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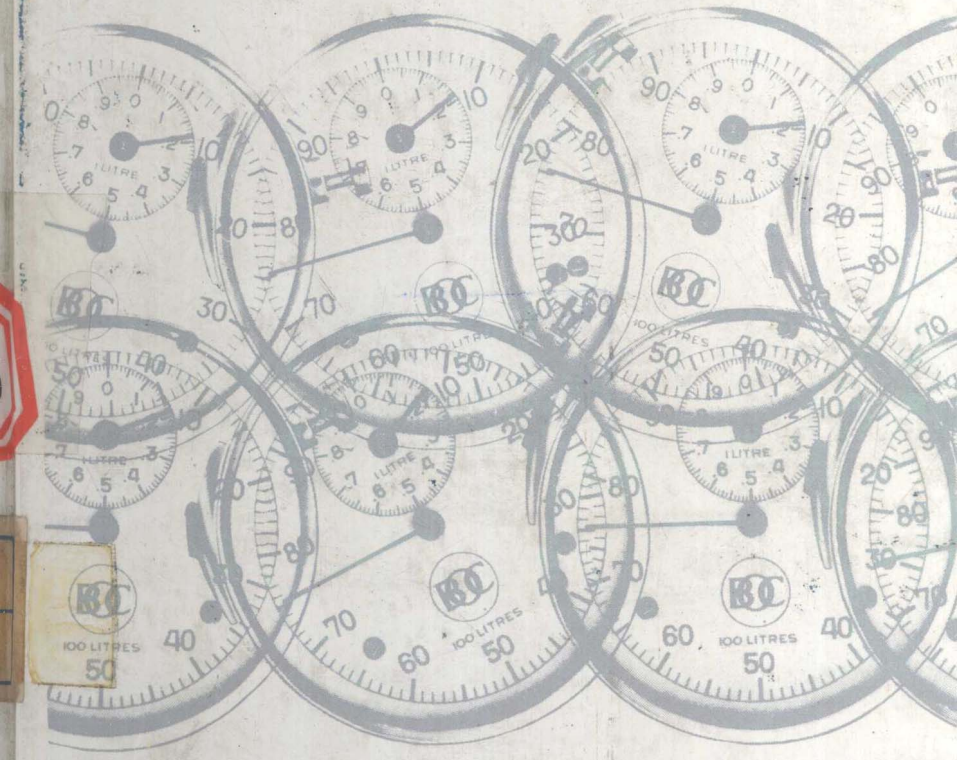

TOPICS IN ANAESTHESIA AND INTENSIVE CARE

for undergraduates

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TOPICS IN ANAESTHESIA AND INTENSIVE CARE

This new book provides a practical introduction to the principles of anaesthetics and their application.

Particular emphasis is given to the physiological principles of respiration, to disturbances in fluid and electrolyte function, and to the effect of drugs on the body. In this way the student, by applying his scientific knowledge to the problems presented to him by the patient, can learn to select sound priorities and develop his clinical skills. Special problems posed by coexisting illness or medication are discussed in relation to the physical and mental stresses of the operation. The important problem of pain, both postoperative and chronic, is discussed.

A section is devoted to the special problems requiring intensive care, notably respiratory and cardiac insufficiency, and burns. The lists of normal values, electrolyte content and energy value of common intravenous fluids, and symbols used in respiratory physiology, will be of constant service.

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PREFACE

This book has been written for the undergraduate medical student on anaesthetic attachment. During this time he has one of the few opportunities during training to perform practical manoeuvres on patients, and the book, though largely a practical guide, incorporates theoretical background where such amplification is required, our aim being to assist him to gain the most from the period of anaesthetic clerkship. He should during this time acquire many skills essential to the practising doctor of any discipline, such as intravenous injection and cannulation, care of the unconscious patient and cardio-respiratory resuscitation, and we explain both the methodology and theory of such skills.

It is our hope that by stimulating an interest in the specialty of anaesthesia and giving an insight into the problems of the anaesthetist, this publication will encourage the reader to consider further study of the subject after qualification as well as being beneficial to his overall training as an undergraduate.

Sheffield 1978

J. A. Thornton
C. J. Levy

Painting of an amputation performed before anaesthetics were developed

Painting by Keller commemorating Morton's operation on Abbott in October 1846

HISTORICAL NOTES

Before the 19th century, when surgery was undertaken the only means of ensuring a relatively immobile patient was by means of physical restraint. Very slight relief of pain and mental torment was occasionally offered through alcohol or opium. As a surgeon who had had his leg amputated once wrote to a brother surgeon about this time, 'the dreadful blackness of spirit that descends upon the patient when he feels himself forsaken not only by man but by God Himself, cannot adequately be described'. To be fair, attempts to allay pain by applying ice to the limb and producing ischaemia by applying a tourniquet were occasionally made. Surgery was, perforce, confined to the external aspect of the body or the extremities, although one or two successful Caesarian sections are believed to have been performed.

In 1800 Humphry Davy, better known for his discovery of the miner's safety lamp, reported on the relief of pain of an unerupted wisdom tooth by the inhalation of nitrous oxide. Some forty years later (1844) an American dentist called Horace Wells received nitrous oxide at his own request for the extraction of a tooth. A former partner, William Thomas Green Morton, made history with his public demonstration at Massachusetts General Hospital of diethyl ether administration. (His claim to be the first user of this substance for anaesthetic purposes was disputed by Crawford Williamson Long, who claimed to have used it in 1842.)

News of this wonderful event rapidly spread across the Atlantic, and on 19 December 1846 diethyl ether was administered in London for the removal of a tooth, and three days later a leg was amputated from a patient under diethyl ether at

University College Hospital, London. The anaesthetist was a Mr Squire and his surgeon was Robert Liston. Here, once again, there is some dispute, as a counter-claim exists for the honour of administering the first ether anaesthetic in Great Britain.

In 1847 a chemist, David Waldie, directed the attention of James Simpson, Professor of Obstetrics at Edinburgh University, to the possible value of chloroform as an anaesthetic agent. Its anaesthetic properties were confirmed when Simpson invited his guests at a dinner party to inhale the vapour of chloroform.

Nitrous oxide, diethyl ether and chloroform became the mainstay of anaesthetic practice far into the 20th century.

Local anaesthesia owes its beginnings to the discovery of the action of cocaine by Koller in 1884. Its toxic effects stimulated research into the development of safer and safer products. The first spinal subarachnoid anaesthetics were given by Corning, and later Bier, before 1889.

A great advance in patient acceptability to general anaesthesia occurred with the advent of barbiturates. The intravenous injection of hexobarbitone (Evipan) in the mid-1930s, soon to be followed by thiopentone (Pentothal), heralded a new approach to anaesthetic practice. In the 1940s, with the introduction of curare, a revolution took place in the whole concept and practice of anaesthesia. The idea of balanced anaesthesia had arrived (see p. 41).

At the turn of the century the possibilities and advantages of endotracheal intubation had been realised, but did not come into common use until the First World War, when Magill and Rowbotham used intubation to facilitate anaesthesia for plastic surgery in war casualties.

In the 1950s a large outbreak of anterior poliomyelitis occurred in Denmark. Lassen of Copenhagen employed relays of medical students to apply intermittent positive pressure ventilation (IPPV) to the lungs of paralysed patients. As a result of this therapy many patients survived who would have died as a result of lack of 'iron lungs'. This breakthrough in the understanding of the management of paralysed patients stimulated the development of artificial ventilators and intensive care units.

1 THE PREOPERATIVE ASSESSMENT AND PREPARATION OF THE PATIENT

Contrary to the practice of the general physician or surgeon, the anaesthetist has only a short time in which to assess each patient before operation. During this time he must decide whether the patient is in an optimal state for anaesthesia and surgery, how to attain this state if it does not already exist, and the possible consequences of the anaesthetic and the operation on that patient. One way of avoiding the postponement of an operation is for the anaesthetist to examine the patient at the outpatient clinic before admission. The success of such an arrangement depends upon the degree of co-operation between the anaesthetist and surgeon, and the facilities and staff available. In most cases the patient is visited in the ward by the anaesthetist at least 24 hours before the operation.

No anaesthetic should ever be given unless an anaesthetist has visited the patient and assessed him.

CASE HISTORY

It is clearly impossible to obtain a comprehensive history in the time available, but with experience the salient points can be elicited by means of leading questions.

Points that must be covered are:

History of previous illnesses and operations.

Evidence of cardiovascular and respiratory decompensation, e.g. exercise tolerance and factors provoking breathlessness.

Cough and sputum.

Details of past and present drug therapy.

Sensitivity to drugs and previous anaesthetics.

Allergies and family history of adverse reactions.

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History of smoking and alcohol intake.
Anxiety and apprehension.

EXAMINATION

The physical examination will be brief but thorough. The experienced doctor can assess a patient very rapidly whilst taking the history, e.g. posture, ease of respiration, distended neck veins, swelling of ankles, etc., colour (anaemia or cyanosis), perspiration, texture of skin, nicotine staining of fingers, presence of tremor and clubbing. Such a simple procedure as holding the patient's hand and at the same time feeling the pulse will reveal abnormalities in rate and rhythm, state of the vessel wall, care of the hands and nails, clubbing, arthritis and tremor.

If there is any doubt as to exercise tolerance, simple tests such as alternately sitting up and lying down may be applied to assess this. Only experience can dictate the normal for these tests. Movement of the neck and the degree of opening of the mouth must be assessed, together with the presence and state of the teeth. It is too late to discover that the patient cannot open his mouth or has loose teeth once he has been rendered unconscious. The venous system should be examined for cardiovascular decompensation, and for suitability of subsequent venepuncture. Oedema over ankles and sacrum should be sought. Heart and lungs must be examined, and the presence of any enlargement of the heart or unusual sounds in heart or lungs carefully noted. Adventitious sounds may infer the retention of secretions and presage trouble in the postoperative period, as may the wheezes associated with bronchospasm. Basal crepitations may indicate left ventricular failure or hypostasis. The blood pressure must be taken.

The preoperative assessment must elucidate the presence or absence of respiratory decompensation (breathlessness and/or cyanosis), sputum production, and any tendency to bronchospasm. Such conditions indicate chronic bronchitis and emphysema, bronchiectasis, asthma, and respiratory obstruction such as may exist in some cases of enlarged thyroid, etc. Acute upper

respiratory tract infection is a contraindication to anaesthesia unless the surgery is for an urgent condition, when anaesthesia should be given under antibiotic cover. The heavy smoker has a greater chance of developing postoperative chest complications and should be discouraged from indulging this habit for a few weeks before surgery. We believe that it is of little value to prohibit smoking for only a day or two preoperatively, as this can but increase the patient's anxiety by adding withdrawal symptoms to his natural apprehension.

A chest X-ray should be requested if there is any doubt about the patient's chest condition, but routine preoperative chest X-ray in patients below the age of 40 years, who appear normal on physical examination, is unlikely to reveal serious abnormality.

Analysis of the urine for sugar and albumin is a routinely performed test on all patients admitted to hospital. Further investigations include estimation of the blood haemoglobin concentration, and in certain cases blood electrolytes and electrocardiography. Patients of some pigmented races (viz. African, West Indian, and those of Eastern Mediterranean origin) may have an abnormal haemoglobin, and a sickle-cell test should be carried out on all those thought to be at risk (see below). Some normal haematological values will be found in chapter 8.

If this preoperative assessment has led to the suspicion of serious abnormality, further investigations must be carried out and appropriate measures instituted (see p. 12).

It is the anaesthetist's duty to ensure that the patient is in an optimal state in relation to the severity of the condition requiring surgery. It would, for example, not be in the patient's interest to postpone surgery for some days or even hours if an ectopic pregnancy had ruptured, producing uncontrollable bleeding.

COPING WITH CONCURRENT DRUG THERAPY

Many patients are receiving drug therapy for some existing disorder. Drug interactions are common and well recognised.

Because in some instances the patient is unable to identify his drugs, a drug history enquiry form is invaluable. Such a form is sent to the patient at the same time as he is given a date for admission, together with instructions to take it to be completed by his family doctor. Experience has shown that this arrangement works well.

Steroids

Steroid therapy is used to treat many conditions such as asthma, rheumatoid arthritis, certain skin diseases and ulcerative colitis. The danger lies in the fact that steroid therapy may depress adrenal cortical function, as a result of which there may be inability of the adrenal gland to secrete sufficient cortisol in response to the stress of the operation. Even a single intra-articular injection of a steroid has been followed by adrenocortical suppression.

Until recently patients who had received steroids within two years of the operation were deemed to require additional steroid cover. More recently, however, therapy within the previous two months only is considered to be an indication for this cover. If any doubt exists as to the ability of the adrenal cortex to respond to stress it may be challenged directly by a synthetic ACTH-like substance, Synacthen, and the rise of plasma cortisol estimated. A failure of the pituitary–adrenal axis may also lead to a lack of response to stress. The pituitary–adrenal axis may be challenged, producing controlled hypoglycaemia, by the administration of insulin. Should additional steroid cover be necessary, a six-hourly dose of 100 mg hydrocortisone hemisuccinate intramuscularly produces the most consistent blood levels.

Contraceptive pill

There is substantial evidence that patients taking the 'Pill' have an increased tendency to postoperative thromboembolism. There is a conflict of opinion as to whether medication should be discontinued for at least a month before operation: on the one hand this would nullify its effect on the blood clotting

mechanism, but on the other hand there is the risk of a pregnancy resulting, which is in itself an increased risk. One view is to leave the patient on the 'Pill' and to administer subcutaneous heparin in small doses or intravenous dextrans, and to encourage early postoperative mobilisation.

Antihypertensive agents

The hypertensive patient stabilised on antihypertensive drugs should continue therapy over the operative period. Patients receiving β-adrenergic blocking agents are likely to have an exaggerated depression of myocardial action if a general anaesthetic agent with a marked myocardial depressive action is used. Diethyl ether in particular should not be used in these cases. Some anaesthetists advise that β-blockers should not be given for 12–24 hours before induction.

Patients with hypertension, whether treated or untreated, tend to have excessively labile blood pressures in response to general anaesthetic agents (see below).

Diuretics

Patients may be treated with diuretics for a variety of reasons, including cardiac decompensation and hypertension. Unless adequate amounts of oral potassium are given concurrently the total body potassium may be depleted, and under such circumstances the patient may have an abnormal response to muscle relaxants.

Digitalis

Digitalis increases myocardial tone and delays conduction in the AV bundle. With halothane and suxamethonium excessive bradycardia may occur.

Narcotics, sedatives, and tranquillisers

Many of these drugs potentiate the effect of general anaesthetics, but exceptions do occur. Further, some are anti-analgesics (they lower the pain threshold), for instance promethazine and the barbiturates. Preoperative phenothiazines make patients

more susceptible to hypotension with the intravenous barbiturates, and also more susceptible to blood loss because of the tendency of the phenothiazines to cause vasodilatation. The barbiturates produce induction of liver microsomal enzymes and may increase the biodegradation of certain agents used in anaesthesia, thus producing tolerance and cross-tolerance. Chronic intake of alcohol can produce similar effects. In addition, alcoholism can be associated with severe liver damage resulting in abnormal response to muscle relaxants.

Psychotropic agents

There are many substances used in the treatment of psychiatric conditions, including the phenothiazines, benzodiazepines, monoamine oxidase inhibitors (MAOIs), and tricyclic antidepressants.

Tricyclic antidepressants. These drugs can give rise to a 4- to 8-fold potentiation of noradrenaline, a 2- to 4-fold potentiation of adrenaline, and a similar potentiation of other pressor agents. Patients receiving tricyclic antidepressants may have dysrhythmias during general anaesthesia. Self-induced overdosage produces marked cardiac excitability (see p. 102).

Monoamine oxidase inhibitors. Monoamine oxidase is responsible for the oxidation of 5–HT and noradrenaline. Patients who are receiving monoamine oxidase inhibitors have an exaggerated response to certain pressor substances, e.g. phenylephrine, and to the narcotic analgesics such as morphine, pethidine, pentazocine and phenazocine. This exaggerated response may be associated with great lability of blood pressure and, in the case of the analgesics, with respiratory depression. Certain tricyclic antidepressants are potentiated by the monoamine oxidase inhibitors. In view of these potentially serious inter-reactions it is customary to suspend MAOI therapy for at least 14–21 days preoperatively. If this is not possible, the anaesthetic should be such that all pressor agents and narcotic analgesics are avoided.

Lithium. This substance is used in the management of manic-depressive states. There have been a number of reports

of prolonged action of anaesthetic agents and muscle relaxants in patients receiving such therapy.

Narcotic addicts

This is unfortunately an increasing problem throughout the world. The patients are often of poor physique, and may have liver and kidney damage and damaged veins. They exhibit cross-tolerance to anaesthetic agents, particularly if addicted to the barbiturates. Withdrawal symptoms may also be encountered. The patient should not be deprived of his sustaining narcotic before, during or after anaesthesia. It should be noted that certain analgesics are narcotic antagonists, e.g. pentazocine, and the administration of this drug in particular may provoke withdrawal symptoms in a narcotic addict.

Antibiotics

Approximately nine antibiotics have been incriminated as causing potentiation of the effect of neuromuscular blocking agents, particularly if the antibiotic is administered in large quantity onto serosal surfaces, viz. the peritoneal and pleural cavities. In some instances their action can be reversed by the administration of calcium together with neostigmine.

Anticholinesterases

Many agents used in medicine have such an action. These include ecothiopate iodine eye drops (used in the management of squints and narrow angle glaucoma), certain anticancer agents (cyclophosphamide, thiotepa, and mechlorethane), immunosuppressive drugs (azothioprine), tetrahydroaminacrine (THA) which is used to antagonise the respiratory depressant effect of morphine, and aprotinin (Trasylol) which is sometimes used in the management of acute pancreatitis and fat embolism. Such drugs may prolong the effect of suxamethonium.

Levodopa

Parkinsonian-type symptoms are due to a deficiency of dopamine in the basal ganglia. Levodopa, used to control these

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