or critical nature of the pathology may be actual or potential, and is often associated with secondary pathological effects on other organs or systems. In addition, the critically ill patient frequently exhibits disorders of essential homeostatic mechanisms,

for example water and electrolyte imbalance, acid-base disorders and haematological disturbance. The multisystem pathophysiology associated with critical illness is reflected in the awareness of the need for a multidisciplinary approach in intensive therapy. Unfortunately, the early emphasis on artificial ventilation as the major feature of intensive therapy led to an unwarranted assumption by others that intensive therapy units were the proper domain of anaesthetists and that anything more than a short visit every day was tantamount to territorial invasion. Thankfully, the determined efforts of the early intensive therapy clinicians to break down these artificial barriers have largely been successful, and a multidiscipline approach to intensive therapy is now widespread with inevitable mutual benefit. Incorporation of intensive therapy experience in training schemes for general medical, surgical, anaesthetic and laboratory medical staff has done a great deal to encourage familiarity with, and continued involvement in, intensive therapy practice.

Progress in intensive therapy over the past 10–15 years has been considerable. The critical nature of the illness or pathology inevitably present results in relatively high mortality figures. These mortality statistics have, however, greatly improved during this period, and continue to fall. Furthermore, increasing attention is being paid towards reducing the high morbidity associated with critical illness or trauma. Intensive therapy practice has, commendably, been accompanied by continual evaluation of results of therapy, and a constant search for improved methods of selection of patients likely to benefit from intensive therapy. Such self-assessment has allowed the definition, however arbitrary, of principles of intensive therapy practice. These include the following:

1. Selection of patients requiring intensive therapy.
2. Initial resuscitation and transfer to the intensive therapy unit.
3. Establishment of measurement and monitoring techniques.
4. Assessment of priorities in therapy.
5. Application and monitoring of primary and secondary therapy.
6. Use of system support or system replacement techniques where indicated.
7. Transfer and rehabilitation of convalescent patients.

At the present time, selection of patients for admission to an intensive therapy unit (ITU) is usually based on clinical judgement and experience. Recognition of the presence or potential development of a critical illness associated with severe physiological disturbance must be accompanied by the expectation of amenability to appropriate therapy and the possibility of a successful outcome. The search continues for an objective, quantitative method for accurate selection of patients most likely to benefit from intensive therapy admission. Several multivariant predictive indices are currently under investigation, and may be helpful to the clinician in quantitating and even predicting the likely overall effect of the primary pathology and secondary complications present in any patient.

In the acutely ill patient, initial resuscitation is of vital importance in restoring some degree of physiological stability in order to 'buy time' for a full assessment of the patient's condition. The shocked patient is an excellent example, where restoration of optimal perfusion and empirical correction of perfusion-related acid–base disturbance must take precedence over detailed investigation. Resuscitation techniques have developed in parallel with intensive therapy, not only in relation to initial presentation, but also in the course of the intensive therapy stay where acute episodes may occur. Successful initial resuscitation should be associated with rapid but controlled transfer of the patient to the ITU. Recent reports have drawn attention to the importance of the transfer phase in critically ill patients, whether within the confines of a particular hospital, or over much greater distances requiring the use of specially equipped and manned transfer ambulances or 'mobile intensive therapy units'.

The establishing of appropriate monitoring and measurement is of fundamental importance in intensive therapy. Lord Kelvin observed in 1889 'when you can measure what you are speaking about and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind'. Selectivity in the choice of parameters to be monitored and measured should be practised, since 'blanket-measurement' of every conceivable measurable index is wasteful, confusing and may impair patient management. Such selectivity requires clinical awareness of the values and limitations of the indices chosen, and is best achieved by continual communication and co-operation between ITU clinicians and laboratory staffs. The biochemist, haematologist, bacteriologist and radiologist should be integral members of the intensive therapy team. In addition, many of the ITU monitoring techniques presently used require sophisticated electronic equipment, and accurate calibration and regular maintenance are necessary in order to ensure optimal sensitivity and reproducibility of desired information. Though current monitoring techniques may appear complex, requiring considerable expertise on the part of physicists and technical staff, there is a continual search for non-invasive monitoring techniques of increased simplicity.

When the critically ill patient has been resuscitated and transferred to the ITU, the initial presumptive diagnosis may be confirmed and the patient's overall clinical status assessed by clinical examination and the information gained from measurement and monitoring. It is then necessary to set out priorities in therapy, to identify and if possible anticipate and prevent the development of complications secondary to the primary pathology. For example, the patient with acute peripheral circulatory failure due to low cardiac output requires immediate optimalization and maintenance of cardiovascular status, while the secondary effects of the low output on brain and kidney, while of significance, are of less immediate priority. Assessment of priorities in therapy and appreciation of the pathophysio-

logical effects of particular pathological conditions demand a high degree of clinical judgement, and considerable experience.

Despite the apparent emphasis on measurement, monitoring and on an awareness of pathophysiology, intensive therapy remains an exercise in therapy. Treatment is, or should always be, what is concentrated upon in the ITU. Furthermore, such treatment is not necessarily of a complex nature, rather that in the presence of a life-threatening situation, the treatment should be appropriate to the condition, adequate in terms of effective dosage at the pathological site, and administered at the optimal time in relation to the time-course of the underlying pathological process. Ideally, the treatment chosen should not be associated with the development of, or aggravation of, secondary complications. This last point is not possible to achieve in every situation.

We believe it to be important to differentiate primary from secondary therapies.

Primary therapy is that directed towards the treatment of the underlying, primary pathology.

Secondary therapy is that directed towards the protection of other vital organs or systems which are secondarily affected by the malfunction of the organ or system affected by the primary pathology. (For example, in acute low cardiac output, adrenaline may be given as a primary therapy, and mannitol infused as a secondary therapy designed to give some degree of renal protection from hypo-perfusion.) The terms primary and secondary do not imply that one is more important than the other, or even that one should be administered before the other in terms of time. It is of great importance, however, that there should be maximal understanding of the nature and anticipated benefits of every treatment given. In addition, the effects of therapy should be carefully monitored, as should meaningful assessments of their biological activity and hence adequacy of dosage.

The application of appropriate therapy may produce the expected improvement in the patient's condition. However, the progress or even the initial severity of the pathology may produce life-threatening malfunction of a vital organ or bodily system, for example respiratory insufficiency in the presence of severe pneumonia. In such a situation, mechanical system support may be necessary until a sufficient improvement in the patient's own system function has occurred. Techniques for respiratory support, circulatory support (the intra-aortic balloon pump), renal dialysis and haemo-perfusion in hepatic failure, are presently available and in widespread use in intensive therapy practice. Where recovery of the patient's failing system is anticipated, such system support techniques are of immense value in the critical phase of the patient's illness. Where the patient's own system fails completely, or where recovery does not occur, system replacement techniques may be feasible. Homotransplantation techniques continue to develop, and mechanical prostheses, e.g. artificial

heart, are also being developed, though such devices are at present largely experimental.

The final principle of intensive care practice concerns the transfer and rehabilitation of successfully treated, convalescent patients. The timing of discharge from the ITU is perhaps of similar importance to the selection of patients for admission. Most ITU patients are transferred back to a general medical or surgical ward, where the nature of medical and nursing care, though no less valuable, must of necessity be less concentrated. The difficulty in discharge timing is indicated by many series reporting the death of several patients after discharge from the ITU, and emphasizes that the provision of 'intermediate' care may be necessary in certain patients.

As previously indicated, principles of intensive therapy practice tend to reflect the personal experience and prejudice of those who propound them. We have, in this textbook, attempted to reflect our appreciation of these broad principles in the choice of authors, subjects and in the overall presentation of the text. The multidisciplinary nature of intensive therapy is reflected in the wide-ranging experience of the authors. The importance given to measurement and monitoring is seen in those chapters devoted to general aspects of haemodynamics, biochemistry, haematology, bacteriology and radiology. In addition, specific mention of appropriate tests and measurements is included in the systematic chapters, where their particular value in the context of particular bodily systems is emphasized. Multi-author textbooks suffer inevitably from the different textual styles of the various authors. While not enforcing a rigid discipline of style, we have suggested to contributing authors of the systematic Chapters 12–22, a rough framework in order to produce some uniformity in the 'systematic approach'. The principal syndromes necessitating intensive therapy are outlined; techniques of measurement and monitoring appropriate to that system are described; pathophysiological mechanisms are discussed in relation to the primary pathology and to the development of secondary complications; therapy is described and classified where appropriate as primary or secondary; finally system support or replacement techniques are detailed where such techniques exist.

The dictionary offers as one definition of principle 'fundamental truth'. This is clearly unsatisfactory in relation to the constantly evolving nature of intensive therapy. We prefer to take the dictionary's alternative of 'a general law as a guide to action, as a basis of reasoning'. For inherent in that definition are thought and action, and the suggestion of forward movement.

Chapter 2

Logistics of Intensive Care

A. B. M. Telfer

INTRODUCTION

Progressive Patient Care

With the advent of intensive care units in the 1960s the concept of progressive patient care was complete. For many years it has been accepted that patients require going through a period of less intensive care, known as convalescence, *following* illness or operation; the increasing complexity of surgical procedures and the availability of complex life support systems made it necessary to manage the most severely ill patients in special units during the acute phase of their illness. Thus intensive care units (ICU) were developed and patients progress from these to intermediate care wards and finally to convalescent wards offering little more than hotel care.

A number of patients inevitably need long-term care, such as those who remain unconscious following a head injury, or who require long-term respiratory support. The Scandinavian poliomyelitis epidemic of 1952 was probably one of the earliest examples of this, with patients continuing to require mechanical assistance to ventilation for many years after their initial illness. The provision of facilities for this type of care has a direct bearing on the work of the acute intensive care unit, since their absence can lead to patients having to remain in the acute unit for much longer than is desirable.

Mobile Intensive Care

Events prior to admission to intensive care obviously have a profound effect, not only on the patient's eventual recovery, but also on the quality of