A SHORT TEXTBOOK OF SURGERY

By

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PREFACE TO THE EIGHTH EDITION

In the 27 years since this book first appeared the whole face of surgery has changed. On the one hand, following the introduction of antibiotics, Tuberculosis, Syphilis, Gonorrhœa and many other infections have lost their significance, while, on the other hand, improved anæsthetics and better techniques have opened new fields of surgery, most notably in the heart and major vessels.

Such advances continue, and in the present edition I have aimed to keep pace with them. With this object the whole book has been revised and hardly a single page has escaped change. In particular the early chapters on Wound Healing, on Hæmorrhage and Shock and on Fluid and Electrolyte Imbalance have been redrafted and brought up to date and a long new section has been introduced on the modern surgery of the heart. More details of operation technique have been introduced and a number of new illustrations have been added.

Equally important, all obsolete matter has been eliminated, and by ruthless pruning it has been possible, though adding much new matter, to avoid any significant increase in the size of the book.

1965. C. F. W. I.

EXTRACT FROM THE PREFACE TO THE FIRST EDITION

With the growth and increasing complexity of the surgical specialties, the task of preparing, single-handed, a comprehensive textbook of Surgery grows steadily more formidable. Yet the very diversity of modern surgical practice emphasises the continued need for textbooks which will give a balanced account of the whole field of surgical work from the standpoint of the general surgeon.

I have endeavoured to mould this book in a form suitable for undergraduate and postgraduate students, avoiding on the one hand the imperfections of the smaller handbooks and, on the other, the encyclopædic unwieldiness of compilations. I have tried to make it comprehensive and yet, by economy of phrase, to keep within the bounds of a single volume; and by the use of simple English constructions and logical sequences, to make it readable.

I must confess a lack of experience in certain of the special branches of Surgery, which will doubtless be reflected in the chapters devoted to those subjects. However, I hope to have made the book suitable for the general reader; as for the specialties, the most I can hope is that my neurology will satisfy the urologists, my gynæcology the orthopædists.

The writer of a textbook must marshal his facts from many sources, from older textbooks, monographs and current literature. Since in a book of this size it would clearly be impossible to quote all one's authorities, whilst to quote a few would be invidious, I have refrained from indicating references in the text. Instead, I wish to make a general acknowledgement of my indebtedness to all such sources of information.

C. F. W. ILLINGWORTH.

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CHAPTER 1

SAFETY FACTORS IN SURGERY

Assessing the Risk of Operation. Before advising operation the surgeon must ask himself the following questions: Is the patient fit for operation? Is the type of operation proposed one that the patient is fit to undergo? Is the operation one necessary to preserve life, in which case certain risks must be faced, or one that may be postponed or avoided? If operation is necessary, how can the technique be adjusted to minimise the risks?

Apart from the routine clinical examination of heart and lungs and urine, it is very important to assess the patient as a whole. His facies, nutrition, attitude and general bearing offer evidence to the practised eye. When possible, he should be examined standing, to study his capacity for effort. In the majority of cases such an examination, carefully performed, will suffice along with the history to pass the patient as fit for ordinary operative procedures.

In patients whose fitness to undergo operation is not beyond question, further examination is necessary. The cardiovascular system requires special care. The pulse rate, the blood pressure, the state of the capillary circulation, the condition of the heart and blood vessels, and particularly the response to effort, must all be taken into account. Routine hæmatology is carried out. An electrocardiogram and a plain chest X-ray may be needed.

Pre-operative Preparation. A young healthy person requires little pre-operative preparation; in fact, the less the better. He should go on a light diet for the day before operation, and take a mild aperient if he is constipated, but that is all.

In a patient in impaired health, especially if a major operation is contemplated, more prolonged preparation is advisable. He should be admitted to hospital several days before operation. A few days' rest in bed makes a great difference to the over-strained business man or the tired housewife. A high protein diet rich in carbohydrate should be given. Alcohol should not be withheld from a patient who has been accustomed to it.

The fluid balance may need special attention, with intravenous infusion of saline and glucose (p. 18). If the hæmoglobin level is low, transfusions of blood or packed red cells are given several days before operation to enable tissues damaged by anoxia to recover. Other special measures are needed in special types of cases.

Operation Room Technique. Consistent success in surgery demands a scrupulous aseptic technique. The patient's skin, the surgeon's hands, the air of the operating theatre, the instruments and dressings must all be maintained in a state of as complete sterility as may be

possible, and the whole conduct of the surgical team must be organised to prevent contamination.

The patient's skin should be shaved, cleaned with alcohol, and painted with an antiseptic. Even then it may not be completely sterile, so once the incision is made towels must be clipped to the wound edges to ensure that no contamination comes from this source.

The surgeon's hands are difficult to sterilise. Reliance must not be placed on the protection offered by rubber gloves, for the gloves often are torn during operation. The difficulty is increased by the fact that many antiseptics suitable for a single application to the patient's skin cause dermatitis if used frequently by the surgeon.

The surgeon must keep his hands in good condition, with the nails well trimmed. He should at all times avoid contact with potentially

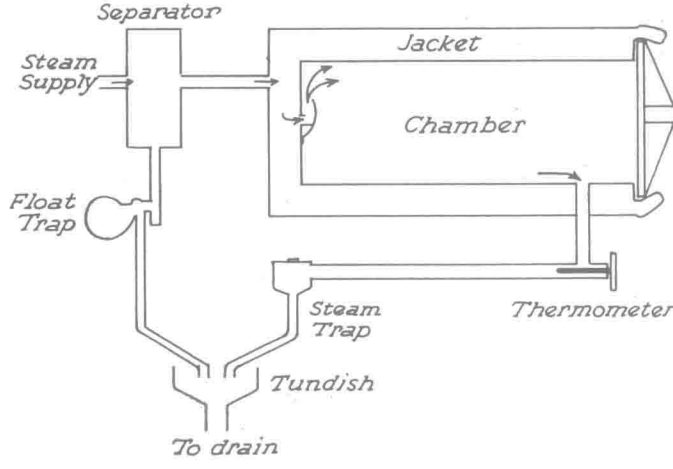

FIG. 1. Steam steriliser. Steam at 121°–126° C. circulates through jacket and, entering chamber, displaces air downwards. Note thermometer on exit tube.

virulent infection and must never touch a septic wound with the ungloved hand. He must never operate if he has a sore throat or a boil or other infective process in the skin.

Air-borne infection occurs most readily in prolonged operations. Contamination from the nose and throat can be controlled by the use of impermeable face masks, which should be compulsory for surgeons, assistants and spectators. The theatre should be ventilated by filtered air from outside rather than contaminated air sucked in from wards and corridors.

Methods of Sterilisation. Instruments, thoroughly cleaned with soap and water, are sterilised in boiling water or a suitably designed autoclave. Boiling will destroy all organisms but not spores. Sharp-edged or pointed instruments, which would be blunted by boiling in water,

may be boiled in oil or sterilised in strong lysol or Dettol solution. Spirit, though in common use, is inefficient as a sterilising agent.

Dressings, towels and swabs are sterilised by exposure to steam, usually at 15 to 20 lb. pressure per square inch. This moist heat at 121° to 126° C. is essential to destroy spores, for example the spores of tetanus, which are commonly present in raw wool.

The materials are packed loosely in bags or fenestrated drums and placed in the autoclave, which is heated by admitting steam to the jacket and chamber. All the air must be removed, preferably by a high vacuum pump or by gradual downward displacement of the air by steam. The steam then percolates down through the materials, condensing as it does so. The resulting transfer of latent heat in the presence of moisture will exert maximum effect. After the appropriate time has elapsed, depending on the method of packing, the temperature and pressure, and ranging from twenty to fifty minutes, the materials are dried quickly by passing warm filtered air through. Browne's tubes, which should change colour from red to green, may be inserted with the materials in each bag as a routine, while occasional bacteriological checks are desirable.

Recovery Ward Routine. After many ordinary procedures a patient's post-operative needs are minimal. During recovery from anæsthesia his air way must be watched, the pulse rate and general appearance checked. He is kept warm, with blankets and a hot bottle if necessary, and usually he needs a sedative. An aperient is given two or three days later, if required. The wound, if not contaminated and without a drain, should need no attention and is best left undisturbed until the stitches are due to be removed.

More serious cases need individual care for several hours or even a few days. In hospital this is best done in an organised Recovery Room, with facilities for continuous monitoring, for administration of fluids and oxygen, for immediate X-ray examination and laboratory investigations. In such cases the pulse rate and blood pressure should be recorded every two hours; blood, saline, electrolytes are given as required; an e.c.g. record can be made available on tap; there may be a need for repeated estimations of blood volume or acid base balance.

Modern anæsthesia is usually safe and trouble free. Nevertheless, in the recovery room care should always be taken to ensure proper respiration, especially in patients with chronic respiratory disease or any impairment of respiratory movement. After relaxant drugs also there is the occasional risk that owing to idiosyncrasy recovery of respiratory movements will be incomplete. This may lead to CO_2 retention, to narcosis (which may be obscured if sedatives have been administered) and to a disastrous fall of blood pressure (see p. 19).

In countries such as Britain where post-operative chest complications are common special steps should be taken to prevent them. Pre-operative chest exercises are useful. After operation the patient is propped up as soon as he is conscious and encouraged to breathe deeply. Chest exercises are continued.

Antibiotics in Surgery

The introduction of antibiotics produced a revolution in surgery second only to Lister's discovery of the causes of wound infection. In the light of these changes it is interesting to look back on the first edition of this textbook which was written before the introduction of penicillin. Since then erysipelas and other streptococcal infections, gas gangrene, pneumococcal diseases, osteomyelitis, syphilis, gonorrhœa and tuberculosis have almost disappeared or at least ceased to be major problems of surgery. A wound of the kneejoint no longer means permanent crippledom; an infected finger no longer implies economic disablement; a carbuncle of the lip no longer spells acute danger to life. But we have leant that antibiotics are not free from danger both to the individual patient and the community at large, and the growth of resistant strains of organisms has brought new problems.

Toxic Effects of Antibiotics. While far fewer than with many other types of drugs these can be serious in a small proportion of cases. *Sulphonamides* often give rise to malaise and vomiting and sometimes to sensitisation effects with pyrexia and various skin reactions. *Penicillin* is still the least toxic of the antibiotics but occasionally causes skin rashes. *Streptomycin* carries the particular risk, serious but fortunately rare, of permanent damage to the vestibular and acoustic nerves. The *tetracyclines* occasionally cause pyrexia and skin rashes and may cause enterocolitis due to resistant staphylococci while *chloramphenicol* may give rise to a fatal type of aplastic anæmia.

Resistant Strains. The development of these is not seen with the sulphonamides but can occur with all the later antibiotics. One result is that the infective process under treatment neither resolves nor comes to a head but persists as a chronic inflammatory mass which may resist treatment for many months. This is seen often in acute mammary abscess, or in puerperal infection where a "frozen pelvis" occurs with extensive granulomatous masses and numerous adhesions. A more dangerous result, seen especially after oral administration of the tetracyclines is that destruction of most of the normal intestinal flora leaves the way clear for resistant strains and leads to thrush infection of the mouth and severe and often fatal staphylococcal enterocolitis.

General Principles of Treatment. (1) To minimise these dangers antibiotics should only be used when a clear indication is present. They should not be used as prophylactics except for operations on the œsophagus and colon. In these cases neomycin or an insoluble sulphonamide such as succinyl-sulphathiazole is preferred and if a tetracycline is used it should be discontinued within three days.

(2) Unless quite impracticable, they should only be used where the infecting organism has been shown to be sensitive.

(3) Subject to bacterial sensitivity, the least toxic drug should be used. Penicillin is in widest use. Sulphonamides are generally effective for diseases of the bowel and urinary tract. The tetracyclines should

only be used where specifically indicated. Erythromycin should be kept in reserve to be used when all else has failed.

(4) Whichever drug is used it should be given in full doses from the start, and apart from particularly stubborn infections such as osteomyelitis, endocarditis, and, of course, tuberculosis, it should not be maintained for more than five days.

Complications of Operation

Cardiac Arrest. Heart-failure in a patient known to be grievously ill is sufficiently distressing, but sudden stoppage of the heart action in a fit patient during or after a standard operation is an unmitigated tragedy. Sometimes it is due to anæsthetic overdosage or to the action of anti-curare drugs, but often the cause cannot be determined. However, if energetic steps are taken at once there is a good prospect of restoring the heartbeat. It is therefore essential that every surgeon should know the correct procedure and be prepared to take action on the instant. Delay is fatal, for if more than two or three minutes elapse the central nervous system will suffer irretrievable damage.

The first step is to see that the airway is patent and to establish artificial respiration, either by mouth to mouth breathing or through a short valved tube. If the anæsthetic tray is available an intratracheal catheter may be introduced and oxygen administered. If these measures do not immediately restore a pulse, *cardiac massage* must be performed.

The closed method may be effective. The patient must be placed quickly on the floor or other hard surface. The surgeon kneels astride him or alongside, places the heel of his hands over the lower sternum and exerts his full weight to compress the chest 40 times a minute. This should suffice to create a pulse in the neck and to maintain a blood flow to the brain for a considerable time. In the meanwhile, help is sought, an artificial respirator is installed and an electrocardiograph connected. If, as is commonly the case, the heart is in ventricular fibrillation, a defibrillator is required. Before it is used, the e.c.g. must be disconnected and the attendants must stand back, for the heavy current gives a shock which may be dangerous. If no defibrillator is available, 1 ml. of 5 per cent. procaine amide should be injected into the ventricle.

If these measures fail, open massage is indicated. Without waiting to wash up or arrange towels or even cleanse the skin, one must take up a knife and slash rapidly along the fourth or fifth interspace through into the pleural cavity over a distance of 6 inches or so. The hand is quickly inserted and the heart compressed through the intact pericardium. Compression at the rate of about 40 beats a minute is maintained.

By this means sufficient circulation can be kept up to prevent cerebral anæmia, so at this stage there is time to plan ahead. If a rib-retractor is available it is introduced, to give more room for the hands; the head of the table is lowered; the airway is again checked; artificial respiration can be given.

If the heart is flaccid, 10 ml. of 1/10,000 adrenalin is injected into the lumen of the left ventricle (1 ml. of 1/1000 adrenalin in 9 ml. water).

If the heart is fibrillating, the cup-shaped electrodes of the defibrillator are applied in close contact with the heart muscle, and four or five electric shocks, each of one-tenth second, given in rapid succession. Failing this, 1 ml. of 5 per cent. procain amide is injected into the ventricle. The massage is continued until the heart is beating regularly.

The wound is then closed, after inserting a water-seal drain, through a stab incision over one of the lower interspaces. No attempt is made to close pericardium or pleura, but only the pectoral muscle layer and the skin. Antibiotics are given to counteract the inevitable contamination.

After successful resuscitation the patient requires careful supervision. The acid-base balance must be checked at once, for metabolic acidosis is often an underlying cause of the arrhythmia, and corrected by intravenous bicarbonate. The pulse rate and blood pressure should be monitored and a continuous check kept on the electrocardiograph tracing.

If there are signs of brain damage due to prolonged ischæmia the patient should be cooled in an ice bath and maintained under hypothermia for a prolonged period.

Gas Distension and Vomiting. Post-operative gas distension may be due entirely to air swallowed during anæsthesia or when retching. It can be prevented by gastric suction in the post-operative period. In the treatment, the most effective measures are to empty the stomach by means of a nasal tube and to deflate the colon by means of an enema. Occasionally, in states of severe dehydration, gas distension is due to potassium deficiency.

Post-operative vomiting may occur transiently without obvious reason, and in certain types of case, e.g. operations on the bile passages, it may recur during a few days. More severe vomiting may be due to many causes, including paralytic ileus, peritonitis, intestinal obstruction, and intoxications associated with hepatic or renal failure. The immediate treatment is to empty the stomach and maintain gastric suction. The underlying cause must be sought and treated.

Hiccup. This very distressing, fatiguing and sometimes dangerous complication is especially apt to follow operations upon the abdomen or urinary tract. Frequently its cause is to be found in a dilated stomach or colon. In other cases hiccup is an indication of impending uræmia.

The treatment is difficult. In mild cases it suffices to give chloroform water or peppermint. If these and other simple measures fail, the stomach must be washed out. Flatus enemas are given to empty the colon. Care must be taken that an atonic distended bladder or some other cause of renal impairment is not overlooked. If renal impairment is regarded as a possible factor, it is advisable to force fluids, if necessary, by means of an intravenous drip. The administration of carbon dioxide at intervals sometimes appears to be of value. To afford the patient some rest from the fatiguing spasms it may be necessary to administer a powerful hypnotic, such as hyoscin.

If all other methods fail, it may finally be necessary to infiltrate the left phrenic nerve with novocain at the root of the neck.

Surgery and Hæmophilia

Until very recently the treatment of hæmophilic persons suffering from injuries or spontaneous hæmorrhage has posed one of the most difficult problems in surgery, while the dangers of post-operative bleeding have been so great as to prohibit all forms of major operative intervention. This picture is now beginning to change, but even so the application of surgical treatment in hæmophilics must still only be considered where the need is grave, and where modern methods of after care are available.

Hæmophilia is a sex linked inherited disorder, occurring only in males but transmitted by females. Thus the daughter of a bleeder does not suffer from the disease but will transmit it to her sons. The son of a

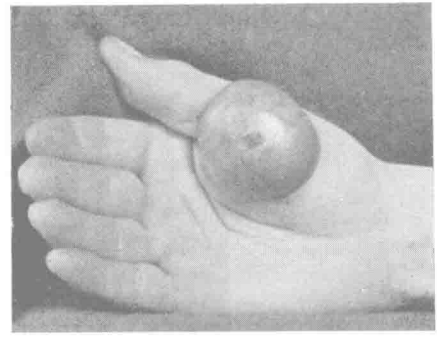

FIG. 2. Hæmatoma in hæmophilic boy at site of injury by splinter of glass.

bleeder does not suffer from it and only transmits it if he himself is a bleeder (which can only occur if both his parents carry the gene). It is now established that the excessive bleeding is due to lack of a globulin normally concerned with clotting, the anti-hæmophilic globulin or A.H.G.

A hæmophilic person is liable to uncontrollable hæmorrhage after trifling injuries, such as a small wound or a tooth extraction. He develops hæmorrhages in the joints (hæmarthrosis) leading to crippling arthritis. He bruises easily, forming large hæmatomas which may persist for months, may form cysts and may burst, becoming infected and leading to death from hæmorrhage. Lastly, unless specially treated, he will inevitably bleed to death after any major operation.

Hitherto the only specific treatment available has been to transfuse fresh blood or plasma, but the results have been variable, for the reason that the missing globulin is very labile and is rapidly destroyed. In recent years, however, anti-hæmophilic globulin has been prepared from ox or pig blood, and these preparations are now becoming available for general use. They are given intravenously, in doses of about 300 mg. daily, which corresponds to the globulin content of $2\frac{1}{2}$ litres of fresh blood.

At the present time the globulin preparations are impure and contain proteins, so they are antigenic. After ten to fourteen daily injections they cause urticaria and rigors, and while these can be controlled by antihistamines, they leave the patient liable to anaphylaxis. The globulin should therefore be reserved for times of real need.

In lesser hæmorrhage, repeated transfusion with fresh blood, or plasma stored at −30° C., will often suffice. In addition, particular care must be taken to immobilise the bleeding part and protect it from trauma.

Surgery and Diabetes

While formerly any operation upon a diabetic patient was fraught with danger, now, with experience in the use of insulin, operation carries little greater risk than in non-diabetics. Moreover, the number of diabetic patients living has increased as a result of insulin therapy, and operations are therefore required more often.

Surgical treatment may be required for the usual indications, as in non-diabetics, and especially for the conditions to which diabetics are prone, namely:—

(1) Acute sepsis, especially carbuncles.

(2) Obliterative vascular disorders, culminating in gangrene of the foot.

The special therapeutic problem is to prevent the onset of ketosis, for this occurs much more readily than in non-diabetics.

Acidosis or Ketosis in Diabetes. This differs from the corresponding condition in non-diabetics only in the ease with which it occurs.

Insulin deficiency—the cardinal feature in diabetes—impairs both the storage and utilisation of carbohydrate. The meagre carbohydrate reserve is then readily exhausted by starvation or vomiting or by liver damage from sepsis or the use of toxic anæsthetics, while the utilisation of carbohydrate is increased when the metabolic rate is raised in pyrexia.

The symptoms, which are similar to those in non-diabetic ketosis, are apt to develop rapidly, especially when precipitated by some form of septic infection. If untreated, ketosis in diabetics becomes rapidly severe and leads to coma and death.

Preparation of Diabetics for Operation. *Interval Cases.* In interval cases it is only necessary to put the diabetes under control by the usual diabetic measures, and insulin if need be. If the operation is of major character, it is advisable to give 10–15 units of insulin subcutaneously a few hours earlier, backed by 20 grams of glucose intravenously.

Emergency Cases. In diabetic patients requiring emergency operation an acute septic condition is usually present, and ketosis is either present or threatened.

In such cases energetic treatment is required, by insulin, covered by sufficient glucose to avoid the risk of hypoglycæmia. It is found that 1 unit of insulin is covered adequately by 2 grams of glucose. In this way sufficient glucose will be metabolised to assure the complete combustion of the ketone bodies.

In the average case 20 units of insulin may be given subcutaneously and 800 ml. of 5 per cent. glucose solution intravenously before operation, and the same repeated every four hours after operation. The urine must be examined each time before the insulin is injected, and if the urine is found to be sugar-free the insulin should be stopped, the glucose alone being given.

Post-operative Treatment. Where the diabetes is not severe, or the operation is of only moderate severity, it suffices to watch the urine and administer insulin, backed by glucose, as required. In more severe cases as much as 20 units of insulin may be needed four-hourly, with 40 grams of glucose intravenously to control the ketosis.

Surgery and Steroids

The wide use of cortisone and similar steroids poses certain problems in relation to surgical operation.

If the patient is under treatment with such drugs and omits to say so, or if no special preparation is undertaken there is a risk of cardiac arrest under anæsthesia, and a risk of precipitating an acute adrenal crisis post-operatively. Even if the treatment by steroids has been stopped several weeks before operation the adrenal cortex may have been rendered so atrophic as to prevent its responding to the added stress of operation.

Fortunately if the previous treatment is known these risks can be avoided by ensuring an adequate blood steroid level during the critical phase. A dose of 100 mg. hydrocortisone should be given intravenously a few hours pre-operatively and a total of 500 mg. during the succeeding 24 hrs. Thereafter the dose should be reduced, over a period of a week, to the pre-operative level. Similar treatment should also be carried out for patients on maintenance cortisone for adrenal disease or after adrenalectomy. There is no evidence that this additional steroid treatment will interfere with wound healing.

CHAPTER 2

DISTURBANCE OF FLUID AND ELECTROLYTE BALANCE

THE fluids of the "milieu internale", the blood, the lymph, the extracellular and intracellular fluids and the secretions of glands are in a constant state of flux and upon their precise regulation life rests precariously in the balance.

During every hour of life the heart propels 300 litres of blood through the vascular system, the glomeruli excrete 7 litres of filtrate, of which 99 per cent. is reabsorbed in the tubules, and the alimentary glands secrete 10 litres of which 99 per cent. is reabsorbed in the intestine All this and all the varying reactions to physiological demands and pathological stresses, depend, inter alia, upon an adequate blood volume (which in turn depends upon available fluid, and the osmotic properties of proteins to retain it within the vessels); upon a sufficiency of hæmoglobin for oxygen transport; upon a sufficiency of water and electrolytes to fill the cells and extracellular spaces; upon the acid-base balance with its complex buffering arrangements; upon a host of hormones including especially the catechol amines and the steroids of the adrenal cortex; and finally, though less urgently, upon sufficient calories to provide the energy reserves.

In the acute crises of disease, in the immediate phase after a severe injury and in the early days after a major operation there are complex disturbances affecting any or all of these components and their speedy correction is a vital element in treatment. The surgeon must understand how these disturbances arise, how to recognise them and measure them, how to assess their significance and how to put them right. He must be a bedside biochemist as well as a sage physician.

The Fluid Spaces. The body fluids occupy the following spaces—(1) the vascular compartment (arteries, veins, capillaries), (2) the interstitial space, (3) the cells, and (4) the trans-cellular spaces (glands, intestine, renal tubules). In health there is a constant and vigorous flow from one compartment to another. In disease the flow may be altered with grave consequences.

Some of these fluid volumes can be measured by dilution techniques in which a suitable substance is injected and, after an interval for mixing, its dilution is measured in a freshly drawn sample.

The *plasma volume* can be measured either by the dye Evans Blue (which attaches itself to the plasma proteins and therefore remains within the vascular compartment for an appreciable time) or by injecting human albumen tagged by radioactive iodine (R.I.H.S.A.). Normally the plasma volume is about 7 per cent. of the total body water or about