

THE NOVA SCOTIA MEDICAL BULLETIN

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This issue contains a
Symposium on Anaesthesia
based on papers presented
at the Atlantic Regional
Meeting of the
Canadian Anaesthetists' Society,
St. John's, Newfoundland,
September 1967.

Coordinating Editor: Dr. David Shephard

Anaesthesia in the Atlantic Provinces

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The presentation of this symposium by anaesthetists of the Atlantic Provinces is in itself significant. It points to the increasingly important role which the specialty and its practitioners are playing in the medical and surgical care of patients in this part of the world.

The subjects covered in this symposium are largely those presented at the Annual Regional Meeting of the Canadian Anaesthetists' Society of the Atlantic Provinces held in St. John's, Newfoundland, last autumn. These meetings, of which this was the seventh, have been held regularly at various centres in the Atlantic Provinces and have grown in stature over the years both in the quality of papers presented and the number of doctors in attendance. The members of the joint divisions of the Canadian Anaesthetists' Society in the Atlantic Provinces are happy to present to the members of The Nova Scotia Medical Society this symposium and hope that the subjects treated are of such a broad nature as to be of general interest to all readers.

Advances in medical science are progressing at such a rapid rate that within the past twenty years there has been an almost complete change in the practice of anaesthesia and doctors practising in this field need constant refreshment and renewal. The regular attendance at regional and national meetings cannot help but make one appreciate the nature and rapidity of these changes. For many years anaesthesia was limited to the subduing of patients for surgical interventions and very little, if any, emphasis was laid on the proper maintenance of physiological normalcy in the major body systems. With the coming of a deeper understanding of various body functions and subsequently the management of malfunctions it has become necessary for the modern anaesthetist to become what has been described as the internist of the operating and post-operative recovery rooms. This is most obvious when one considers the great number and variety of surgical and diagnostic procedures now being carried out on the very young, the very old and the very ill patient.

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Anaesthetists are constantly presented with a full spectrum of abnormal body functions related to the disease, the surgical procedure and the drugs which they themselves use to carry the patient through the particular illness and operation. In order to cope adequately with this wide variety of problems it is essential that the anaesthetist be very broadly trained. Although technical expertise is considered a *sine qua non* of the expert, the individual must resist the temptation to become a mere technician and must keep abreast of changes in knowledge and technique and be malleable enough to apply these changes so that they will help to improve the care of patients entrusted to him.

Anaesthesia in the Atlantic Provinces, we believe, has kept up to date and in fact certain advances have been introduced by anaesthetists in the first instance. Some of these were post-anaesthesia recovery rooms, followed more recently by intensive care units, inhalation therapy departments and resuscitation teams. In these areas the anaesthetist has become recognized as a leader and plays a large role in the teaching of programs for the treatment of shock, respiratory disorders and resuscitation to both medical and paramedical personnel.

A rough survey of the health department statistics in the Atlantic region reveals the surprising fact that approximately two hundred thousand (200,000) anaesthetics are administered in the four Atlantic Provinces annually. Of these it is estimated that from fifty to sixty percent are administered by fully trained specialists. These figures would point to the fact that, if we believe that every patient deserves anaesthesia supervised and administered by fully trained specialists we still have a lot of work left to be done. Having said this, we should hasten to commend those of our colleagues doing part-time anaesthesia, who are doing an excellent job, often under adverse conditions. Those of us who for economic and population reasons have ample scope to practise the specialty full time have a responsibility at all times to encourage part time physicians interested in anaesthesia to obtain more training.

For many years in the Atlantic Provinces there were several individuals known to many of us who pioneered the specialty of anaesthesia, but it was not until about twenty years ago that an organized teaching program was started at Dalhousie University Medical School. Graduates of this training program have made themselves felt throughout the Atlantic region and many have settled in distant parts of Canada and in fact throughout the world. Undoubtedly, they have made their presence felt in an upgrading of anaesthetic care wherever they have settled. In New Brunswick and Newfoundland training programs of a less ambitious nature have been going on for about fifteen years, and it

might be of some interest to note that a recent review of a residency program at the St. John's General Hospital (Nfld.) reveals that of thirty-seven residents who have passed through the program since 1955 thirty have continued on in anaesthesia and have been successful in obtaining Certification or Fellowship, or are presently qualified to write these examinations. Most of the anaesthetists in the province of Newfoundland at this time have had contact in some way with the training program at the St. John's General Hospital but others have unfortunately for us migrated to distant areas where economic and climatic conditions appeared to be more desirable.

Another important aspect of the overall training program in this area has been the series of refresher courses produced by the University staff primarily for part-time anaesthetists, or to express it more clearly family physicians who do some anaesthesia. These courses have been run at least annually by the staff of Dalhousie University, and have always been popular and useful. The Atlantic Regional Meeting of the Canadian Anaesthetists' Society has served as a refresher course for specialists in the field and has the added advantage of permitting the physicians involved to meet annually, and thus get to know one another's problems.

Furthermore the new medical school which is progressing rapidly at the Memorial University of Newfoundland will bring advances in anaesthesia education in this area. The formation of a full university department of anaesthesia and the inception of a full training program in the specialty of anaesthesia is being actively pursued and will undoubtedly lead to the provision of more and better trained physicians for the field of anaesthesia.

Recent surveys by The Royal College of Physicians and Surgeons of Canada reveal a large deficiency in numbers of physicians in the field of anaesthesia in Canada based on a suggested ideal of one anaesthesiologist per fifteen thousand population. This opportunity then should be taken to present a plea to those of you who may now be part-time anaesthetists, or students or internes contemplating a future career, to consider coming into this field, which has become a vitally interesting multidisciplinary specialty, one which if practised at a high standard provides physicians with a most satisfactory form of service to their patients.

In presenting this Symposium it is hoped that a picture will form highlighting some of the aspects of medical practice with which anaesthetists in the Atlantic region concern themselves. We thank The Medical Society of Nova Scotia for the opportunity of presenting this material and we hope that light has thus been cast on the vitally important role played by the specialty of anaesthesia in medicine today. □

Problems of Iatrogenic Disease

With Special Reference to Anaesthesia

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Advances in medicine all cause their own problems. These may be due to the increasing demands they make on nursing and medical staffs, and the money available or, as in the case of the recent heart transplant operations, their ethical implications. Some of these difficulties may be envisaged during the preliminary research and others become resolved in the course of time.

The past two decades have seen the introduction of many powerful drugs and this therapeutic volcano has produced the unique problem of drug side effects. This has assumed such magnitude that most countries have committees with power to limit the use of new remedies until they are satisfied with their safety. Regrettably deaths have resulted from these disorders, often because their true aetiology was not fully realised for some time. The prime example of this was the thalidomide tragedy in which sedatives taken by a mother during early pregnancy affected the in utero development of the child who was subsequently born with multiple deformities. These effects are called *iatrogenic*, or more correctly *iatrogenetic*, since they are "induced by the physician".

In some instances commonly used therapeutic agents produce undesired effects only when other drugs, such as anaesthetics, are administered or when the patient is subjected to severe stress (e.g. operation, sepsis, parturition). These are the subject of the present paper. Their danger lies partly in the difficulty in diagnosis, since many of these drugs have no obvious toxic effects in the conscious patient or else the complications which they cause are quite different from those normally associated with their therapeutic use. Furthermore, the iatrogenic effects of some agents may last for a considerable time after their administration has been stopped. Since this topic first came into prominence about 10 years ago, many drugs have been incriminated and the list is still growing. This brief survey cannot be expected to discuss all of them; however, it is hoped that it will show what kind of reactions can happen, and how unexpectedly they can occur. As with so many other medical conditions, when doctors are aware of the problem, they are well on their way to its solution, so that awareness of the enormous potential of iatrogenic disease should make catastrophes less likely, particularly for the occasional anaesthetist.

Iatrogenic disease, as a condition affecting the course of anaesthesia, first came into prominence with the introduction of the *hypotensive* drugs and the *corticosteroids*. The former upset the normal balance between the capacity of the vascular bed and the volume of its contents, while the latter may impair the body's ability to respond to the stress of anaesthesia and surgery. Most of the drugs which cause iatrogenic disease are given before the induction of anaesthesia, but recently there have been examples of drugs given routinely by surgeons and obstetricians affecting the course of anaesthesia. Thus physicians must know not only the therapeutic applications of the drugs they use, but also their toxicology.

Classification of Reactions

Before discussing individual drugs (or drug groups) it is worth considering the types of reactions which could happen and their significance.

- (a) prolonged narcosis: this is important in out-patients, possibly in obstetrics, but causes no real threat to life.
- (b) cardiovascular collapse: this may be dangerous depending on its severity and duration, prolonged hypotension damaging the brain and kidneys and cardiac irregularities carrying the risk of ventricular fibrillation.
- (c) respiratory depression: probably more of a nuisance than a threat to life; "prolonged curarisation" has been reported in patients who had not received muscle relaxants.
- (d) miscellaneous: including convulsions, pseudo Parkinsonism, vomiting and the great problem of yet unknown reactions.

Drugs

HYPOTENSIVE AGENTS: Irrespective of their exact mode of action, these drugs produce their therapeutic effect by a reduction of peripheral vascular tone. Thus it is not surprising to find that their hypotensive action can be augmented by general anaesthetics, all of which produce some degree of vasodilatation. Theoretically, the risk should be greater when thiopentone or halothane are used, because of their effect on circulating catecholamines. While more accidents were reported with

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the early hypotensive drugs, such as the *methonium compounds*, than with more recent preparations, this may be due to the greater awareness of the problem today. It must be remembered that the effect of hypotensive drugs lasts for several days after stopping treatment and that their action is increased during very hot weather. Should severe hypotension follow the administration of an anaesthetic given to a patient on hypotensive therapy, the initial treatment should be aimed at increasing the blood volume with dextran, plasma, lactate-Ringer's solution or blood as required, with recourse to vasopressors only as a last resort. Great care should be taken in the use of the latter as some patients may show sensitivity to nor-adrenaline, as occurs in patients who have undergone sympathectomy. The postural effects of hypotensive drugs must also be remembered and considered in the treatment of hypotension.

ANTIBIOTICS: These are recent additions to the list of drugs incriminated in iatrogenic disease associated with anaesthesia and their importance is limited almost entirely to major surgery carried out in hospital. In 1956 and 1957 there were reports of fatal apnoea following the instillation of *neomycin* into the peritoneal cavity^{1,2}. These occurred in patients who had received ether or non-depolarising relaxants (drugs of the curare type: tubocurarine, gallamine) and it is known that a large number of compounds can cause myoneural block of the curare type. This is long lasting and is potentiated by ethers and antagonised by neostigmine. In most reported cases apnea was evident at the end of anaesthesia or else respiratory depression occurred shortly after the end of surgery.

It is possible to incriminate (at least theoretically) a large number of antibiotics in these events. They differ greatly in their myoneural blocking activity, which partly depends on whether they are given preoperatively or by the intraperitoneal or intravenous routes during operation. In the absence of more precise information on the relative potency of the available antibiotics with respect to their ability to potentiate the neuromuscular effects of ether or relaxants care should be taken when any of the following are given: *neomycin*, *streptomycin sulphate*, *polymyxin B*, *kanamycin*, *viomycin*, *bacitracin* and *colistin*. Should prolonged apnoea occur following the rise of any of these in association with ether or curare, the effect of neostigmine (2.5-5.0 mg.) given with the appropriate dose of atropine (1.2 — 2.0 mg.) should be tried. Animal experiments³ and clinical reports⁴ show that under certain circumstances calcium gluconate may succeed in reversing the block and restoring respiration when neostigmine has failed. One must not imagine that the use of depolarising relaxants will entirely eliminate this risk since large doses or prolonged use of succinylcholine results in a type of neuromuscular block (dual block: phase two block) which

will be intensified and prolonged by either *neomycin* or *streptomycin*.

While it is established that large doses of both *neomycin* and *streptomycin* can cause neuromuscular block, this is unlikely to occur with the therapeutic doses employed in man. However, if the patient happens to be suffering from *myasthenia gravis* then muscular weakness may occur. Patients may not show clinical evidence of the disease but fall into the group of subclinical cases who react excessively to clinical doses of curare. This may explain the unexpected happenings in three reported cases⁴.

Antibiotic-induced iatrogenic disease is of general interest for a number of reasons.

- (a) It is a type of drug interaction not previously described in clinical literature.
- (b) It is of particular significance to those studying the effects of new drugs. Early pharmacological studies of one of the antibiotics suggested that, under appropriate conditions, the drug could augment the action of certain muscle relaxants, but the clinical circumstances when this was likely to occur were not appreciated.
- (c) The thoroughness with which these antibiotics and their effect on anaesthetics and muscle relaxants have now been investigated testifies to the importance attached to iatrogenic disease. The results have been reported in journals devoted to surgery, pharmacology, anaesthesia, and antibiotics as well as in general medical journals.
- (d) A review published in 1963⁵ listed 16 references to this event occurring since 1956. Now that the phenomenon is understood there have been virtually no reports in the past five years.

PHENOTHIAZINES: The word *Largactil*, one of the trade names for *chlorpromazine*, gives some indication of the multiple uses to which this group of drugs can be put. In view of their widespread effects on the body one might expect this group of drugs to head the list of those involved in iatrogenic diseases. This is not so and it is instructive to consider some reasons for this and the possible interactions that can occur.

Chlorpromazine, probably the first phenothiazine to gain wide popularity, was one of the most toxic. In addition to its oral use in psychiatric practice, it was frequently given intravenously by anaesthetists when its acute toxic effects were quickly observed and its hypotensive action was fully appreciated. Anaesthetists placed more emphasis on the toxicity of chlorpromazine than their surgical, psychiatric or medical colleagues, so that they were naturally very careful in the management of a patient on phenothiazine therapy.

The preoperative administration of any phenothiazine makes patients more susceptible to the

hypotensive action of general anaesthetics, particularly the rapidly-acting barbiturates⁷. They are also unduly sensitive to the effects of blood loss. This appears to apply whether patients are on long term therapy or receive a single preoperative dose as routine preanaesthetic medication or as an anti-emetic. Animals experiments point to a potentiation of barbiturate narcosis by some phenothiazines⁸, but if this were a factor of real importance many cases of delayed recovery should be reported in the literature by now.

Algesimetry studies carried out on volunteers by the author and colleagues show that some phenothiazines make patients more sensitive to some painful stimuli (so-called "antanalgesic" effect) and increase the incidence of involuntary spontaneous muscle movements, tremor or hypertonus following barbiturate induction.^{9,10} This effect is so marked following methylated barbiturates, that it is unwise to give *promethazine* (Phenergan), *perphenazine* (Trilafon), *fluphenazine* (Moditen) before induction with methohexital (Brevital) and they must not be combined with scopolamine⁹. The above effect has only been observed following intramuscular injection of the phenothiazines and is unlikely to occur following their prolonged oral administration. They are of clinical importance in anaesthesia for minor surgery in ambulant patients - often outpatients. Here one may prefer methohexital because of its brevity of action and some patients may receive anti-emetic premedication as a result of a history of previous postoperative vomiting.

Chronic administration of phenothiazines - like that of any other sedative - results in tolerance to their soporific effects and this may cause cross tolerance to the action of intravenous barbiturates. The extent of this varies from patient to patient and while it does not always occur anaesthetists must be aware of the possibility of its happening. About 1 : 100 patients on long term chlorpromazine develop liver dysfunction of the obstructive type which may result in prolongation of the action of opiate analgesics (including their respiratory depressant action). This can also cause resistance to the non-depolarising relaxants (curare, gallamine) or sensitivity to succinylcholine.

The extrapyramidal effects, which are most common following the use of phenothiazines with a piperazine side chain, are worth mentioning as the advice of anaesthetists may be sought in their diagnosis and treatment or, on the other hand, they may be responsible for their occurrence. The most distressing effects are oculogyric crisis, restlessness or other dystonic muscle movements and they respond rapidly to the intramuscular injection of 25-50 mg. promethazine. The phenothiazines most commonly involved in their occurrence are *fluphenazine* (Moditen), *perphenazine* (Trilafon), *thiethylperazine* (Torecan) and *trifluperazine* (Stelazine). Attention should be drawn to the occurrence of these

complications associated with two new drugs which are becoming increasingly popular in anaesthetic practice and as anti-emetics, viz. *haloperidol* (Haldol) and *dihydrobenzperidol* (Droperidol). These side effects occur less frequently and are less severe when the drugs are given with an opiate.

OTHER TRANQUILLISERS: The problems of cross tolerance with most other tranquillisers is similar to that for the phenothiazines. Recently attention has been drawn to the potentially harmful effects of some *monoamine oxidase inhibitors*. These include overaction of some opiates, particularly meperidine (Demerol) and *iproniazid* is the tranquilliser most implicated. Some monoamine oxidase inhibitors also make patients unduly susceptible to the hypertensive effects of methamphetamine (Methedrine) - and possibly other pressor amines. In the light of present knowledge it is impossible to predict what can occur when opiates or vasopressors are given to patients on monoamine oxidase inhibitors. It is suggested that, when in doubt, a test dose of one tenth of the normal therapeutic dose of the former should first be given, followed by twice this amount if the response to the previous one is normal, etc. until the desired effect is obtained.

SEDATIVES AND ANALGESICS: These are currently prescribed to so many patients, in so great a variety of doses and for so many conditions that it would be quite impossible to predict all the various iatrogenic conditions that could be associated with their use. As a compromise these are classified below in the order of their importance and related to the method of their administration.

1. Long term use:

- (a) Cross tolerance to other sedatives, including general anaesthetics;
- (b) Tolerance to curare-type drugs and sometimes sensitivity to succinylcholine;
- (c) Risk of "withdrawal" symptoms in the post-operative period if opiates are not given, or following compounds containing levallorphan or nalorphine.

2. Preoperative use:

- (a) Increased risk of postural hypotension;
- (b) Opiates are a major factor in the aetiology of postoperative vomiting;
- (c) Augmentation of the respiratory depressant effects of barbiturates;
- (d) Prolongation of action of succinylcholine if the opiate is combined with tacrine (THA) or other anticholinesterases. The latter may be the constituents of some eye drops.

The resistant patient can be best managed by the preoperative administration of a suitable dose of opiate or sedative related to their daily requirements. The tolerance to the non-depolarising relaxants is accompanied by a corresponding ease of reversal by neostigmine. The other interactions are easier to avoid than treat and this policy should be followed.

CORTICOSTEROIDS: Steroid therapy, with its aftermath of adrenal insufficiency, may affect the patient's ability to respond to any severe stress, of which anaesthesia is only one form. It was the severe hypotension during and after anaesthesia, sometimes accompanied by respiratory depression and delay in return of consciousness, which first drew attention to steroid therapy as a cause of iatrogenic disease. The administration of any of the corticosteroids can result in adrenal hypofunction, which may persist for up to two years after the drugs have been stopped. Dose does not seem to be important as some degree of impairment has been detected after a single intra-articular injection of cortisone. This is due to inhibition of the pituitary by the exogenous steroid, thus reducing the level of circulating corticotropin once the steroid therapy is stopped. ACTH therapy will have a similar effect since it stimulates the adrenal cortex to produce an excessive amount of cortisol, which in turn causes pituitary inhibition.

In adrenocortical insufficiency, patients react to the stress of anaesthesia and surgery by hypotension (out of proportion to the blood loss), respiratory depression and delay in return of consciousness. Different degrees of response are seen depending on the extent of the adrenal hypofunction and the severity of the stress. There are published cases of peripheral circulatory failure developing during or after anaesthesia in patients who had steroid therapy which was stopped for more than one year before operation, and in others in whom the treatment continued right up to the day before surgery, but in whom the all-important preoperative dose was missed. It has also occurred in patients who because of delayed recovery from anaesthesia, missed the dose they were due at the end of the operation. It is worth noting that in many instances the operative procedure was a very minor one and the period of anaesthesia was very brief.

These catastrophes are easily preventable. Patients on steroid therapy should have the dose increased before operation. If treatment has been stopped for some time it should be started again on the day before operation, a double dose being given with the premedication. In all preoperative visits patients should be questioned routinely regarding steroid therapy. Many clinics issue cards stating that the patients have had or are receiving steroids and these should become as routine (and as important) as cards giving the dose of insulin. If in doubt, in emergency cases, or in comatose patients, one may either give a prophylactic preoperative dose or else be prepared to give intravenous cortisol if unexpected and unexplained hypotension develops during surgery. This should then be continued for several days after operation with a gradual reduction in dosage depending on the patient's response, bearing in mind that an acute respiratory or other infection may act as a stress requiring a further

increase in steroid dosage. An interesting approach to this problem has recently been suggested¹¹ in which a large single dose given every 48 hours does not cause adrenal suppression because ACTH release and adrenal stimulation occurs in the second part of the 48-hour period. This approach to therapy certainly has some limitations and patients with life threatening diseases who require large doses of steroids may not respond to this regime. From the above it will be evident that a few bottles of 100 mg. cortisol (or other soluble equivalent) should now be routine in every anaesthetic drug cabinet and anaesthetist's bag. It is safe to give several of these intravenously, if in doubt, with no fear of a delayed effect on wound healing.

Miscellaneous

There are a number of other drug interactions which are either not related directly to anaesthesia, or which occur less frequently than those discussed above. These are discussed in detail in recent reviews^{6,12,13} and are listed below for the sake of completeness:

- (a) Additive hypertensive effects of *ergometrine* and *pressor amines*;
- (b) Potentiation (often dangerous) of the sedative effects of *barbiturates* (and possibly of some antihistamines) by *alcohol*;
- (c) stimulation by *phenobarbital* of the rate of breakdown of *coumarin* anticoagulants and decrease in efficacy so that larger doses may be required. The prothrombin will fall to dangerously low levels if the barbiturate is stopped;
- (d) Loss of potassium induced by *thiazide diuretics* which increases the toxicity of *digitalis* and prolongs the action of *muscle relaxants*;
- (e) Alkalinisation of the urine (as following *bicarbonate administration*) decreasing excretion of weak bases such as *meperidine* and *amphetamine* and prolonging their action;
- (f) Enhanced cardiovascular depressant effects of anaesthetics, particularly of the intravenous drugs, by *Emetine*;
- (g) *Adrenergic blockers* and an adverse effect in the cardiovascular response to stress (or anaesthesia), including blood loss.
- (h) *Oxytocic drugs*, which may contain vasopressin as an impurity, can cause coronary constriction which may be enhanced by light *cyclopropane* anaesthesia.
- (i) *Massive blood transfusion*, or a large transfusion in a hypothermic patient or one with liver disease can cause 'citrate intoxication', which should be suspected in the presence of an unexplained rise in central venous pressure and hypotension with progressive cardiac failure. The treatment is with calcium gluconate or

chloride, preferably given under electrocardiographic control.

Comment

It is evident that the most hazardous part of iatrogenic disease is that preceding the first appreciation of its relationship to various drugs. There are examples of the significance of animal results not being fully appreciated when unusual reactions occurred in man, as with the antibiotic-relaxant interactions. In the thalidomide tragedy the type of abnormal reaction was one not seen before in clinical practice. Thus one cannot predict what iatrogenic disease may hold in the future - whether it be an interaction with an anaesthetic, a sedative or some quite unexpected complication. *Clinical Pharmacology and Therapeutics* attaches so much importance to this topic as to publish regular papers on "Diseases of Medical Progress." It is hoped that this publication will emphasize the types of bizarre reactions that can occur and make one think of some drug interaction when an unusual response does occur. □

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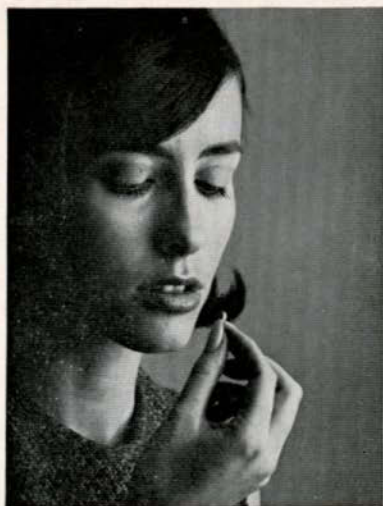
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The Anxious Surgical Patient and Anaesthesia

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The patient who is about to undergo anaesthesia for a surgical operation is faced with an uncertain situation. It is one which frequently leads to anxiety, a state which has been defined as "a specific unpleasurable state of tension which indicates the presence of some danger to the organism".¹ Much contributes to this uncertainty; the effects of illness on the patient and his life-situation, the reaction to hospitalization, the anticipation of anaesthesia and surgery, as well as postoperative discomfort and disability, are all factors which besiege the patient. The surgical experience is a stress which requires both psychological and physiological adaptation.

Preoperative anxiety is often accepted as being part of the reaction to surgery, and it is assumed that most patients overcome this aspect of their disability. However, even superficial contact with patients demonstrates not only the wide range in intensity of their anxiety (extending from the patient, so terrified of anaesthesia and surgery that he refuses to subject himself to an operation, to the patient who apparently is unconcerned) but also the kaleidoscopic pattern of individual fears and fantasies which give rise to this anxiety. Apparent also is the patient's gratitude for interest evinced by the anaesthetist on his preoperative visit; his reassurance is beneficial, and indeed the patient's reaction to anaesthesia and surgery may be influenced from this moment.

It is the purpose of this article to emphasize some significant aspects of anxiety, a condition perhaps considered intangible and insignificant by many physicians, yet of greater reality to the patient than some of the more concrete aspects of surgery.

Origins of Anxiety

(1) REACTION TO ILLNESS. The sick person develops changes in his personality and his view of the world becomes very different from that of the healthy. Illness means disability: and this in itself leads to apprehension and anxiety. Anxiety also results from the effects of illness on the total life-situation; worry about the family, about employment and earning ability affect the patient, as do more obvious factors such as concern over diagnosis and fear of pain.

(2) REACTION TO HOSPITALIZATION. It is easy for those who work in hospitals to forget that hospitals have their own environment; that, as Kennedy has written: "Admission to a hospital ward involves for most patients translation into a world

where almost every detail of daily routine is different from that to which they are accustomed". The surgical floor has also been likened to a foreign country. Feelings of strangeness and helplessness augment the feeling of dependency resulting from illness; it is not surprising that under such circumstances patients are confused and apprehensive. Particularly poignant are the effects of illness and hospitalization upon children. In Langford's words, "physical illness in a child, no matter how trivial, has its own unique meaning. . . . and may be a focus out of which emerge emotional disturbances of far-reaching significance".³ All children appear to show at least minimal reactions to the experience of hospitalization, that of overt anxiety being commonly observed.

(3) SIGNIFICANCE OF SURGERY. The surgical patient has a particular concern, that of "mutilation". Deutsch has stated that the patient views operation as a bloody attack; her explanation for anxiety formation is that old fears of castration or parturition anxiety are mobilized.⁴ More acceptable to many perhaps would be the realistic contribution of Titchener and Levine, who emphasize the special meaning of operations such as mastectomy, hysterectomy and orchidectomy.⁵ They explained that "emotional reactions are. . . quite specific for the individual and the experience he is undergoing" and suggested that "this is further reason for a deeper scrutiny of surface emotional reactions". Surgery therefore creates an intrinsic and special source of anxiety which is related to the psychosexual development of the individual.

(4) FEARS ASSOCIATED WITH ANAESTHESIA. Similarly, the concept of anaesthesia creates an intrinsic source of anxiety. Preoperative interviews tap a rich vein of fears and dislikes associated with anaesthesia, which often extends into the deeper strata of the psyche. Representative attitudes were readily discovered during a six-month period of observation (Table 1). While it is unnecessary here to detail these attitudes, the information gathered merits some discussion.

(a) The variety of attitudes reflects the frequency of preoperative anxiety. For each patient, the experience of an operation is unique, an event of a lifetime, while for the anaesthetist and the surgeon it is merely one more job. The patient's fears are real and demand attention.

*From the Departments of Anaesthesia, Dalhousie University and Halifax Infirmary, Halifax.

- (b) However fantastic such fears may seem, they are often founded upon a rational basis. The person who fears anaesthesia because of some earlier suffocative experience with a mask; the patient whose fear originated in his having been told "we nearly lost you" owing to tongue-obstruction; the one who worried about not waking after an operation, having slept unduly long after a previous operation; and the person who remembered being awake but paralyzed during earlier surgery: these patients had quite explicable anxiety.
- (c) Equally worrisome for patients appeared to be certain attitudes which could be considered part of the "mythology" of anaesthesia. Deutsch has pointed out that anaesthesia, like loss of consciousness, represents a going away of life, and hence leads to a fear of death.⁴ The expression "being put to sleep" may be equated with that fatal step, albeit performed on animals. Patients are aware that death does occur in the anaesthetised individual: stories and filmed scenes often underline this. An awareness of death as a possibility is not far beneath the surface: this was illustrated by the patient who remarked to his surgeon, just before consciousness was lost, "If I die, I'm going to come back and haunt you".

TABLE
Fears and Dislikes of Anaesthesia

1. Not going to sleep
2. Waking during operation: (a) Awake and paralyzed
(b) In pain
3. Not waking after operation: (a) Fear of death
4. Heart and lungs not strong enough
5. Loss of self-control: (a) Participation vs. passivity
(b) "Secrets" being given away
(c) Shameful behaviour
(d) Interference - "bad things happen"
- punishment
6. Body exposure
7. Suffocation
8. Smells, sights, sounds: (a) "Lights and flashing knives" in O.R.
(b) Hospital and antiseptic atmosphere
9. Needles
10. Miscellaneous sensations: (a) Aura of music at induction
(b) Sadness - thoughts of family at home
11. Spinal and other regional techniques
12. Postoperative sequelae: (a) Vomiting
(b) Alteration of personality

Effects of Anxiety

When a patient is terrified that he will not survive anaesthesia and surgery, the question arises as to the effects of this state of mind upon the course of anaesthesia. For since the day when poor frightened Hannah Greener found a place in history by being the first person to die under chloroform anaesthesia, fear or fright has been involved as a cause of

death under anaesthesia. There have been many reports of patients, often apparently healthy and young and requiring but simple surgery, who have died at induction of anaesthesia or soon afterwards, in which one etiological factor was that of fear. Stephenson remarked that "Cases of cardiac arrest in which the patient expressed a tremendous amount of terror at the onset of induction have been noted frequently".⁶ Eckenhoff also declared that "The markedly apprehensive patient is a potential candidate for death in the operating room"; he told of "four patients who died during or immediately after operation having evinced marked preoperative apprehension".⁷

What evidence is there that preoperative apprehension might cause the most serious of all organic derangements, namely cardiac arrest? The frightened or anxious person shows evidence of many physiological changes; the most significant affect the endocrine, cardiovascular and nervous systems.

(1) THE ENDOCRINE SYSTEM.

The influence of the pituitary and adrenal glands in the reaction to stress was emphasised particularly by Cannon and Selye. Cannon, half a century ago, showed that adrenaline is important in the body's adaptation to stress, and since then, the correlation between the secretion of catecholamines and various types of stress has been confirmed; for example, preoperatively, levels of catecholamines may be abnormally high.⁸ The catecholamines have especial relevance to preoperative anxiety and anaesthesia, which Levy's work in connection with deaths under chloroform first underlined; an association was found between light chloroform anaesthesia in cats, injection of adrenaline, and ventricular fibrillation.⁹ Moreover, any factor increasing cardiac work, such as sensory stimulation, injection of adrenaline, a change from deep to light anaesthesia, as well as excitement, could precipitate an arrhythmia. It is now realised that certain hydrocarbon inhalational agents may cause cardiac arrhythmias by sensitizing the heart to the action of endogenous or exogenous catecholamines. Price has indicated that "A primary increase in cardiac rate, no matter how caused, can produce serious disturbance of cardiac rhythm during anaesthesia produced by certain agents, particularly cyclopropane, trichlorethylene, halothane and chloroform";¹⁰ and since fear is one cause of tachycardia, cardiac arrest may be related to the endogenous release of adrenaline in those who are apprehensive before operation.

(2) THE CARDIOVASCULAR SYSTEM.

Cardiac work is increased in anxious patients; increases in cardiac output, arterial pressure, heart rate and usually peripheral resistance and oxygen consumption have been found. Certain types of peripheral vascular activity are also associated with anxiety, as indicated by digital plethysmography.

It is therefore not surprising that abnormal electrocardiographic patterns have been discovered in preoperative patients. Arrhythmias are commonly observed in anxious patients, and in the surgical patient these may disappear after induction of anaesthesia. However, some ECG changes may persist. In one study of apparently healthy patients, who had normal ECG patterns before their being informed of impending surgery, abnormal patterns developed immediately before induction of anaesthesia.¹¹ These were similar to those of coronary insufficiency: since the technical conditions for recording were unchanged, and as drugs were excluded from this study, the findings were attributed to preoperative fear. Moreover, although in most the ECG became normal either immediately after induction or within 24 hours, in three cases the ECG had not returned to normal even after 24 hours. These authors concluded the "Death from anaesthesia as well as during anaesthesia should, therefore, at least in some cases, be considered as the extreme outcome of an otherwise usual fear-reaction. . . . increased by the excitement while under the anaesthetic."

There is, therefore, circumstantial evidence to support the idea that fear may be a factor in otherwise unexplained catastrophes. Not only may the cardiovascular system be the target or effector organ in anxious, conscious patients, but also in the patient anaesthetised with the so called "sensitizing" agents, it is subject to further strain by virtue of the potential hazard of circulating catecholamines.

(3) THE NERVOUS SYSTEM.

The influence of the higher centres and personality, quite apart from the relation of the central nervous system to the endocrine and cardiovascular systems, is manifest in many ways. Differences between patients - between those who are well-prepared inwardly and those who are a "bundle of nerves" - are often marked. Many factors influence the personality - hereditary, environmental, cultural, and social - which in turn affect the preoperative state. The self-control of those of strong religious faith is a clinical impression which receives some corroboration from the finding that there is a difference in analgesic requirements for persons of different faiths.¹² Similarly, racial differences in reaction to pain have been described,¹³ also to anaesthesia; it has been suggested that differences in anaesthetic response are due in part to differences in the sympathetic nervous system, especially in relation to the circulation¹⁴ and carbohydrate metabolism.¹⁵ Writing of Zulus, Findlay has remarked that they often hold the naive view that the hospital is the place where people are sent to die.¹⁶ "They are inordinately afraid of anaesthetic and surgical procedures"; he reported exaggerated responses to moderate physiological and pharmacological interference.

Personality factors would seem from general experience to be important. While attempts to find a relationship between physiological factors and patient response to surgery under anaesthesia have been made, it is doubtful whether we can elaborate on what Crampton, years ago, said: "The patient's mentality undoubtedly affects anaesthesia. We can render a patient unconscious in a matter of seconds, but "frightened" respiratory, cardiac and spasmodic effects may persist afterwards. . . ."¹⁷

Management of the Anxious Surgical Patient

A "deeper scrutiny of surface emotional reactions" should be made for several reasons:

- (1) As far as the illness and the operation are concerned, an explanation of these is important. This is not to say that detailed accounts of surgical techniques or pathology are desirable; but accurate information, however brief, will dispel some concern and will prepare the patient for postoperative stresses. Patients justifiably complain of lack of information.
- (2) Preoperative anxiety may be associated with abnormal behaviour during induction and maintenance of anaesthesia. Some of this has been mentioned. Eckenhoff has shown that preoperative upset, due to lack of proper preparation or sedation, may lead to problems at induction such as cyanosis, struggling, vomiting, and respiratory obstruction.¹⁸
- (3) Preoperative anxiety may also be followed by a poor postoperative course. In children having otolaryngological operations, unsatisfactory premedication and induction of anaesthesia was associated with a high incidence of personality changes.¹⁹ And in some anxious adults a poor recovery from operation may be observed.
- (4) Since an experience like forceful induction by mask may act as a trauma, fear of anaesthesia may be created. Careful and considerate management of the patient resulting from an understanding of his problems may allow him to realise that such fear need not continue to haunt him.
- (5) Anxiety often results from misconceptions or misunderstandings in the patient's mind. Through explanation and reassurance anxiety may be dissipated.
- (6) There is evidence that patients benefit from the attention paid to their difficulties by the anaesthetist. Egbert and others have demonstrated "psychologic benefits lasting for at least 18 hours after the visit by the anaesthetist";²¹ both the immediate preoperative and postoperative condition are affected.

This reasoning recognises the part played in treatment by what Beecher has termed "nonspecific forces".²² The management of the frightened surgi-

cal patient will mostly consist of "nonspecific" therapy; in other words, the physician should show sympathy, interest, and confidence in the outcome, complementing this with the judicious use of drugs and technical skill.

In brief, helpful aspects of management are these:

(1) **PREOPERATIVE PSYCHOLOGICAL PREPARATION:** All patients benefit from some form of preparation which helps them to adapt to the surgical experience.

(a) Children especially benefit from careful preparation, for behavioural changes often follow hospitalization. Vernon et al., in a review of the subject of illness and hospitalization of children, have described the benefits of such preparation: information is given to the child, his emotional expression is encouraged and trust and confidence are gained in the hospital staff.²³ Robertson, from a parent's point of view, has underlined the value of preparation and the traumatic results of lack of preparation,²⁴ while Jackson, looking at this matter as an anaesthetist, leaves no doubt as to the ideal way in which a paediatric team can prepare a child before operation so that, with gentle and compassionate management of the child at the time of anaesthesia, postoperative behavioural changes are less frequent.²⁵

(b) Those adults who are anxious, benefit from simple explanation of the operation and reassurance, as has already been indicated. Janis, who related preoperative anxiety to postoperative behaviour, classified patients into those with low, moderate and high degrees of anxiety, and advised that each group be regarded differently as regards postoperative behaviour and technique of reassurance.²⁰ A moderate degree of anxiety was associated with an ability to develop "immunity reassurances" about some of the associated stresses, particularly if information was made available: these patients were able to cope relatively well post-operatively. A high degree of anxiety implied inability to develop adequate inner defences with which to deal with the situation, and preparation was of little value unless it included some form of therapy to decrease the pathogenic influence of repressed sources of fear. The third group, those with a low degree of anxiety showing no perceptible signs of fear or emotional disturbance pre-operatively, nevertheless reacted following surgery with resentment and varying degrees of anxiety and depression; these patients, some of whom were neurotic and did not consider the implications of a

threatening situation, were best managed by causing them to become involved with the likely stresses ahead of them.

(2) **SEDATION:** The commonest means of lessening anxiety is the use of drugs which depress different parts of the central nervous system. Some comments may be made about this. First, drugs have undesirable side-effects such as depression of the respiratory and cardiovascular systems; second, perhaps a greater use should be made of tranquillizing and ataractic drugs; third, drugs such as barbiturates are sometimes less effective than the encouraging preoperative visit by the anaesthetist. However, drugs will always be of value, especially for unusually apprehensive patients and patients with whom contact is difficult to establish, for example very young children and retarded children. Sedation does help protect the anxious patient from a potentially traumatic experience which would induce fear of future anaesthesia.

(3) **INTERPERSONAL RELATIONSHIPS:** Among "nonspecific forces" affecting the patient are the relationships with medical and nursing staff. Mention has been made of the importance of the visit by the anaesthetist; the essential point made was that, "differences in the behaviour of the anaesthetist influence the patient".²¹ Schulman et al. have also indicated that differences among anaesthetists are significant; important was the ability to establish rapport with the child, especially in the few minutes before induction.²⁶ This study was designed mainly to evaluate the presence of the child's mother during induction of anaesthesia: and there was support for their hypothesis that children so accompanied during induction were less upset than those separated from their mothers. Similarly, the confidence placed in the surgeon and the patient's regular physician is another intangible factor, but one which does play a role in lessening anxiety.

The effect of such a relationship may sometimes be a negative one. Indeed anxiety may be stimulated by attitudes among medical and nursing personnel which are unsympathetic or tactless. The patient may misinterpret statements made by a physician so that misplaced worry results; there is no substitute for simple but correct information. Nor is there a substitute for the natural sympathy that enters into most patient-physician relationships. One could hope that the following story about a two-year old undergoing a herniorrhaphy for the second time might be very rare: "...the child, young as he was, remembered vaguely the scene and was apprehensive from the beginning. But the greatest blow to him was delivered by the anaesthetist, a young, almost brash, bachelor, who boasted of his "way with children" and attempted to illustrate it by calling our toddler "Professor". Instead of allowing my husband to carry our baby into the theatre as before and hold him while he administered the anaes-

thetic, this young man took him from the security of his father's arms and carried him screaming, kicking and violent into the theatre himself. He reported to us later, quite gleefully, that he had had "fisteuffs" with him on the table. Physically our son recovered quickly again, but emotionally he has still a very long way to go."²⁴

Comment on this object lesson is superfluous.

(4) HYPNOSIS: An extension of the idea that the physician's personality significantly affects the patient is the application of hypnosis. Kolouch has stated that the introduction of ether anaesthesia was responsible for the neglect of hypnosis as analgesic and anaesthetic agent,²⁷ but a number of anaesthetists and surgeons continue to use hypnosis, not only to abolish pain during surgery, but also to reassure the patient before, during and after surgery. Cheek, too, has advocated hypnosis to allay preoperative anxiety due to fear, to protect the patient from adverse effects of conversation heard by the

anaesthetized person, to reduce anxiety in the immediate postoperative period, to reduce the amount of analgesia required following operation, and to speed convalescence.²⁸ Hypnosis is a controversial technique: one may or may not agree with Raginsky's view of it as being "The most forceful method of allaying anxiety without resort to medication."²⁹

Comment.

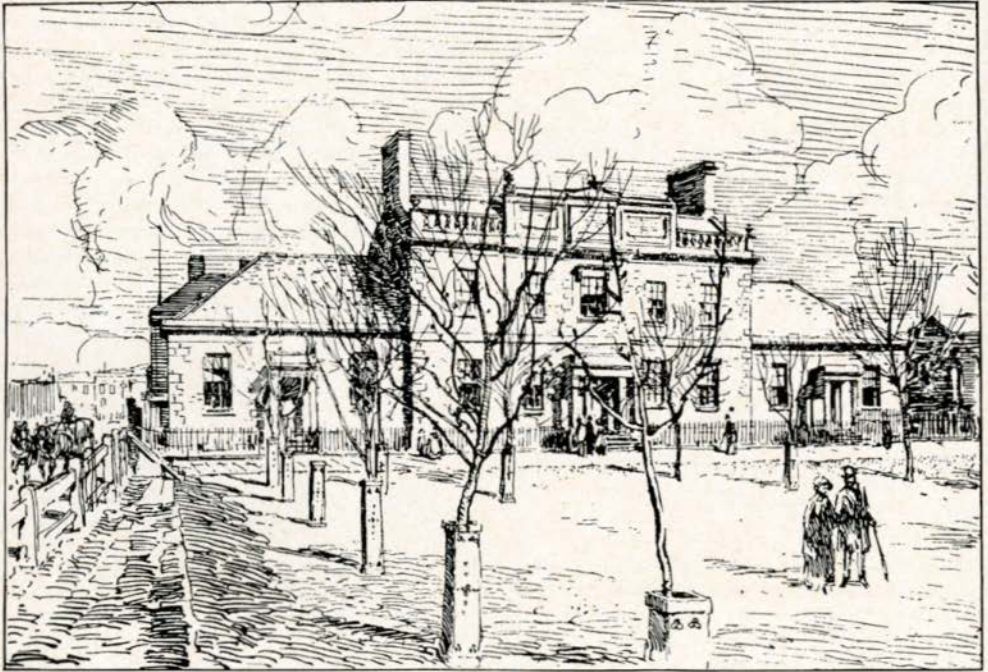
In "The Doctor's Dilemma" George Bernard Shaw claimed that anaesthesia expunged merely the pain of the knife.³⁰ Shaw was dramatising the idea that the surgical patient has much to bear from and operation; although the operation itself, performed when the patient is unconscious, is virtually free of discomfort, there is much else which he finds unpleasant. While this may be an exaggeration, there is yet a grain of truth in it. This article has discussed one aspect of discomfort of the surgical patient, with Shaw's general idea as a touchstone. □

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One Hundred Years Ago

December 27, 1867



THE ORIGINAL DALHOUSIE COLLEGE, 1820-1887

Situated on the Grand Parade

The Dean reported the following communications from Jas. Thompson, secretary of the Board of Governors.

“Extract from Minutes of a meeting of the Board of Governors of Dalhousie College held on February 25, 1868.”

“James F. Avery, M.D. then moved the Hon. I. W. Ritchie seconded and it was passed unanimously that the proposed Medical Faculty consisting of the following officers and lecturers viz:

Rev. James Rop, D.D., Principal per officio
William I. Almon, M.D., President
Alexander P. Reid, M.D., Dean

Wm. I. Almon, M.D. & Alex G. Hattie, M.D.
Edward Farrell, M.D.
Prof. G. Lawson, Ph.D., L.L.D.
Alex P. Reid, M.D.
A. H. Woodill, M.D.
James Rop, M.D.
Thomas R. Almon, M.D.

Lecturers on Midwifery (or Obstetrics)
Lecturer on Anatomy
Lecturer on Chemistry
Lecturer on Physiology or Institutes of Medicine
Lecturer on Materia Medica
Demonstrator of Anatomy
Prosecutor to Chair of Anatomy

appointed and confirmed as the Medical Faculty of Dalhousie College.

The Hon. I. W. Ritchie then moved James F. Avery Esq. M.D. seconded and it was passed unanimously that the statutes and Byelaws submitted by the said Faculty for the approval of this board be the statutes and Byelaws governing and regulating the said Medical Faculty”, James Thompson, Secretary, Dalhousie College.”

Centennial

1868
1968

Dalhousie Faculty of Medicine

Come to the

CENTENNIAL

Sept. 11, 12, 13

Halifax, N. S.

**THE PHYSICIAN OF THE FUTURE:
HIS UNIVERSITY AND HIS COMMUNITY**

**medic -
IN '68**

- * major scientific meeting
- * keynote speakers and
group leaders
- * daily concurrent
panel discussions
- * round table sessions
- * seventy contributors
of international acclaim

The Years Ahead

A look at the future of medicine in three rapidly developing and expanding areas - genetics, organ transplants and medical education will be the theme of three days of scientific meetings next September when world leaders in medicine participate in Dalhousie University's Faculty of Medicine's centennial program.

On the occasion of its 100th birthday, Dalhousie's medical school will be host to scientists, researchers, educators and administrators of international acclaim when they take part in the centennial proceedings on Sept. 11, 12 and 13, in Halifax.

The keynote speakers and chairman of each of the six panels which will run concurrently on all three days are impressively qualified. All have had distinguished careers and have made major contributions to the advancement of medicine.

One of the prominent visitors will be Dr. Ralph W. Tyler, recently retired director of the Centre for Advanced Studies in the Behavioural Sciences at Stanford University, California, who will give the keynote address on Sept. 11, when the sessions will be devoted to medical education and practice. The continuing education of the practising physician, the training of the doctor at the undergraduate and post-graduate level, a study of the learning process, the patterns of future practice and the use of paramedical personnel and improved techniques of practice will constitute the six sections of this phase of the program.

The keynote address at the Sept. 12 session on genetics will be given by Dr. Murray L. Barr, head of the department of microscopic anatomy at the University of Western Ontario. This will be followed by five panel presentations by leading geneticists, biologists, paediatricians and statisticians.

Outstanding scientists and surgeons, and persons connected with the church and the law will take part in discussions on organ transplants on Sept. 13, the final day of the centennial meeting, when the major address will be given by Sir Peter Medawar, director of the National Institute for Medical Research in London and president-elect of the British Association for the Advancement of Science.

Canadians will be high on the list of over 70 contributors to this major scientific meeting which will have representation from France, England, Scotland, Czechoslovakia and the United States. Among them are scientists, researchers, nobel prize winners, Markle and Rhodes scholars from a number of major teaching institutions and medical centres.

The meeting will be of special interest to Dalhousie medical alumni who will be on hand for the 100th anniversary of the medical school, but the Faculty of Medicine expects to attract many others to these centennial meetings. □

Focus on Dalhousie

Dalhousie will be well represented on the participants roster at the centennial meeting of the Faculty of Medicine next September. Among the 70 contributors, 40% are Canadian and of these, seven are graduates of the Dalhousie Medical School.

Dr. C. B. Stewart, host-dean will serve on a four-man panel on the first day when the theme of their discussions will centre on the medical education of the undergraduate. Joining him on the same panel will be Dr. Ian Rusted, Dean of the newly established medical school at Memorial University, St. John's, Newfoundland.

In his capacity as medical educator, Dr. Stewart has provided valuable assistance and information to the Memorial University Committee and the New Brunswick Medical Survey Committee on the feasibility and need for new medical schools in the Atlantic Provinces. In addition he has reported on the adequacy of medical education for the practising doctor and has carried out research on the future availability of medical schools.

Dr. Rusted has been active in the medical education and residence program in Newfoundland. He is familiar with the pattern of medical care in the province and has been prominent in medical education affairs nationally through his positions with the Royal College of Physicians.

Before his appointment as dean he served as director of the postgraduate medical education - the first position filled in the newly created Faculty of Medicine at Memorial.

Dr. Paul Cudmore, assistant director of Dalhousie's postgraduate division has been interested in the evaluation of the learning process and has just returned from a year of training at the University of Illinois investigating this process as it applies to medicine. He is the first Canadian doctor to spend a full field year of training in medical education and one of two authorities on the learning problems in the learning process of the graduate doctor. The panel on which Dr. Cudmore will serve will be devoted to the learning process.

Dr. Walter Mackenzie, a Cape Breton native and Dean of Alberta's Medical School in Edmonton will act as group leader in discussions on the medical education at the postgraduate level. He is considered one of Canada's most prominent medical educators with international experience in his association with administrative medical institutions.

The interrelation of paramedical personnel will be examined by a panel of six. Dr. Arthur H. Shears in his capacity as medical director of the Nova Scotia Rehabilitation Centre and director of Dalhousie's School of Physiotherapy will participate. Dr. Shears has been training physicians to make use of physiotherapy methods.

(continued on page 115)

Ralph W. Tyler, recently retired director of the Centre for Advanced Studies in the Behavioural Sciences, Stanford University.

. . . teacher and author of such publications on education as: constructing achievement tests; appraising and recording student progress, basic principles of curriculum and instruction.

. . . viewpoints on medical education and practice will be voiced on Sept. 11th by deans representing leading Canadian medical schools, educators, psychologists, research director for the Hall Commission, president of the American Medical Association and personnel in the paramedical field.

Murray L. Barr, department of microscopic anatomy at McMasters . . . pioneer researcher on sex chromatin.

. . . contributors from major centres for genetic studies will focus attention on this theme on Sept. 12, the second day of Dalhousie's centennial meeting.

Sir Peter Medawar, director of the National Institute for Medical Research, London and Nobel laureate for his discoveries in tissue transplantation.

. . . presentations encompassing ethical, legal and surgical aspects, graft rejection, transplant tolerance and donor selection by a renowned roster of international scientists on Sept. 13 . . . theme for the final day of the scientific sessions will be organ transplants.

When Dalhousie's Faculty of Medicine hosts a major scientific program next September on the occasion of its centennial, it will have marked 100 years of growth and achievement.

The Medical School today is recognized as one of the best and has over the years established itself as a model in the field of instruction and in continuing education.

Housed in a small wooden structure on the site where the present Halifax City Hall now stands, the School made its humble beginnings in 1868.

Fourteen students registered for instruction in such primary subjects as obstetrics, chemistry, anatomy, physiology, medicine and materia medica which was given by eight lecturers. The first class graduated in 1872.

In the school's 99th year, it moved into its fourth home - a fifteen storey medical complex which was officially opened by Queen Elizabeth the Queen Mother. The new structure which was Nova Scotia's memorial to the centennial of Canadian confederation was appropriately named the Sir Charles Tupper Medical Building.

In 100 years the Faculty of Medicine has graduated over 2200 students. It is the research centre for the Atlantic provinces, and is developing new programs in such areas as medical genetics, computer science, electron microscopy, X-ray microscopy and virology in addition to others in the clinical and scientific fields.

In keeping with the theme of the centennial meetings which will take a forward look at medical education and practice; genetics; and organ transplants - the School is in the process of doing the same thing. A thorough revision of the medical curriculum is underway, the first appointee in genetics has been made and two more will follow shortly and a researcher in the field of kidney transplantation will take up his duties in July. □

Focus on Dalhousie (continued from page 114)

Future patterns of health care will be developed in a panel discussion with Professor Bernard Blisshen, research director of the Hall Commission; Dr. Alexander Leighton, Harvard professor of Mental Health; Dr. Dwight L. Wilbur, president-elect of the American Medical Association and Dalhousie graduate Dr. Donald I. Rice. Dr. Rice is executive director of the College of General Practice. He has travelled extensively in Europe, Africa, United States and Canada. He has been studying what the family practitioner does and what he should do in the future.

Organ transplants, a field of medicine which has developed rapidly in recent years will occupy discussions on the final day of the Dalhousie scientific meeting. Dr. S. G. Lannon, who graduated from Dalhousie in 1957 and now with the department of urology will join in talks on the surgical aspects of organ transplants with Dr. Thomas Starzl, University of Colorado School of Medicine, Dr. R. C. Lillehei, experimental surgeon at the University of Minnesota and Dr. Thomas King, professor of surgery at the University of Utah. □

People and Panelists . . .

. . . *Dr. Christine McGuire*: on study of curriculum organization, instructional systems, and educational evaluation . . . *Professor Brendan A. Maher*: authority in clinical psychology and experimental psychopathology . . . *Professor Mark Field*: investigator of systems in Russia and author of a paper on the Doctor and Patient in Soviet Russia . . . *Dr. Gordon W. Thomas*: the use of the Outpost Nurse as an illustration of the assistance provided through paramedical personnel . . . *Dr. E. Harvey Estes*: on Physician's Assistance Program at Duke University . . . *Oliver Smithies*: outstanding researcher in the whole field of genetics . . . *Willys K. Silver*: on the genetics of transplantation . . . *James German*: on the use of auto-radiography of chromosomes . . . *Victor McKussick*: studies in clinical and population genetics . . . *Francis D. Moore*: featured on cover of TIME for his distinguished achievements in surgery and author of laymen's book on the history of tissue transplantation . . . *John Edwards*: director of Institute of Criminology, University of Toronto, who has given attention to the ethical, legal and moral problems associated with medicine . . . *Sherwood Lawrence*: of the Infectious Disease and Immunology Division of New York University's Medical School with some answers to key problems in disease and in homograft rejection . . . *William Curran*: lecturer in legal medicine and researcher on legal and legislative bases of governmental medical care systems in European countries . . . *Jean Dausset*: from the Universite de Paris and noted for his research in blood types . . . *R. C. Lillehei*: Markle Scholar and experimental surgeon at the University of Minnesota. □

And Places . . .

. . . *R. S. McLaughlin Examination and Research Centre*, University of Alberta: now doing studies in multi-choice examinations for the Royal College of Canada . . . *Scripps Clinic and Research Foundation*, La Jolla, Calif.: the centre where samples of blood and other materials are sent for analysis on any human organ transplant taking place in the US . . . *Permanente Medical Group*, Hayward, Calif.: who have had great success with paramedical personnel in their medical clinic . . . *Ontario Cancer Treatment Centre and Atomic Energy of Canada, Ltd.* . . . *University of Colorado School of Medicine*: where director Thomas Starzl's as organ transplant program has encompassed 198 kidney transplant patients and 18 liver transplant patients; Carl B. Pollock whose staff handles all psychiatric consultations from the medical and surgical services of the Colorado centre; and E. A. Murphy, biostatistician and author of works on genetics and haematology . . . *Glasgow University*: a centre for studies in human genetics; Division of Medicine and Religion for the American Medical Association. □

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Fluid and Electrolyte Requirements During Anaesthesia and Surgery

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Introduction

In 1831, Latta in Scotland successfully treated a patient with cholera using Maresch's solution intravenously.¹ Since then there has developed a widespread awareness of the importance of both water and electrolytes in the management of disease states.

In relation to anaesthesia and surgery the guide lines for parenteral therapy have changed radically in the past several years.^{2,3,6}

"Stress" Theory

In 1959, Moore proposed that anaesthesia and surgery were a stress, the response to which was antidiuresis and salt retention in the postoperative period³. These proposals stemmed from data showing postoperative falls in urinary output and sodium excretion after major intra-abdominal surgical procedures. This was assumed to be due to a pituitary-adrenal response inhibiting normal water and electrolyte clearances by the body.

"Third-Space" Theory

During this same period other studies were appearing suggesting that the ability of the body to handle both water and salt was unimpaired by surgery.^{4,5} These latter studies suggested that Moore's original data could be interpreted as showing that the body was, after trauma, functionally short of both water and electrolytes. From these proposals the "third-space" concepts have evolved.

These ideas may be clarified by considering the general response of the body to surgical trauma. If one considers, for example, an operation on the peritoneal cavity, the pathophysiological response to injury consists of: (a) ileus, (b) retroperitoneal, visceral and omental oedema, and (c) intraperitoneal effusion. The fluid involved, extracellular fluid (ECF), is sequestered by virtue of the process involved, and thus relatively inaccessible to other body compartments. It is functionally, in effect, another body compartment or "third-space".

This inaccessible ECF "third-space" is drawn from other body compartments. The body will therefore then be relatively short of both water and electrolytes. Tests designed to evaluate this would show antidiuresis and salt retention due to the effort of the body to conserve both water and electrolytes. Replacing the body's ECF stores with an amount of fluid and electrolyte equal to that sequestered should in theory, and does in fact, appear to restore normal function.

In short, anaesthesia and surgery do not represent a "stress" of the type proposed initially. All evidence would seem to indicate that if the body's functional extracellular fluid stores of water and electrolytes are maintained at normal levels, the excretion of water and electrolytes will remain within normal limits. In other words, parenteral therapy will lead to normal responses on the part of the body, and not antidiuresis or salt retention. Thus, homeostasis would appear to require a replacement of an amount of fluid and electrolytes in an amount equivalent to that sequestered.

Normal Requirements

On considering the implications of this for the management of per-operative infusions in normal patients, two general statements can be made. These are: (a) the ordinary requirements of the individual patient must continue to be met, (b) if sequestration occurs in association with the anaesthetic or the operation, an amount of ECF-like fluid equal to that volume sequestered should be administered to maintain normal homeostasis. As a corollary it may be said that if sequestration does not occur, fluid in excess of normal daily requirements should not be given.

Normal fluid requirements for a 70 kg. adult generally fall between 2 and 4% of body weight in kgs. per day; therefore the usual 2,500 - 3,000 ml. administered per day can be considered normal. Values for children and smaller adults are closely related to this on a proportionate basis. For the patient's water and electrolyte status to be normal, adequate hydration must be present on arrival in the operating room. In ordinary practice this is rarely the case. Patients usually come to the operating room having had nothing by mouth since some time in the evening prior to operation. Therefore a normal-sized adult may have a negative water balance of 1000 - 2,000 ml. depending upon the length of this interval; and can be given these amounts of fluid fairly rapidly - even before the induction of anaesthesia, and still not be over-hydrated. Since the patient is not in need of a great deal of sodium ion, the majority of this fluid can be given as dextrose and water or as a pre-mixed maintenance solution.

The normal daily adult requirements for minerals generally include 5 to 10 gms of sodium chloride. For purposes of comparison it should be noted that the 154 mEq. of sodium contained in 1,000 ml.

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of normal saline are equivalent to approximately 3.5 gms of sodium which is, in turn, equivalent to approximately 9.0 gms of sodium chloride. Therefore for ordinary daily replacement of this patient the indicated solution will probably be 1/3 normal saline or a mixed electrolyte solution of the type containing daily electrolyte requirements in 3,000 ml. (eg., Normosol M Abbott).

Requirements for Operation

During operations normal requirements may be modified by: (a) the need to supply fluid to augment the size of the intravascular portion of the extracellular fluid compartment in order to maintain reasonable cardiovascular stability during the course in anaesthesia; (b) the pathophysiological effects of the operation; and (c) intercurrent disease with any of the fluid-electrolyte disorders which may be present.

Effect of Anaesthesia

In relation to anaesthesia it should be noted that use of halothane is associated with a moderate rise in plasma volume which, in ordinary situations, tends to be largely complete approximately 45 minutes after induction.⁷ It is of interest that this rise parallels the hemodynamic improvement which occurs after the initial fall in blood pressure associated with induction of anaesthesia. It is probably true to say that, as the patient's blood volume increases, cardiovascular stability in terms of blood pressure improves. It is widely appreciated that induction of anaesthesia in hypovolemic or dehydrated patients, using halothane, may certainly be a hazardous undertaking; and that this hazard is much less in the optimally hydrated patient. The effect of halothane on the plasma volume would appear to do much to explain this. There is then a logical ground for vigorous hydration of the patient before induction of anaesthesia - especially in the light of the length of time the patient has been deprived of fluids prior to this.

In terms of operation it is obvious that not all procedures will result in sequestration of extracellular fluid by creation of a "third-space". In general it may be said that if there is no development of ileus, effusion, or gross cellular oedema, there will be, in effect, no "third-space". Translated into clinical terms it is obvious that, in operations which avoid a body cavity, little or no sequestration develops. On the other hand, with abdomino-perineal resections the "third-space" may be large indeed.⁸

Balance studies in patients having standardized upper abdominal procedures indicate that the size of this non-functional extracellular fluid compartment is approximately 1.5 - 3.0 litres in adult men undergoing cholecystectomy.⁹ It has been shown to be as large as 4 to 5% of body weight with other types of surgical trauma and not present at all after minor procedures.

Fluid sequestration due to intraperitoneal trauma is largely complete within 24 hours. These

changes appear to be stable over the course of the next 24 hours. Clinically it seems that ileus formation is completed at or almost immediately after operation. In any case it would seem safe to infuse the solutions to be used at a rate sufficient to allow for the almost complete development of ileus within a 12 hour period during and following the operation. The solution infused should be ECF-like in character; that is, a balanced salt solution, the classic example being lactated Ringer's solution.

In summary then, at time of operation, the patient should have infused the types of solution appropriate to maintain adequate hydration. In addition to this, there should be infused on or about the day of operation an amount of balanced salt solution equivalent to that amount likely to be sequestered due to the patient's disease or operation.

With recovery the inflammatory changes will subside. The fluid sequestered will then be remobilized and made available to the patient. It will then be necessary for him to be capable of handling this volume of fluid. Capacity to do this may be compromised by cardiovascular or renal disease. The remobilized fluid may therefore be a potential hazard. In such cases the amount of fluid infused in excess of the patient's daily needs at time of operation should then be subtracted from the volumes of infusion given at time of remobilization, i.e., resolution of the ileus. This should minimize the cardio-renal embarrassment.

Postoperatively, after satisfaction of the extracellular fluid compartment, continued use of balanced salt solutions would be ill-advised since conservation of the daily water needs in the face of the great excess of electrolytes present in such solutions would impose an inordinate amount of metabolic work on the kidney - the body needs the water, but not that much electrolyte. Balanced salt solutions are for the replacement of actual or relative losses of ECF - not maintenance of water and electrolyte balance.

Infusion regimens designed for normal maintenance should include, aside from the necessary water, carbohydrate (dextrose) for its caloric and protein-sparing action and sufficient amounts of electrolytes to make up for normal losses. For sodium and potassium these figures are thought to be approximately 150 and 60 mEq. per day respectively for adults. Magnesium may be a valuable addition, but calcium is probably not necessary due to the large body reserves. These needs may be met using the conventional 1/3 saline to 2/3 dextrose mixtures, adding whatever else is needed, or by the pre-mixed special solutions, eg., Normosol M in D5-W, (Abbott).

Specific Solutions

Five per cent dextrose in water is a somewhat acid solution with a pH of about 5.5 and, when infused, is capable of expanding both the extracellular

and intracellular fluid compartments, but at the cost of hemodilution. The consequent fall in serum sodium may produce neurological and cardiovascular depression if sudden and severe enough; in addition, acute depression of serum sodium below 120 mEq. may also compromise the ability of the kidney to excrete the extra fluid while still conserving the sodium necessary to correct the problem. Therefore if there is any need for electrolytes as part of the patient's problem, that is, where there has not been a loss of water alone, dextrose and water should not be used. Its use is specific only for the correction of simple dehydration or as part of a regimen for maintenance of water balance.

Normal saline is another somewhat acid solution containing 154 mEq. of sodium and chloride per liter. This represents a slight excess of sodium in relation to normal levels found in the body, but a great excess of chloride. Rapid infusion of this solution, (eg., amounts equal to or greater than 50 ml. per minute) dilutes the bicarbonate side of the Henderson-Hasselbach equation and provides a large chloride excess thus expanding the body's "chloride space". The consequence of this for the patient may be a relative or actual loss of bicarbonate and the development of significant levels of metabolic acidosis¹⁰. Infused at moderate rates in ordinary amounts it is of course economical and well tolerated.

Balanced salt solutions, the classical example of which is lactated Ringer's, contain electrolytes and bicarbonate precursor in amounts similar to those existing in the body. There are many examples of this type of solution. Calcium is absent in the more recent of these (eg., Normosol R., Abbott). This, in a patient who is digitalized, hyperventilated, and thus potentially hypokalemic probably represents a safety factor.

For routine maintenance, solutions containing the usual daily requirements for electrolytes and dextrose in every 3 litres probably represent a step forward. Unless specific fluid and electrolyte therapy is needed, it is now, for the most part, only necessary to give extracellular fluid-like balanced salt solutions equal to the amount of extracellular fluid sequestered on the day of operation and maintenance type fluids during and after operation to maintain perfectly normal electrolyte and water balance.

Some Considerations Regarding Disease

In disease, as in health, one must bear in mind that there is, in the ECF compartment, mainly sodium, chloride and potassium; in ICF, potassium and phosphates. By virtue of the osmotic pressure these ions exert, water is distributed throughout the body. Osmolality, usually expressed in terms of milliosmoles per litre, represents the osmotic attraction exerted by the ionic or solute particles in a solution be they large or small. If a compound is not ionized one mole will exert one osmole of attrac-

tion; if, like sodium chloride, it is wholly ionized into two particles it will then exert two units, and if, like calcium chloride, ionized into three particles it will then exert three units (eg., 1 mEq. NaCl gives 1 mOsm. sodium and 1 mOsm. chloride). It is the osmotic pressure which controls the distribution of water in the body; that is, the water follows the distribution of electrolytes which create the osmotic pressure. It is this osmotic pressure that the body's homeostatic mechanisms vigorously attempt to keep at stable levels.

Disorders of fluid and electrolytes may come from:

- (a) **Loss** - mainly water, or water and electrolytes in varying combinations up to the concentration of extracellular fluid,
- (b) **Inappropriate treatment** - with consequent losses or gains of water or one or more electrolytes depending upon the antecedent problem in the patient's management,
- (c) **Change in osmotic pressure** - from blood sugar or urea (*vide infra*),
- (d) **Asymptomatic hyponatremia** - often seen in patients with cardiac and hepatic disease in the absence of other obvious abnormalities and which may only signify resetting of the body's osmo-receptor mechanisms.

Maintenance of normal osmolality appears to be a dominant homeostatic mechanism of the body. In simple dehydration, the body will lose electrolytes in an attempt to restore osmolality to normal. Similarly after over-hydration with dextrose and water, marked salt retention by the kidney may be seen.

Osmolar attraction may also be exerted by compounds other than the sodium, chloride and potassium ions usually considered. The principle ones are urea and glucose. For every 5 mgms. percent that the blood urea nitrogen is raised above normal, 2 mOsm. of osmotic pressure are added. This necessitates a compensatory loss of 1 mOsm. of a cation and 1 mOsm. of an anion - usually sodium and chloride, through the kidneys. For every 35 mgms. percent rise in blood sugar above normal, there is a similar change in osmotic pressure and a similar loss of sodium chloride. Therefore in a patient with a BUN of 115 mgm percent one would not be surprised to see a serum sodium of about 125 mEq. per litre. Similarly with a blood sugar of 450 mgm. per cent one might expect a reduction in serum sodium of about 10 mEq. per litre. In both examples the abnormal amounts of urea and glucose significantly raised the osmolar attraction in the extracellular fluid compartment and caused a loss of sodium. Failure to recognize that hyponatremia in such cases is compensatory and that urinary sodium losses may be obligatory could lead

to over-treatment with electrolyte-containing fluids; surely a dangerous course in some patients.

When hyponatremia is not associated with either of these disturbances, or with cardiac or hepatic disease, the patient will probably benefit from treatment with sodium-containing solutions. How could the deficiency be assessed and what solutions should be used?

Assessment will depend upon ability to estimate the volume of the total body water. The "functional" extracellular fluid compartment is probably about 1/3 of the total. The total body water depends upon age, sex, and body habitus, and lies between 75% of body weight in infants and 50% in desiccated little old ladies. For clinical purposes in emergencies it may be considered to be about 60% of body weight in all individuals. The functional part of the ECFV will be 1/3 of this - therefore about 20% of the body weight in kgm., (eg., in a 75 kgm. man it is about 15 kgms. or 15 litres). If, for example, after transurethral resection of the prostate, serum sodium is found to be 124 mEq. i.e., 20 mEq. below the normal of 144, then one may elect to treat 10 mEq. of this deficit. The size of the ECF pool in this 75 kgm. patient is 15 litres; therefore he needs 15×10 or 150 mEq. of sodium. If this patient is under-hydrated he may be given this as 1 litre of normal saline (containing 154 mEq. of sodium); if well hydrated he may be given hypertonic (5%) saline (855 mEq. per litre of sodium) - 180 cc will give approximately 153 mEq. of sodium.

With this approach the factor of 20% is not a critical one and depends upon how one describes the ECF compartment. One may take a factor of 30% or almost 1/3 of body weight in kgs. as does Astrup. In any case it should be realized that this approach, if it errs, does so on the side of under-treatment. The other approach¹⁰ uses as a guide for the size of the treatment pool the total body water, and assumes that this is what is necessary to be treated. This is also a legitimate approach, but may tend to overtreat the problem when ECF-like fluids rich in sodium are used, since more than half the total body water is sodium-poor fluid.

In summary it should be emphasized that the ability to treat electrolyte, and indeed some acid-base, disorders, depends upon our ability to estimate the size of the compartment of the body in which we hope our treatment will act. Due to the way water is partitioned in the body it would seem most logical to use a factor of 1/5 to 1/3 of body weight in kgms; that is to assume that the extracellular fluid is almost half of the total body water. Since the functional part of the extracellular fluid volume is somewhat smaller than this, making this

assumption implies that the treatment pool will include part of the intracellular compartment. Empirically this has proved successful in our hands.

Evaluation of Water and Electrolyte Balance

Evaluation of water and electrolyte balance depends upon clinical evaluation and laboratory studies. History and physical examination should give a reasonable idea of what, in terms of water and electrolyte, was lost, and perhaps some suspicion of the amount that was lost. Evidence of clinical dehydration in terms of tissue turgor does not generally appear in adults until 4 to 6 litres have been lost. This, with laboratory investigation should give more specific idea of what has been going on. In the laboratory, levels of electrolytes should be correlated with: (a) evidence of possible hemo-concentration expressed by raised levels of BUN and hemoglobin or hematocrit, and (b) the relation of these to the hourly volumes of urine output and central venous pressure.

Conclusion

Reviewed are the normal responses of the body to anaesthesia and surgery, some of the foundations for the various regimens that have been used for maintenance of fluid and electrolyte requirements in the operative period, and some of the approaches which could be used to evaluate and guide treatment in patients during the operative period. □

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Postoperative Hypoxia

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In the days of deep ether anaesthesia, of high spinal blocks and of procedures carried out entirely with intravenous barbiturates, postoperative hypoxia was relatively common. The more observant and concerned anaesthetists dealt with cyanosis by giving oxygen, and tried to avoid chest complications by using carbon dioxide-oxygen mixtures or rebreathing bags to stimulate respiration. Later, a generalised stimulating regime was advocated, and this postoperative "stir-up" did much to offset the depressant effects of anaesthesia, and surgery.

Until accurate methods of measuring carbon dioxide tensions in expired air or blood became available, it was not generally appreciated that moderate depression of respiration led to carbon dioxide accumulation, which was in itself depressant and could lead to further accumulation, depression, coma and death.

These measurements showed that ventilation which was depressed by carbon dioxide retention could be further depressed by the administration of oxygen, since this removed the stimulus of hypoxia. Consequently, the impression grew that oxygen should not be given in respiratory failure, and its use, together with that of carbon dioxide-oxygen mixtures and the rebreathing bag, fell into disfavour.

Recently, it has become a practical possibility to measure oxygen tensions in blood samples and it has been demonstrated that marked falls in the oxygen tension of arterial blood may occur in a very wide variety of circumstances, and that many of these merit closer attention.

Since anaesthetists have been in the forefront of the development of these methods of measuring changes in the oxygenation of the blood, it is not surprising that many of the significant observations on this subject have been made in relation to anaesthesia and surgery.

The purpose of this paper is to review the mechanism through which lowered oxygen tensions may be produced in the postoperative patient, to review the evidence that anaesthetic techniques may contribute to postoperative hypoxia and to suggest ways in which this hypoxia may be avoided with safety.

The Chain of Oxygen Transport

Atmospheric oxygen may fail to reach the lungs in adequate concentration when inert gases are mixed with air, where there is obstruction to the inflow of air into the lungs, or when there is a failure of the

mechanism of breathing. Nevertheless, the fact that adequate concentrations of oxygen reach the lungs does not necessarily mean that there will be adequate levels of oxygen in the blood, since the oxygen may be poorly distributed, and the blood vessels in unoxygenated areas of the lungs will then carry venous blood to the arterial side without oxygenation. The pattern of distribution of inspired air and of the blood vessels surrounding the alveoli differs in different parts of the lung, leading to a degree of shunting in normal individuals, referred to as "the physiological shunt." The fact that blood from the bronchial arteries is returned to the arterial side of the heart via the pulmonary veins accounts for some of the physiological shunt. Thus the oxygen tension of arterial blood is always lower than that present in the alveoli, and a gradient or difference exists between them, called the alveolar-arterial oxygen gradient.

The alveolar-arterial gradient for oxygen could be increased by defects of diffusion of oxygen across the alveolar-capillary membrane, a situation seldom encountered in normal individuals, but which may become important in pulmonary oedema, in certain chronic lung diseases or following cardio-pulmonary bypass.

The commonest cause of an increased alveolar-arterial oxygen gradient is an alteration of ventilation-perfusion relationships secondary to changes in the pattern of ventilation produced by disease, anaesthesia or surgery.

Within the bloodstream, the ability to carry adequate amounts of oxygen to the tissues is profoundly influenced by the haemoglobin concentration, since a fall in haemoglobin is reflected in a disproportionately large decrease in the oxygen carrying capacity of the blood. This cannot be compensated for by increasing the concentration of inspired oxygen, for once the available haemoglobin is saturated, additional oxygen can only be carried in simple solution in the plasma, and plasma has an oxygen carrying capacity some 200 times less than haemoglobin.

Of greater clinical importance is the cardiac output, since a lowered cardiac output will result in the carriage of a smaller quantity of oxygenated blood to the tissues.

The parameters of haemoglobin concentration and cardiac output contain the elements of a vicious circle: if less oxygen is available to the tissues,

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there will be increased extraction of oxygen from arterial blood, and venous blood will be more desaturated. A proportion of this more desaturated blood is shunted to the left side of the heart, thus increasing still further the desaturation of arterial blood. Through the hypoxic drive to respiration, respiration increases in rate and depth, and this increase in respiratory work becomes progressively less efficient, requiring more oxygen to sustain it. The increased oxygen requirements of the tissues will thus lead to more oxygen extraction and desaturation of venous blood, with further desaturation of arterial blood.

One may therefore summarise the chain of oxygen transport as follows:

- Inspired oxygen concentration
- Alveolar oxygen concentration
- Ventilation-perfusion ratio
- Diffusion capacity
- Physiological shunt
- Cardiac output
- Haemoglobin concentration
- Tissue perfusion
- Tissue oxygen consumption
- Desaturation of venous blood

Aetiology of Postoperative Hypoxia

While underventilation due to the respiratory depressant affects of anaesthetics or to restriction of respiration by the pain of surgery could result in hypoxia, hypoxia can occur without underventilation. Nunn and Payne demonstrated in 1962¹ that hypoxia occurred almost universally in healthy patients undergoing minor elective surgery, and certainly, few of their patients could have had significant respiratory depression. Among possible aetiological factors, attention has been directed to alterations in the mechanics of breathing during and after anaesthesia and surgery, the effects of breathing various gas mixtures, and of alterations in cardiac output and haemoglobin concentration.

(1) THE PATTERN OF BREATHING

Using ether and air mixtures, Marshall and Grange demonstrated in 1966² that on spontaneous respiration on air there was a fall in arterial oxygen tension persisting for up to three hours postoperatively, and that this was accompanied by a fall in alveolar ventilation and a rise in the alveolar-arterial oxygen gradient. During this time the pCO_2 and the ratio of dead space volume to tidal volume remained unchanged. When patients were given artificial ventilation at normal minute volumes, pO_2 's remained low, the alveolar-arterial oxygen gradient increased further, and the ratio of dead space to tidal volume increased. When ventilation was increased to twice the normal minute volume, as would be expected, alveolar ventilation increased and pCO_2 fell. While there was a further increase in the alveolar-arterial oxygen gradient, the pO_2 now rose to normal levels, and there was no further increase in the ratio of dead space to tidal volume.

This confirms the observations of Bendixen's group in 1964³ that the oxygen tensions of patients under anaesthesia, after falling progressively, may be raised by three or four deep inflations. This group has popularised the use of the deep sigh at intervals in patients being ventilated at a steady rate.

From these observations it would seem that anaesthesia is associated with an increased physiological shunt, or venous admixture, as shown by the increased alveolar-arterial oxygen gradient. This is due in part to alterations in the number of alveoli perfused but not adequately ventilated. This change is increased by artificial ventilation, which increases dead space and further alters ventilation-perfusion relationships. However, normal safe oxygen tensions in arterial blood can be obtained by using large tidal volumes and a minute volume about twice that of normal ventilation.

These observations receive confirmation from a theoretical analysis of Fairley in 1966⁴ which showed that while hyperventilation could raise the tension of oxygen in the alveolus, oxygen tension in arterial blood would rise to a lesser degree, thus producing an increased alveolar-arterial oxygen gradient.

(2) THE EFFECT OF BREATHING OXYGEN

In 1965, Nunn and others⁵ demonstrated in volunteers that forced expiration produced radiological evidence of atelectasis with lowering of the arterial pO_2 , but that this change was readily reversible on return to a normal breathing pattern. If, however, oxygen was breathed, forced expiration produced more marked atelectasis which persisted for a much longer period.

In the same year, Dery and his co-authors⁶ showed that alveolar collapse could be induced by denitrogenation under anaesthesia and in conscious volunteers breathing oxygen. These changes did not occur when the volunteers were given mixtures of 50% oxygen and 50% nitrogen, and anaesthetised patients given these mixtures also showed no change.

This implies that the steady fall in pO_2 observed by Bendixen et al.³ was indeed due to progressive atelectasis, and could be prevented by breathing oxygen-nitrogen mixtures.

(3) ALTERATIONS IN CARDIAC OUTPUT.

The marked fall in cardiac output frequently demonstrated during anaesthesia has been attributed to the direct myocardial depressant effects of anaesthetic agents, combined with the effects of hyperventilation. While increased cardiac outputs have been demonstrated in the postoperative period in association with CO_2 retention, it is likely that cardiac output may remain subnormal in many surgical patients where there is hypotension, vasoconstriction and persistent hypovolaemia. Under these circumstances, venous blood will be more desaturated, and the normal physiological shunt will therefore add blood of a lower oxygen content to the arterial side, resulting in an increased alveolar-arterial oxygen difference. This effect will be

enhanced by assisted or controlled respiration, by a lowered hemoglobin concentration, or by the great increase in respiratory work following many surgical procedures.

(4) THE EFFECTS OF SURGERY

In addition to the restrictions imposed upon respiration by postoperative pain, it must be recognised that whenever the chest or abdomen is entered, there is a loss of the normal intracavity negative pressure, with compression of the lung to a new level of slight deflation. This deflation may be reinforced by the residual effects of muscle relaxant drugs. If voluntary deflation of the lung can lead to atelectasis⁵, then it is equally likely that atelectasis will follow this deflation of the lung induced by surgery and anaesthesia. The marked reduction in compliance and functional residual capacity and the frequent occurrence of bronchospasm seen in patients with flail chests is but an exaggeration of the state of affairs which may exist in many postoperative patients.

(5) THE EFFECTS OF PROLONGED OXYGEN THERAPY

Pratt in 1965⁷, reported that patients who had received concentrations of more than 50% oxygen for more than two days show thickening of alveolar septae and capillary proliferation at post-mortem. Northway and others in 1967⁸, showed profound clinical, radiological and pathological changes in a group of infants treated with warmed humidified oxygen for more than 24 hours., and felt that these changes could be directly related to the concentration of oxygen employed and the duration of treatment. This indicates that the use of oxygen is not without risk, and that care must be taken to use low concentration for as short a period as it appears clinically necessary.

The Treatment of Postoperative Hypoxia

We have seen that anaesthesia, whether carried on under spontaneous respiration or under controlled respiration, is almost invariably followed by some degree of hypoxia for varying periods. It has been shown that this hypoxia can be avoided by the administration of 30% oxygen⁹, and it is probable that this simple measure should be applied to all postoperative patients, but should certainly be used in those who are most at risk from hypoxia. Thus, elderly patients, those showing vasoconstriction, or in whom hypovolaemia is suspected, and those patients with myocardial impairment, should certainly be given oxygen postoperatively for at least two to three hours. Adequate measures may be needed to restore blood volume and lost haemoglobin in many patients, but are vitally necessary in this elderly poor risk group. Care should be taken to reverse residual curarisation, or if this is not possible, adequate ventilation must be maintained with a respirator. The correction of postoperative acidosis with 50 - 100 mls of sodium bicarbonate solution (44.3 mEq/vial) should be carried out empirically in any patient who shows poor tissue perfusion, or who has

shown prolonged hypotension under anaesthesia. Correction of acidosis will also assist in counteracting the effects of residual curarisation. In the minor elective patient, rebreathing devices may encourage the patient to take deep breaths, and expand atelectatic areas. Alternatively, chemical stimulants, such as Dopram 20 mg by slow intravenous injection, will encourage deep breathing and improve cardiac output. With these two methods, our own studies have demonstrated a small but useful rise in arterial pO₂ following their use.

In our intensive care area, it has become our practice to carry out vigorous hyperventilation with the Ambu bag using air, on all patients maintained on respirators, and this practice has been followed by a marked improvement in pO₂ levels where the pO₂ had previously been below normal. In addition, the evidence of Frumin and others in 1959¹⁰ that a positive pressure of 5 mm Hg. applied to the airway during expiration will cause an increase in functional residual capacity and an increase in arterial oxygenation has been put to work in patients showing lowered pO₂s on artificial ventilation, particularly the post-open-heart patient. It has become our practice in these patients to use the retard cap of the Bird respirator, or the expiratory positive pressure device of the Engstrom respirator, to provide continuous positive expiratory pressures in these patients, with resulting improvement in arterial oxygen saturations. We believe that this improvement is caused by returning the chest from a position of partial deflation favouring atelectasis, to a more normal position where atelectasis is less likely to occur.

In addition to these measures, we are much more critical of our standards of adequate ventilation, and will maintain patients intubated, and on respiratory assistance in the recovery room until there is ample evidence that the patient has recovered from all residual effects of respiratory depressants and curarising drugs.

In the relief of postoperative pain, there are a number of measures which may be helpful. The use of neurectomy at the time of surgery, the combination of narcotic with narcotic antagonist to reduce respiratory depression, and the use of continuous segmental epidural blocks all have their place in the treatment of patients at risk from chronic lung diseases.

Whenever prolonged ventilation is contemplated or undertaken, an attempt is made to ventilate the patient on oxygen air mixtures containing less than 30% oxygen. If higher percentages of oxygen are required, then they are given, but the arterial pO₂ is carefully monitored, and oxygen is withdrawn as rapidly as the clinical circumstances permit. In this connection it is worth emphasising that the pressure-cycled respirators such as the Bird or Bennett, deliver from 70 to 90% oxygen when they are driven from an oxygen source, even when they are set on

full air dilution. To deliver lower percentages, these respirators must be operated on air, and a low flow of oxygen added in through the Venturi air intake, or through the nebuliser supply. The Engstrom respirator operates normally on room air, and oxygen percentages can be increased by the addition of calculated volumes of oxygen through a rotameter.

Summary

In summary, it may be said that postoperative hypoxia is a widely unrecognized syndrome of

frequent occurrence, and that the effects of this hypoxia can be avoided by the administration of 30% oxygen. Concentrations greater than 30% employed for periods longer than 24 hrs may lead to pathological changes in the lungs. In avoiding the effects of tissue hypoxia, an adequate cardiac output must be sustained through volume replacement, and the haemoglobin concentration and electrolyte balance maintained at normal levels. Additional measures which may prove helpful in the management of both minor and major elective surgical procedures have been discussed. □

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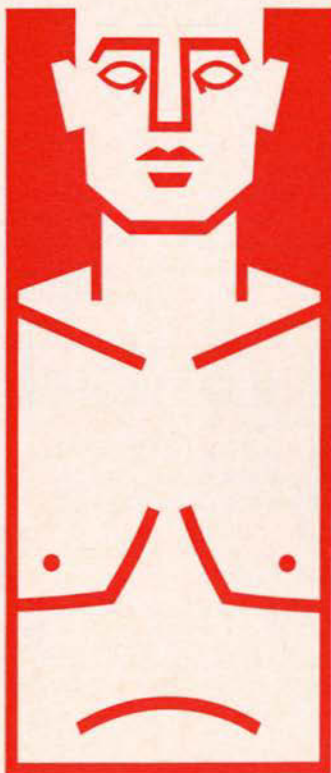
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LEGISLATION REGARDING ABORTION

"... Similarly I will not give to a woman a pessary to cause abortion" — Oath of Hippocrates 460-370 B.C.

It has been estimated that every year one out of every twenty Canadian women undergoes a criminal abortion. Small wonder then that there have been extensive discussions of this matter over the past ten years in medical and legal circles and in the lay press.

The relevant law in Canada is contained in Sections 237 and 238 of the **Criminal Code** which state in effect that anyone, including the pregnant woman herself, who employs any means to procure a miscarriage is guilty of an indictable offence and is liable to life imprisonment. Sections 195 and 209 are in conflict with these later sections; Sec 195 defines a human being as "a child which has completely proceeded in a living state from the body of its mother, whether or not it has breathed" and Sec 209 specifically exonerates "any person who, by means that, in good faith, he considers necessary to preserve the life of the mother . . . causes the death of a child which has not become a human being."

In August, 1966, the Canadian Bar Association recommended the following amendments to the Criminal Code:

- (A) That, if performed by a licensed medical practitioner in an accredited hospital on the written consent of the woman or her legal guardian and after approval by the Therapeutic Abortion Committee of the hospital, an operation for the termination of pregnancy be lawful:
- (i) if continuation of the pregnancy endangers the life or health of the pregnant woman,
 - (ii) there is substantial risk that the child may be born with a grave mental or physical disability,
 - (iii) there are reasonable and probable grounds to believe a sexual offence has been committed from which pregnancy has resulted.
- (B) That such termination of pregnancy be lawful only if application has been made to a provincial "Termination Board" consisting of seven members, three being

medical practitioners, two barristers and solicitors, and two social workers, such hearings being held in camera.

In June, 1967, the Council of the Canadian Medical Association approved the first of these two points, but not the second one which recommended the establishment of Termination Boards. It communicated its recommendations to the Minister of Justice.

In December, 1967, the Minister indicated his intention to introduce a Bill amending the **Criminal Code**, Clause 17 of which, no doubt in part due to the submissions, would amend Section 237 to permit a qualified medical practitioner to carry out therapeutic abortion with the permission of the pregnant woman on the authorization of a hospital abortion committee if this committee certifies in writing that continuation of pregnancy would endanger her life or health.

We discussed the question of abortion previously in THE BULLETIN in June, 1967, and in July the Committee on Medical Legal Liaison conducted a panel discussion on the subject at the Summer Meeting of the Medical Society.

In November a second panel discussion was held under the aegis of the Medical Legal Society of Nova Scotia.

It occurred to us that the views of the distinguished panelists would be of interest to the many members of the Medical Society who were unable to attend these discussions. Accordingly, each of the panelists was asked to answer the following two questions:

- (A) *What are your comments concerning the recommendations by the Canadian Bar Association and the Canadian Medical Association with respect to legalizing abortions?*
- (B) *What changes would you recommend yourself?*

In this, and the subsequent two issues of THE BULLETIN we shall be publishing the answers which we have received.

H. B. Atlee, M.C., M.D., C.M., LL.D.
F.R.C.P.S., F.I.C.S.

*Emeritus Professor of Obstetrics and Gynecology,
Dalhousie University*

My comment on the recommendations of the Canadian Bar Association and the Canadian Medical Association with respect to legalized abortion is that they are hopelessly inadequate to meet the abortion situation. They are designed simply to legalize medical intervention where the life of the mother and well being of the child are at stake. This merely touches the hem of the garment, since of all the abortions done yearly on this continent, those done for medical reasons are a fraction of a percent.

The real problem is the abortion done illegally either by doctors or others under such inferior surgical conditions that there is a high mortality to the woman and an even higher morbidity. What we need to do is so legislate that this human wastage can be ended. This means taking the onus of deciding who will have an abortion and under what circumstances away from the medical and legal professions, and giving it to the woman concerned. It means that a woman should be as free to obtain an abortion as she now is to obtain an automobile.

She simply requests that a properly qualified doctor do the abortion in a properly run hospital. It should be as simple as that.

Under the grounds proposed by the Bar and the Medical Profession, the onus would fall on the doctor. Human nature being what it is, he will be asked to strain the points laid down to cover a much wider license than intended in the legislation. The situation so created will not be unlike that which beset the medical profession under prohibition, where every doctor in the country was plagued to write prescriptions - and practically every doctor did - knowing full-well that the liquor so prescribed was for a thirst and not a sickness. Nor would this legislation in any way cut down the illegal abortions. The woman who wants to get rid of an unwanted fetus, and is unable to do so legally, will continue to do so as at present - illegally.

While as an obstetrician I welcome any legislation that safeguards my profession in a situation where at present there are no legal grounds for interrupting pregnancy, I feel that sooner or later legislation must be enacted to deal with the very much more serious and deadly circumstances I have indicated. My recommendation therefore is that all statutes in the criminal code dealing with abortion be rescinded.

(To be continued)

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Inadequate Prenatal Care and Toxemia of Pregnancy

Reprinted from The Canadian Medical Association Journal, August 27, 1966, Vol 95, page 410.

A 31-year-old married woman, pregnant for the second time and with a history of a spontaneous abortion seven years before the second pregnancy, made her first prenatal visit to her physician at 29 weeks' gestation. At this time she weighed 206 lb. (a weight gain of 31 lb. from her non-pregnant weight); her height was 64 in.; her urine was normal; and her hemoglobin (Hb.) was 11.5 g. % The blood pressure was not recorded. She was of low mentality and was extremely unco-operative during the pregnancy.

The patient made her second prenatal office visit when 35 weeks pregnant. In the six weeks between the first and second office visits she had gained 14 lb. Her blood pressure was 220/110 mm. Hg; her urine contained 150 mg. % of albumin and she had pitting edema of her legs. She refused hospitalization at this time and was placed on 50 mg. of hydrochlorothiazide daily.

The patient did not return for a third office visit until four weeks later, when she was 39 weeks pregnant. At this time she was immediately hospitalized because of severe headache, edema of her legs, a blood pressure of 220/120 mm. Hg. and 200 mg. % of albumin in her urine. She was not in labour and would not stay in bed as requested. The patient was placed on a salt-free diet, $\frac{1}{2}$ grain of phenobarbital three times daily and 0.2 mg. of reserpine and 50 mg. of hydralazine (Serpasil-Apresoline) three times daily.

On the third hospital day, her blood pressure was 150/96 mm. Hg. and the urine albumin was 200 mg. %. Because the patient had refused surgical induction of labour, an unsuccessful medical induction was attempted using 2 minims of oxytocin (Syntocinon) intramuscularly every half hour for six doses.

Her blood pressure varied from 160/88 mm. Hg. to 220/124 mm. Hg on the sixth hospital day.

On the seventh hospital day, her blood pressure was 205/105 mm. Hg, her fasting blood sugar was 114 mg. % and her Hb. was 8.6 g. % Oral iron therapy was begun.

Spontaneous labour began on the tenth hospital day. Radiographic pelvimetry, done on the eleventh hospital day, was reported as follows: "A single fetus is presenting in the right occipital anterior position. The head is engaged and at the level of the ischial spines. There are no maternal or fetal abnormalities. No definite cephalopelvic disproportion

is present. The placenta is in the upper uterine segment."

After 17 $\frac{1}{2}$ hours of labour the cervix was dilated 8 cm.; however, most of the fetal head was above the pelvic inlet. The cervix was fully dilated after 21 $\frac{1}{2}$ hours of labour and the fetal head appeared to be engaged. Nitrous oxide, ether and oxygen anesthesia was given after 22 $\frac{1}{2}$ hours of labour, and a vaginal examination showed the cervix to be fully dilated; the fetal head was in "deep transverse arrest" in the right occipital transverse position. Using forceps, an unsuccessful attempt was made to rotate the fetal head to the anterior occipital position. After this failed, the attending physician and the other general practitioner who had been giving the anaesthesia agreed that a Caesarean section was indicated. The blood pressure was still elevated and the fetal heart sounds were normal. A third doctor was summoned from a neighbouring town to give the anaesthesia while the two local doctors performed the surgery.

Two hours after the "failed forceps", a second anaesthesia of nitrous oxide, ether and oxygen was given and a Caesarean section was begun. It is not known whether a classical or low transverse Caesarean section was performed. On exposure of the uterus, 10 units of oxytocin was injected into the myometrium. After the uterine incision had been made, the attending physician and his assistant took 10 minutes to dislodge and deliver the impacted fetal head. When the head was delivered 20 minutes after the beginning of surgery, "it came out with a plop". Immediately, after the delivery of the head, the blood pressure, which had been 230/140 mm. Hg before delivery, fell to 80/20 mm. Hg. The placenta was manually removed and there was no excessive bleeding or laceration of the uterus. The patient received 0.5 mg. of ergonovine maleate (Ergotrate Maleate) intramuscularly after the delivery of the placenta. Dextran was given intravenously, but the blood pressure continued to fall and respirations ceased 55 minutes after the delivery of the head. Autopsy permission was refused.

The 10 lb. 12 $\frac{1}{2}$ oz. female infant was in poor condition at birth and, when respiration was established, the infant had a "shrill cry". She was resuscitated at birth by oxygen and mouth-to-mouth breathing. The infant's condition appeared to improve up to two days of age when she suddenly

*This series of articles arranged by an editorial subcommittee of the C.M.A. Committee on Maternal Welfare, and originally published in the Canadian Medical Association Journal, is being reproduced in the Bulletin at the request of The Medical Society of N. S. Committee on Maternal and Perinatal Health, by kind permission of the Editor of the Canadian Medical Association Journal.

died, after developing petechiae on the arms and face. Autopsy was not done but the clinical cause of death was considered to be "cerebral hemorrhage".

Decision of the Provincial Committee on Maternal Welfare

The following conclusions were reached by the Provincial Committee on Maternal Welfare after a review of this case.

"This was a preventable direct maternal death. As an autopsy was not done, the exact cause of the maternal death was unknown. In a patient with a blood pressure of 230/140 mm. Hg, the precipitous drop in blood pressure following the traumatic efforts during Caesarean section to dislodge the impacted fetal head suggests that death was due either to cerebral hemorrhage or pulmonary infarction. There were combined patient and professional preventable factors.

"The patient did not seek early and adequate prenatal care and was extremely uncooperative during the course of her pregnancy.

"The professional factors were: inadequate prenatal care; failure to determine the Hb. until the seventh day after admission to hospital; inadequate treatment of the anemia; inadequate treatment of the pre-eclampsia; the use of intramuscular oxytocin to induce labour; the use of an ergot preparation in a patient with hypertension; performance of a Caesarean section in the presence of severe anemia without blood for transfusion and without additional specialized assistance, or without transferring the patient to a hospital where blood transfusion, adequate facilities and specialists were available.

"This maternal death was considered ideally 'preventable' under the terms of reference of the Provincial Maternal Welfare Committee and there is no implication of any negligence."

Discussion

This patient's hemoglobin level was not determined until the seventh day after her admission to hospital, at which time it was found to be 8.6 g. %. Prenatal Hb. determination should be done when the patient is first seen, should be repeated at least once during the pregnancy, preferably at 36 weeks' gestation, and should be done again when the patient is admitted to hospital. When delivery is imminent and the Hb. is found to be at a critical level, arrangements for immediate blood procurement and replacement should be made.

Ideally, maternity patients should make prenatal office visits at least monthly for the first seven months, every two weeks during the eighth month and weekly during the ninth month. When an uncooperative maternity patient does not seek adequate prenatal care, the attending physician has an obligation to attempt to stimulate the patient to obtain such care. There are several ways to accomplish this: telephone contacts with the patient or

home visits by the attending physician, regional medical officer, or public health nurse.

Delayed hospitalization and/or inadequate therapy for pre-eclampsia have been reported following many maternal mortality studies. This patient did not seek prenatal care until she was 29 weeks pregnant. She did not return to the physicians office for a second visit until six weeks later. At this time she had gained an additional 14 lb. (a total weight gain during pregnancy of 45 lb. up to this time), the blood pressure was 220/110 mm. Hg. and albuminuria and pitting edema of the legs were present. The patient refused to go to hospital at this time. When a physician is presented with such a situation, he must explain to the patient in the most forceful manner that she is seriously ill and must be immediately hospitalized and treated. If he is not successful in convincing the patient of the need for hospital care, the husband or other responsible members of the family must be informed of the seriousness of the situation and their co-operation sought. If this patient had been admitted to hospital and the pre-eclampsia adequately treated when she was 35 weeks pregnant, this death would probably have been prevented. Adequate treatment of the pre-eclampsia at this stage would have included bed rest, diet, sedation, oral diuretics and hypotensive agents or magnesium sulfate intramuscularly. If the pre-eclampsia did not improve with this regimen, a pre-term induction of labour should have been undertaken, and if this was unsuccessful or if the labour did not proceed normally, a Caesarean section should have been performed.

The use of oxytocin intramuscularly to induce labour is a dangerous procedure which may result in hypertonic uterine contractions with the risk of fetal anoxia, fetal death, or uterine rupture. When it is used to induce labour, oxytocin should only be administered in a dilute intravenous drip, beginning with 2 to 5 units of oxytocin in 500 c.c. of 5% glucose in water at the rate of 15 drops per minute. This rate of intravenous infusion should be varied according to the uterine response and should be under the constant supervision of the attending physician.

Cases have been described in the literature where the use of ergot preparations following the delivery of the infant and placenta has resulted in severe hypertension with cerebrovascular hemorrhage. Because of this association it is sound obstetrical practice to use 10 units of oxytocin intravenously instead of ergot preparations after the delivery of the placenta in hypertensive or pre-eclamptic patients. Some obstetricians now use 5 to 10 units of oxytocin (Pitocin or Syntocinon) intravenously after the delivery of the placenta for all parturients, because of the hypertensive effect of ergot derivatives in some patients.

The 10 units of oxytocin which was injected into the myometrium immediately before the delivery

of the infant probably contributed to the difficulty in extracting the fetus at Caesarean section. Such intramyometrial injection of oxytocin before delivery by Caesarean section is not recommended because it may cause uterine spasm and make extraction of the infant difficult.

After a trial of labour or "failed forceps", particularly when the membranes have been ruptured for several hours, the head may become deeply impacted in the pelvis. In such an instance it is not unusual to have difficulty in extracting the fetal head at Caesarean section. When the head is thus impacted, an assistant should push the head up from below (i.e. with a hand in the vagina) to help its prompt delivery after the uterine incision has been made.

The attending physician in this case was confronted with many obstetrical complications (the

uncooperative patient, severe pre-eclampsia, severe anemia, failed induction of labour and probable cephalopelvic disproportion). He would have been well advised to transfer the patient to a larger hospital where blood transfusion, additional specialized assistance and adequate facilities were available. It was unfortunate that the attending physician did not insist that an autopsy be performed before he signed the death certificate.

Summary

A maternal death was reviewed by the Provincial Committee on Maternal Welfare. An autopsy was not done; therefore the exact cause of death was unknown. However, the clinical course suggests that the death was due either to cerebral hemorrhage or pulmonary infarction. The preventable factors are discussed. □

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Public Health News

Rehabilitation

The rehabilitation program of the Department of Public Health is expected to be transferred to the Department of Public Welfare and expanded considerably there, F. G. Wellard, director of rehabilitation, said.

He said it was expected this would be done "for practical reasons and to provide better services to more handicapped persons." As yet "there has been no action on this at the ministerial level," Mr. Wellard said.

The expected transfer follows a recommendation of the Welfare Minister's Advisory Committee on Rehabilitation. This committee also called for a rehabilitation adviser, responsible to the director of welfare services, to advise on how best to develop an effective rehabilitation program in the province.

In addition, the committee recommended the appointment of a provincial advisory committee on rehabilitation to advise the Minister of Public Welfare on how best to spend the funds available. It also called for the setting up of local advisory committees.

The committee wants the province to promote the development of integrated sheltered workshops in all communities where there is a need and to pay 80 per cent of the costs involved in establishing these workshops.

The province should institute, the report said, "a program of research to determine the needs of disabled children and particularly what can be done to assist in their treatment and rehabilitation, as well as in establishing preventive services."

The committee recommended that consideration be given to allowing trustworthy prisoners to attend training courses during the day and to return to their cells at night until their confinement ends.

An alternative suggestion was to make available training courses for prisoners in the evenings in trades training schools or academic institutions. The committee felt "study classes and library facilities" should be "made available in jails" to encourage prisoners to further their education.

Members of the committee were: G. P. Coleman, Q.C. chairman; Frank Wellard, rehabilitation director; H. S. Farquhar, director, old age assistance, Nova Scotia Department of Public Welfare; D. A. McLeod, Plant Manager, Crossley-Karastan, Carpet Mills Limited, Truro; P. T. Meyer, Retired United States Consul-General; and Mrs. Edith A. Phillips, Port Morien, N. S.

Measles Vaccine Program

"Nova Scotia has halted its proposed program of measles vaccination for the time being", said Dr. H. B. Colford, Communicable Diseases Control Director, Nova Scotia Department of Public Health.

A number of severe reactions had been reported throughout the world, he said, when the "killed" vaccine was given followed by a dose of the "live" vaccine. The province had planned to use the "killed" vaccine by incorporating it in the general immunization program. Instead it will wait for further tests on the vaccine.

Cattle with Tuberculosis

Three cattle herds in the Fundy Health Unit were found infected with tuberculosis but the risk of humans contracting the disease is not too great, Dr. G. M. Smith, unit director, said.

He pointed out that testing of one of the herds revealed 43 reactors, which on slaughtering, revealed 18 with extensive glandular lesions, in five instances so great that the carcasses were condemned. The usual testing of families who had been in contact with the herd revealed nothing unusual.

In Nova Scotia, it would appear, he said, that "bovine tuberculosis as a cause of disease to the general population is negligible" but it was a "possible source of infection and disease to veterinarians and those working with cattle or in slaughtering houses." Exclusive of the three herds, the infectivity rate in cattle for the province was found to be in the vicinity of 0.1 per cent, as for all of Canada.

He felt attention should still be given to families with infected herds and he urged veterinarians and those in slaughter houses to have annual X-rays. □

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