GENERAL SURGERY

Lecture Notes

Harold Ellis
Sir Roy Calne
Christopher Watson

12th Edition

WILEY-BLACKWELL

with website

Lecture Notes:
General Surgery

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Introduction

The ideal medical student at the end of the clinical course will have written his or her own textbook – a digest of the lectures and tutorials assiduously attended and of the textbooks meticulously read. Unfortunately, few students are perfect, and most approach the qualifying examinations depressed by the thought of the thousands of pages of excellent and exhaustive textbooks wherein lies the wisdom required of them by the examiners.

We believe that there is a serious need in these days of widening knowledge and expanding syllabus for a book that will set out briefly the important facts in general surgery that are classified, analysed and as far as possible rationalized for the revision student. These lecture notes represent our own final-year teaching; they are in no way a substitute for the standard textbooks but are our attempts to draw together in some sort of logical way the fundamentals of general surgery.

Because this book is written at student level, principles of treatment only are presented, not details of surgical technique.

The need after only 4 years for a new, 12th, edition reflects the rapid changes which are taking place in surgical practice. We are confident that our constant updating will ensure that this volume will continue to serve the requirements of our medical students. We advise you to read this book in conjunction with *Clinical Cases Uncovered – Surgery*, which provides illustrated case studies, MCQs, EMQs and SAQs, cases that correspond to the chapters in this volume.

H.E.
R.Y.C.
C.J.E.W.

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Abbreviations

ABPI	ankle brachial pressure index
ACE	angiotensin-converting enzyme
ACTH	adrenocorticotrophic hormone
ADH	antidiuretic hormone
AFP	α-fetoprotein
AIDS	acquired immune deficiency syndrome
ALP	alkaline phosphatase
ALT	alanine transaminase
APACHE	Acute Physiology And Chronic Health Evaluation
APUD	amine precursor uptake and decarboxylation
ASA	American Society of Anesthesiologists
AST	aspartate transaminase
ATN	acute tubular necrosis
BCG	bacille Calmette–Guérin
CABG	coronary artery bypass graft
CEA	carcinoembryonic antigen
CNS	central nervous system
CRP	C-reactive protein
CSF	cerebrospinal fluid
CT	computed tomography
DCIS	ductal carcinoma *in situ*
DIC	disseminated intravascular coagulopathy
DMSA	dimercaptosuccinic acid
DOPA	dihydroxyphenyl alanine
DTC	differentiated thyroid cancer
DTPA	diethylene triamine pentaacetic acid
ECG	electrocardiograph
EMG	electromyography
ER	oestrogen receptor
ERCP	endoscopic retrograde cholangiopancreatography
ESBL	extended spectrum beta-lactamase
ESR	erythrocyte sedimentation rate
ESWL	extracorporeal shock wave lithotripsy
EUS	endoscopic ultrasound
FAP	familial adenomatous polyposis
FEV_1	forced expiratory volume in 1 second
GCS	Glasgow coma scale
GFR	glomerular filtration rate
GGT	gamma glutamyl transferase
GLA	gamma linolenic acid
GTN	glyceryl trinitrate
HAART	highly active anti-retroviral treatment
HbA1c	glycosylated haemoglobin
HCC	hepatocellular carcinoma
HER2	human epidermal growth factor receptor 2
HHT	hereditary haemorrhagic telangiectasia
HHV	human herpes virus
HIV	human immunodeficiency virus
HLA	human leucocyte antigen
HPOA	hypertrophic pulmonary osteoarthropathy
HPV	human papilloma virus
HRT	hormone replacement therapy
HTIG	human tetanus immunoglobulin
ICP	intracranial pressure
ICSI	intracytoplasmic sperm injection
IFN-γ	interferon γ
IPMN	intraductal papillary mucinous tumour
IVC	inferior vena cava
IVF	*in vitro* fertilization
IVU	intravenous urogram
JVP	jugular venous pressure
KSHV	Kaposi sarcoma herpes virus
'KUB'	kidneys, ureters and bladder
LAD	left anterior descending artery
LCIS	lobular carcinoma *in situ*
LHRH	luteinizing hormone-releasing hormone
MAG3	*m*ercapto-*a*cetyl triglycine
MCN	mucinous cystic neoplasm
MEN	multiple endocrine neoplasia
MHC	major histocompatibility complex
MIBG	meta-iodobenzylguanidine
MIBI	methoxyisobutylisonitrile
MR	magnetic resonance
MRCP	magnetic resonance cholangiopancreatography
MRSA	meticillin-resistant *Staphylococcus aureus*
NAFLD	non-alcoholic fatty liver disease
NPI	Nottingham Prognostic Index
NSAIDs	non-steroidal anti-inflammatory drugs
NSGCT	non-seminomatous germ cell tumour
NST	'no special type'
OCP	oral contraceptive pill
OPG	orthopantomogram
PET	positron emission tomography
PNET	primitive neuroectodermal tumour
POSSUM	Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity
PSA	prostate-specific antigen
PTA	percutaneous transluminal angioplasty
PTC	percutaneous transhepatic cholangiography
PTCA	percutaneous transluminal coronary angioplasty

PTFE	polytetrafluoroethylene
PTH	parathormone
SGOT	serum glutamic oxaloacetic transaminase (synonymous with AST)
SGPT	serum glutamic pyruvic transaminase (synonymous with ALT)
SIADH	syndrome of inappropriate antidiuretic hormone
SLE	systemic lupus erythematosus
SLN	sentinel lymph node
T3	tri-iodothyronine
T4	tetra-iodothyronine, thyroxine
TACE	transarterial chemoembolization
TCC	transitional cell carcinoma
TED	thromboembolism deterrent
TIA	transient ischaemic attack
TIPS	transjugular intrahepatic portosystemic shunt
TNF	tumour necrosis factor
TOE	transoesophageal echocardiography
TPA	tissue plasminogen activator
TPN	total parenteral nutrition
TSH	thyroid-stimulating hormone
TUR	transurethral resection
UW	University of Wisconsin
VAC	vacuum-assisted closure
VATS	video-assisted thoracoscopic surgery
VIP	vasoactive intestinal polypeptide
VRE	vancomycin-resistant *Enterococcus*
β-HCG	β-human chorionic gonadotrophin

1

Surgical strategy

Learning objectives

- ✓ To understand the principles of taking a clear history, performing an appropriate examination, presenting the findings and formulating a management plan for surgical diagnosis.
- ✓ To understand the common nomenclature used in surgery.

Students on the surgical team, in dealing with their patients, should recognize the following steps in their patients' management.

1. *History taking*. Listen carefully to the patient's story.
2. *Examination of the patient*.
3. *Writing notes*.
4. *Constructing a differential diagnosis*. Ask the question 'What diagnosis would best explain this clinical picture?'
5. *Special investigations*. Which laboratory and imaging tests are required to confirm or refute the clinical diagnosis?
6. *Management*. Decide on the management of the patient. Remember that this will include reassurance, relief of pain and, as far as possible, allaying the patient's anxiety.

History and examination

The importance of developing clinical skills cannot be overemphasized. Excessive reliance on special investigations and extensive modern imaging (some of which may be quite painful and carry with them their own risks and complications) is to turn your back on the skills necessary to become a good clinician. Remember that the patient will be apprehensive and often will be in pain and discomfort. Attending to these is the first task of a good doctor.

The history

The history should be an accurate reflection of what the patient said, not your interpretation of it. Ask open questions such as 'When were you last well?' and 'What happened next?', rather than closed questions such as 'Do you have chest pain?'. If you have a positive finding, do not leave the subject until you know everything there is to know about it. For example, 'When did it start?'; 'What makes it better and what makes it worse?'; 'Where did it start and where did it go?'; 'Did it come and go or was it constant?'. If the symptom is one characterized by bleeding, ask about what sort of blood, when, how much, were there clots, was it mixed in with food/faeces, was it associated with pain? Remember that most patients come to see a surgeon because of pain or bleeding (Table 1.1). You need to be able to find out as much as you can about these presentations.

Keep in mind that the patient has no knowledge of anatomy. He might say 'my stomach hurts', but this may be due to lower chest or periumbilical pain – ask him to point to the site of the pain. Bear in mind that he may be pointing to a site of referred pain, and similarly do not accept 'back pain' without clarifying where in the back – the

Table 1.1 Example of important facts to determine in patients with pain and rectal bleeding

Pain	Rectal bleeding
Exact site	Estimation of amount (often inaccurate)
Radiation	Timing of bleeding
Length of history	Colour – bright red, dark red, black
Periodicity	Accompanying symptoms – pain, vomiting (haematemesis)
Nature – constant/colicky	Associated shock – faintness, etc.
Severity	Blood mixed in stool, lying on surface, on paper, in toilet pan
Relieving and aggravating factors	
Accompanying features (e.g. jaundice, vomiting, haematuria)	

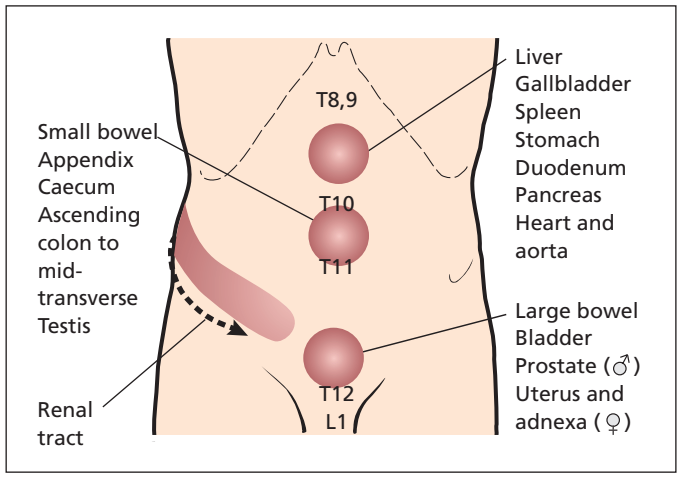

Figure 1.1 Location of referred pain for the abdominal organs.

sacrum, or lumbar, thoracic or cervical spine, or possibly loin or subscapular regions. When referring to the shoulder tip, clarify whether the patient means the acromion; when referring to the shoulder blade, clarify whether this is the angle of the scapula. Such sites of pain may suggest referred pain from the diaphragm and gallbladder, respectively.

It is often useful to consider the viscera in terms of their embryology. Thus, epigastric pain is generally from foregut structures such as stomach, duodenum, liver, gallbladder, spleen and pancreas; periumbilical pain is midgut pain from small bowel and ascending colon, and includes the appendix; suprapubic pain is hindgut pain, originating in the colon, rectum and other structures of the cloaca such as the bladder, uterus and fallopian tubes (Figure 1.1). Testicular pain may also be periumbilical, reflecting the intra-abdominal origin of these organs before their descent into the scrotum – never be fooled by the child with testicular torsion who complains of pain in the centre of his abdomen.

The examination

Remember the classical quartet in this order:

1 inspection;
2 palpation;
3 percussion;
4 auscultation.

Learn the art of careful inspection, and keep your hands off the patient until you have done so. Inspect the patient generally, as to how he lies and how he breathes. Is he tachypnoeic because of a chest infection or in response to a metabolic acidosis? Look at the patient's hands and feel his pulse.

Only after careful inspection, proceed to palpation. If you are examining the abdomen, ask the patient to cough. This is a surrogate test of rebound tenderness and indicates where the site of inflammation is within the peritoneal cavity. Remember to examine the 'normal' side first, the side that is not symptomatic, be it abdomen, hand, leg or breast. Look at the patient while you palpate. If there is a lump, decide which anatomical plane it lies in. Is it in the skin, in the subcutaneous tissue, in the muscle layer or, in the case of the abdomen, in the underlying cavity? Is the lump pulsatile, expansile or mobile?

Writing your notes

Always write up your findings completely and accurately. Start by recording the date and the time of the interview. Write all the negative as well as positive findings. Avoid abbreviations since they may mean different things to different people; for instance, PID – you may mean pelvic inflammatory disease but the next person might interpret it as a prolapsed intervertebral disc. Use the correct surgical terminology (Table 1.2).

Illustrate your examination unambiguously with drawings – use anatomical reference points and measure the diameter of lumps accurately. When drawing abdominal findings use a hexagonal representation (Figure 1.2). A continuous line implies an edge; shading can represent an area of tenderness or the site where pain is experienced. If you can feel all around a lump, draw a line to indicate this; if you can feel only the upper margin, show only this. Annotate the drawings with your findings (Figure 1.2). At the end of your notes, write a single paragraph summary, and make a diagnosis, or write down a differential diagnosis. Outline a management plan and state what investigations should be done, indicating which you have already arranged. Sign your notes and print your name, position and the time and date legibly underneath.

Case presentation

The purpose of presenting a case is to convey to your colleagues the salient clinical features, diagnosis or differential diagnosis, management and investigations of your patient. The presentation

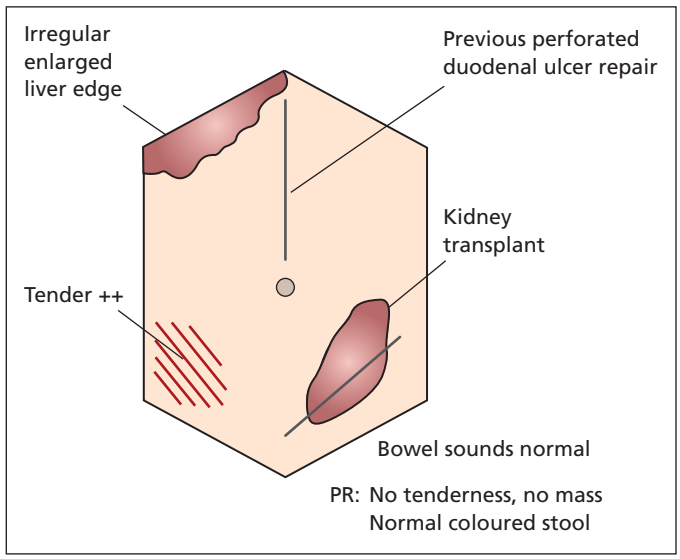

Figure 1.2 Example of how to record abdominal examination findings.

Table 1.2 Common prefixes and suffixes used in surgery

Prefix	Related organ/structure
angio-	blood vessels
arthro-	a joint
cardio-	heart
coelio-	peritoneal cavity
cholecysto-	gallbladder
colo- and colon-	colon
colpo-	vagina
cysto-	urinary bladder
gastro-	stomach
hepato-	liver
hystero-	uterus
laparo-	peritoneal cavity
mammo- and masto-	breast
nephro-	kidney
oophoro-	ovary
orchid-	testicle
rhino-	nose
thoraco-	chest

Suffix	Procedure
-centesis	surgical puncture, often accompanied by drainage, e.g. thoracocentesis
-desis	fusion, e.g. arthrodesis
-ectomy	surgical removal, e.g. colectomy
-oscopy	visual examination, usually through an endoscope, e.g. laparoscopy
-ostomy	creating a new opening (mouth) on the surface, e.g. colostomy
-otomy	surgical incision, e.g. laparotomy
-pexy	surgical fixation, e.g. orchidopexy
-plasty	to mould or reshape, e.g. angioplasty; also to replace with prosthesis, e.g. arthoplasty
-rrhapy	surgically repair or reinforce, e.g. herniorrhaphy

should not be merely a reading of the case notes, but should be succinct and to the point, containing important positive and negative findings. Do not use words such as 'basically', 'essentially' or 'unremarkable', which are padding and meaningless. Avoid saying that things are 'just' palpable – either you can feel it or you cannot. Make up your mind. At the end of a good presentation, the listener should have an excellent word picture of the patient and his/her problems, what needs to be watched and what plans you have for management.

2

Fluid and electrolyte management

Learning objective

✓ To understand the distribution and composition of body fluids, and how these may change following surgery.

The management of a patient's fluid status is vital to a successful outcome in surgery. This requires preoperative assessment, with resuscitation if required, and postoperative replacement of normal and abnormal losses until the patient can resume a normal diet. This chapter will review the normal state and the mechanisms that maintain homeostasis, and will then discuss the aberrations and their management.

Body fluid compartments (Figure 2.1)

In the 'average' person, water contributes 60% to the total body weight: 42 L for a 70 kg man. Forty per cent of the body weight is intracellular fluid, while the remaining 20% is extracellular. This extracellular fluid can be subdivided into intravascular (5%) and extravascular, or interstitial (15%). Fluid may cross from compartment to compartment by osmosis, which depends on a solute gradient, and filtration, which is the result of a hydrostatic pressure gradient.

The electrolyte composition of each compartment differs. Intracellular fluid has a low sodium and a high potassium concentration. In contrast, extracellular fluid (intravascular and interstitial) has a high sodium and low potassium concentration. Only 2% of the total body potassium is in the extracellular fluid. There is also a difference in protein concentration within the extracellular compartment, with the interstitial fluid having a very low concentration compared with the high protein concentration of the intravascular compartment.

Knowledge of fluid compartments and their composition becomes very important when considering fluid replacement. In order to fill the intravascular compartment rapidly, a plasma substitute or blood is the fluid of choice. Such fluids, with high colloid osmotic potential, remain within the intravascular space, in contrast to a saline solution, which rapidly distributes over the entire extravascular compartment, which is four times as large as the intravascular compartment. Thus, of the original 1 L of saline, only 250 mL would remain in the intravascular compartment. Five per cent dextrose, which is water with a small amount of dextrose added to render it isotonic, will redistribute across both intracellular and extracellular spaces.

Fluid and electrolyte losses

In order to calculate daily fluid and electrolyte requirements, the daily losses should be measured or estimated. Fluid is lost from four routes: the kidney, the gastrointestinal tract, the skin and

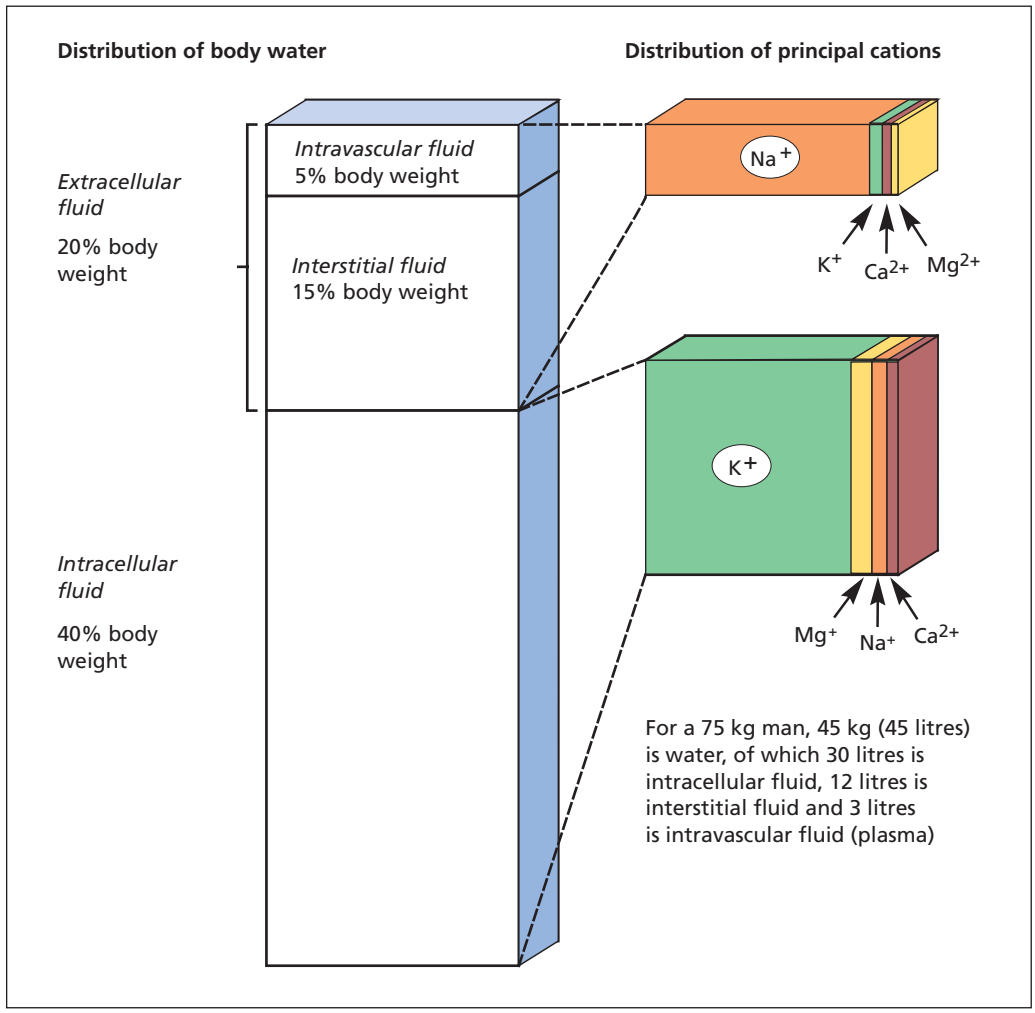

Figure 2.1 Distribution of fluid and electrolytes within the body.

the respiratory tract. Losses from the last two routes are termed insensible losses.

Normal fluid losses (Table 2.1)

The kidney

In the absence of intrinsic renal disease, fluid losses from the kidney are regulated by aldosterone and antidiuretic hormone (ADH). These two hormone systems regulate the circulating volume and its osmolarity, and are thus crucial to homeostasis. Aldosterone responds to a fall in glomerular perfusion by salt retention. ADH responds to

Table 2.1 Normal daily fluid losses

Fluid loss	Volume (mL)	Na^+ (mmol)	K^+ (mmol)
Urine	2000	80–130	60
Faeces	300		
Insensible	400		
Total	2700		

the increased solute concentration by retaining water in the renal tubules. Normal urinary losses are around 1500–2000 mL/day. The kidneys control water and electrolyte balance closely, and can function in spite of extensive renal disease, and abuse from doctors prescribing intravenous fluids. However, damaged kidneys leave the patient exquisitely vulnerable to inappropriate water and electrolyte administration.

The gastrointestinal tract

The stomach, liver and pancreas secrete a large volume (see Table 2.3) of electrolyte-rich fluid into the gut. After digestion and absorption, the waste material enters the colon, where the remaining water is reabsorbed. Approximately 300 mL is lost into the faeces each day.

Insensible losses

Inspired air is humidified in its passage to the alveoli, and much of this water is lost with expiration. Fluid is also lost from the skin, and the total of these insensible losses is around 700 mL/day. This may be balanced by insensible production of fluid, with around 300 mL of 'metabolic' water being produced endogenously.

Abnormal fluid losses

The kidney

Most of the water filtered by the glomeruli is reabsorbed in the renal tubules so impaired tubular function will result in increased water loss. Resolving acute tubular necrosis (Chapter 41, p. 349), diabetes insipidus and head injury may result in loss of several litres of dilute urine. In contrast, production of ADH by tumours (the syndrome of inappropriate ADH, or SIADH) causes water retention and haemodilution.

The gastrointestinal tract

Loss of water by the gastrointestinal tract is increased in diarrhoea and in the presence of an ileostomy, where colonic water reabsorption is absent.

Vomiting, nasogastric aspiration and fistulous losses result in loss of electrolyte-rich fluid. Disturbance of the acid–base balance may also occur if predominantly acid or alkaline fluid is lost, as occurs with pyloric stenosis and with a pancreatic fistula, respectively.

Large occult losses occur in paralytic ileus and intestinal obstruction. Several litres of fluid may be sequestered in the gut, contributing to the hypovolaemia. Resolution of an ileus is marked by absorption of the fluid and the resultant hypervolaemia produces a diuresis.

Insensible losses

Hyperventilation, as may happen with pain or chest infection, increases respiratory losses. Losses from the skin are increased by pyrexia and sweating, with up to 1 L of sweat per hour in extreme cases. Sweat contains a large amount of salt.

Effects of surgery

ADH is released in response to surgery, conserving water. Hypovolaemia will cause aldosterone secretion and salt retention by the kidney. Potassium is released by damaged tissues, and the potassium level may be further increased by blood transfusion, each unit containing in excess of 20 mmol/L. If renal perfusion is poor, and urine output sparse, this potassium will not be excreted and instead accumulates, the resultant hyperkalaemia causing life-threatening arrhythmias. This is the basis of the recommendation that supplementary potassium may not be necessary in the first 48 hours following surgery or trauma.

Prescribing fluids for the surgical patient

The majority of patients require fluid replacement for only a brief period postoperatively until they resume a normal diet. Some require resuscitation preoperatively, and others require replacement of specific losses such as those from a fistula. In severely ill patients, and those with impaired gastrointestinal function, long-term nutritional support is necessary.

Replacement of normal losses

Table 2.1 shows the normal daily fluid losses. Replacement of this lost fluid in a typical adult is

Table 2.2 Electrolyte content of intravenous fluids

Intravenous infusion	Na^+ (mmol/L)	Cl^- (mmol/L)	K^+ (mmol/L)	HCO_3^- (mmol/L)	Ca^{2+} (mmol/L)
Normal saline (0.9% saline)	150	150	–	–	–
4% dextrose/ 0.18% saline	30	30	–	–	–
Hartmann's (compound sodium lactate)	131	111	5	29	2
Normal plasma values	134–144	95–105	3.4–5.0	22–30	2.2–2.6

Table 2.3 Daily volume and composition of gastrointestinal fluids

Fluid	Volume (mL)	Na^+ (mmol/L)	K^+ (mmol/L)	Cl^- (mmol/L)	H^+/HCO_3^- (mmol/L)	
Gastric	2500	30–80	5–20	100–150	H^+	40–60
Bile	500	130	10	100	HCO_3^-	30–50
Pancreatic	1000	130	10	75	HCO_3^-	70–110
Small bowel	5000	130	10	90–130	HCO_3^-	20–40

achieved by the administration of 3 L of fluid, which may comprise 1 L of normal saline (150 mmol NaCl) together with 2 L of water (as 5% dextrose) (Table 2.2). Potassium may be added to each 1 L bag (20 mmol/L). Alternatively, compound sodium lactate (Hartmann's solution) has been advocated as the more effective fluid replacement in the postoperative period since it is similar in composition to plasma (Table 2.2). Adjustments to this regimen should be based on regular clinical examination, measurement of losses (e.g. urine output), daily weights (to assess fluid changes) and regular blood samples for electrolyte determination. For example, if the patient is anuric, 1 L/day of hypertonic dextrose without potassium may suffice, which has the added advantage of reducing catabolism with the breakdown of protein and accumulation of urea.

Replacement of special losses

Special losses include nasogastric aspirates, losses from fistulae, diarrhoea and stomas and covert losses such as occur with an ileus. Loss of plasma in burns is considered elsewhere (Chapter 8). All fluid losses should be measured carefully when possible, and this volume added to the normal daily requirements. The composition of these special losses varies (Table 2.3) but, as a rough guide, replacement with an equal volume of normal saline should suffice. Extra potassium supplements may be required when losses are high, such as in diarrhoea. Biochemical analysis of the electrolyte content of fistula drainage may be useful.

Resuscitation

Estimation of the fluid deficit in patients is important in order to enable accurate replacement. Thirst, dry mucous membranes, loss of skin turgor, tachycardia and postural hypotension, together with a low jugular venous pressure, suggest a loss of between 5% and 15% of total body water. Fluid losses of under 5% body water are difficult to detect clinically; over 15%, there is marked circulatory collapse.

As an example, consider a 70 kg man presenting with a perforated peptic ulcer. On examination he is noted to have dry mucous membranes, a tachycardia and slight postural fall in arterial blood pressure. If the loss is estimated at 10% of the total body water, itself 60% of body weight, the volume deficit is 10% × 60% of 70 kg, or 10% of 42 L = 4.2 L.

As this loss is largely isotonic (gastric juices and the peritoneal inflammatory response), infusion of a balanced crystalloid solution (e.g. Hartmann's solution) is appropriate. A general rule of thumb is to replace half of the estimated loss quickly, and then reassess before replacement of the rest. The best guide to the success of resuscitation is the resumption of normal urine output; therefore, hourly urine output should be measured. Central venous pressure monitoring will help in the adjustment of the rate of infusion.

Nutrition

Many patients undergoing elective and emergency surgery are reasonably well nourished and do not require special supplementation pre- or postoperatively. Recovery from surgery is usually swift, and the patient resumes a normal diet before he/she has become seriously malnourished. There are, however, certain categories of patients in whom nutrition prior to surgery is poor, and this may be a critical factor in determining the outcome of an operation by lowering their resistance to infection and impairing wound healing. Such patients include those with chronic intestinal fistulae, malabsorption, chronic liver disease, neoplasia and starvation, and those who have undergone chemo- and radiotherapy. Wherever possible in such patients, nutritional support should be instituted before surgery, as postoperative recovery will be much quicker.

Enteral feeding

If the gastrointestinal tract is functioning satisfactorily, oral intake can be supplemented by a basic diet introduced through a fine nasogastric tube directly into the stomach. The constituents of the diet are designed to be readily absorbable protein, fat and carbohydrate. Such a diet can provide 8400 kJ with 70 g protein in a volume of 2 L. The commonest complication is diarrhoea, which is usually self-limiting.

If a prolonged postoperative recovery is anticipated, or a large preoperative nutritional deficit needs to be corrected, consideration should be given to insertion of a feeding jejunostomy at the time of surgery. This has the advantage of avoiding a nasogastric tube.

Parenteral feeding

For patients with intestinal fistulae, prolonged ileus or malabsorption, nutrition cannot be supplemented through the gastrointestinal tract, and therefore parenteral feeding is necessary. This is usually administered via a catheter in a central vein because of the high osmolarity of the solutions used; there is a high risk of phlebitis in smaller veins with lower blood flow. However, peripheral parenteral nutrition with less hyperosmolar solutions can be used for short-term feeding. The principle is to provide the patient with protein in the form of amino acids, carbohydrate in the form of glucose, and fat emulsions such as Intralipid. Energy is derived from the carbohydrate and fat (30–50% fat), which must be given when amino acids are given, usually in a ratio of 1000 kJ/g protein nitrogen. Trace elements, such as zinc, magnesium and copper, as well as vitamins such as vitamin B_{12} and ascorbic acid, and the lipid-soluble vitamins A, D, E and K, are usually added to the fluid, which is infused as a 2.5 L volume over 24 hours. Daily weights as well as biochemical estimations of electrolytes and albumin are useful guides to continued requirements.

The ability of a patient to benefit from intravenous feeding depends on the general state of metabolism and residual liver function. Nutritional support should be continued in the postoperative period until gastrointestinal function returns and the patient is restored to positive nitrogen balance from the perioperative catabolic state. Restoration of a positive nitrogen balance is often apparent to the nurses and doctors as a sudden occurrence, when the patient starts smiling and asks for food. Occasionally, in chronic malnutrition with intestinal fistulae or in patients who have lost most of the small bowel, parenteral feeding may be necessary on a long-term basis.

Complications of total parenteral nutrition (TPN) include sepsis, thrombosis, hyponatraemia, hyperglycaemia and liver damage. To minimize sepsis, the central venous catheter is tunnelled with a subcutaneous Dacron cuff at the exit site to reduce the risk of line infection. Thrombosis may occur on any indwelling venous catheter, and, in patients requiring long-term TPN, this is a major cause of morbidity. Hyperglycaemia is common, particularly following pancreatitis, and may necessitate infusion of insulin.

3

Preoperative assessment

Learning objectives

- ✓ To be aware of the principles of preoperative assessment.
- ✓ To be able to identify and manage likely complicating factors prior to surgery.

The preoperative assessment involves an overall analysis of the patient's condition and preparation of the patient for the proposed procedure. This involves taking a careful history, confirming that the indication for surgery still exists (e.g. that the enlarged lymph node that was to be removed for biopsy has not spontaneously regressed), and that the patient is as fit as possible for the procedure. Do not accept someone else's diagnosis – it might be wrong. In particular, verify the proposed side of surgery and mark the side; write the operation name next to the arrow.

Fitness for a procedure needs to be balanced against urgency – there is no point contemplating a referral to a diabetologist for better diabetic control for someone with a ruptured aortic aneurysm in need of urgent repair. The assessment process can be considered in terms of factors specific to the patient and to the operation.

Patient assessment

In assessing a patient's fitness for surgery, it is worth going through the clerking process with this in mind.

History of presenting complaint

An emergency presentation may warrant an emergency procedure, so the assessment aims to identify factors that may be a problem during or following surgery. Some problems may be readily identifiable and treated in advance; for example, a history of vomiting or intestinal obstruction would indicate that fluid volume replacement is necessary, and this can be done swiftly prior to surgery. A long history of a condition that is scheduled for elective surgical treatment may afford time in which the patient's comorbid conditions can be improved before surgery.

Past medical history

- *Diabetes* – whether controlled by insulin, oral hypoglycaemics or diet. Severe diabetes may be complicated by gastroparesis with a risk of aspiration on induction of anaesthesia.
- *Respiratory disease* – what is the nature of the chest problem, and is the breathing as good as it can be or is the patient in the middle of an acute exacerbation?
- *Cardiac disease* – has the patient had a recent myocardial infarct, or does he/she have mild stable angina? What is his exercise tolerance?
- *Rheumatoid arthritis* – may be associated with an unstable cervical spine so a cervical spine X-ray is indicated.
- *Rheumatic fever or valve disease* or presence of a prosthesis – necessitating prophylactic antibiotics.
- *Sickle cell disease* – a haemoglobin electrophoresis should be checked in all patients of African–Caribbean descent. Homozygotes are prone to sickle crises under general anaesthetic, and postoperatively if they become hypoxic.

Past surgical history

- *Nature of previous operations* – what has been done before? What is the current anatomy? What problems were encountered last time? Ensure a copy of the previous operation note is available.
- *Complications of previous surgery*, e.g. deep vein thrombosis, MRSA wound infection or wound dehiscence.

Past anaesthetic history

- *Difficult intubation* – usually recorded in the previous anaesthetic note, but the patient may also have been warned of previous problems.
- *Aspiration during anaesthesia* – may suggest delayed gastric emptying (e.g. owing to diabetes), suggesting that a prolonged fast and airway protection (cricoid pressure) are indicated prior to induction.
- *Scoline apnoea* – deficiency of pseudocholinesterase resulting in sustained paralysis following the 'short-acting' muscle relaxant suxamethonium (Scoline). It is usually inherited (autosomal dominant) and so there may be a family history.
- *Malignant hyperpyrexia* – a rapid excessive rise in temperature following exposure to anaesthetic drugs due to an uncontrolled increase in skeletal muscle oxidative metabolism and associated with muscular contractions and rigidity, sometimes progressing to rhabdomyolysis; it carries a high mortality (at least 10%). Most of the cases are due to a mutation in the ryanodine receptor on the sarcoplasmic reticulum, and susceptibility is inherited in an autosomal dominant pattern, so a family history should be sought.

'Social' habits

- *Smoking* – ideally patients should stop smoking before any general anaesthetic to improve their respiratory function and reduce their thrombogenic potential.
- *Alcohol* – a history suggestive of dependency should be sought, and management of the perioperative period instituted using chlordiazepoxide to avoid acute alcohol withdrawal syndrome.
- *Substance abuse* – in particular a history of intravenous drug usage should be sought and appropriate precautions taken; such patients are a high risk for transmission of hepatitis B, hepatitis C and human immunodeficiency virus (HIV).

Drugs

Most drugs should be continued on admission. In particular, drugs acting on the cardiovascular system should usually be continued and given on the day of surgery. The following are examples of drugs that should give cause for concern and prompt discussion with the surgeon and anaesthetist:

- *Warfarin* – when possible it should be stopped before surgery. If continued anticoagulation is required, then convert to a heparin infusion.
- *Aspirin and clopidogrel* cause increased bleeding and should also be stopped whenever possible at least 10 days before surgery.
- *Oral contraceptive pill* is associated with an increased risk of deep vein thrombosis and pulmonary embolism; it should be stopped at least 6 weeks preoperatively. The patient should be counselled on appropriate alternative contraception since an early pregnancy might be damaged by teratogenic effects of some of the drugs used in the perioperative period.
- *Steroids* – patients who are steroid dependent will need extra glucocorticoid in the form of hydrocortisone injections to tide them over the perioperative stress.
- *Immunosuppression* – patients are more prone to postoperative infection.
- *Diuretics* – both thiazide and loop diuretics cause hypokalaemia. It is important to measure the serum potassium in such patients and restore it to the normal range prior to surgery.
- *Monoamine oxidase inhibitors* are not widely used nowadays, but do have important side-effects such as hypotension when combined with general anaesthesia.

Allergies

It is important to determine clearly the nature of any allergy before condemning a potentially useful drug to the list of allergies. For example, diarrhoea following erythromycin usually reflects its action on the motilin receptor rather than a

true allergy, but a skin rash does suggest an allergy such that its use should be avoided. In particular, consider allergies to the following:

- *anaesthetic agents*;
- *antimicrobial drugs*;
- *skin preparation substances*, e.g. iodine;
- *wound dressings*, e.g. Elastoplast.

Management of pre-existing medical conditions

Diabetes

Patients with diet-controlled diabetes require no special preoperative treatment. Patients on oral hypoglycaemics or on subcutaneous insulin should stop therapy the night before, and be commenced on a glucose and insulin infusion. In particular, long-acting insulin preparations should be avoided the night before surgery in order to prevent unexpected intraoperative hypoglycaemia. Patients with diabetes should be placed first on the operating list.

Respiratory disease

Asthma

The degree of respiratory compromise can be readily assessed with a peak flow meter. In addition, patients will know whether their chest is as good as it can be, or whether they are currently having an exacerbation. Some patients with allergic asthma have poor peak flows in summer owing to pollen allergies, but have no problems in winter months. Elective surgery should be planned to avoid the summer in such patients.

Obstructive pulmonary disease

This is often more of a problem, since there is less reversibility and, even at the patient's best, respiratory reserve might be poor. Consider whether the patient will require postoperative ventilation on an intensive care unit, or whether epidural analgesia would be sensible to avoid opiates early postoperatively.

Cardiac disease

Angina is not a contraindication to general anaesthesia provided it is stable. An indication of the severity of angina can be gauged by the frequency with which the patient uses glyceryl trinitrate preparations for acute attacks. High usage is an indication to refer to a cardiologist for improved management. Similarly if the patient has a good exercise tolerance, regularly walking his or her dogs half a mile, for example, it suggests that the cardiac disease is not limiting.

Coronary artery bypass graft (CABG) surgery

Patients who have had successful CABG surgery should have better cardiac function than they had prior to surgery; the same applies following balloon angioplasty and stenting. If CABG surgery was done some time previously, ascertain whether the patient's symptoms have changed, particularly whether there was any recurrence of angina or breathlessness, suggesting that the graft(s) may have thrombosed or the disease progressed.

Routine electrocardiogram (ECG) may detect abnormalities at rest. To rule out significant cardiac disease, consider stressing the heart, such as with an exercise ECG, stress-echocardiogram or radionuclide myocardial perfusion scan. Local anaesthesia should be considered in all patients with a history of cardiac or respiratory disease.

Other problems

Bleeding disorders or anticoagulation

Patients should be managed in close collaboration with the haematology department. Patients with haemophilia A or B should be given the specific clotting factor replacement. Patients on warfarin should be converted to heparin preoperatively. When patients are anticoagulated on account of previous thromboembolic disease, additional prophylaxis should be given, including measures such as thromboembolism deterrent (TED) stockings, intermittent compression boots while on the operating table and early mobilization (when possible with local anaesthesia to facilitate this). Rapid reversal of warfarin may be achieved with clotting factor replacement (human prothrombin complex, e.g. Beriplex) or pooled fresh frozen plasma.

Obstructive jaundice

Patients with obstructive jaundice often have a prolonged prothrombin time and require vitamin K and either human prothrombin complex (e.g. Beriplex) or fresh frozen plasma prior to surgery to correct the abnormality. They are also more prone to infection and poor wound healing. Intraoperatively, it is important to maintain a diuresis with judicious fluid replacement and diuretics (such as mannitol) to prevent acute renal failure (hepatorenal syndrome) to which these patients are susceptible. In the presence of liver impairment, metabolism of some commonly used drugs may be reduced.

Chronic renal failure

Chronic renal failure carries many additional perioperative problems. Electrolyte disturbances, particularly hyperkalaemia, are common and, in the absence of adequate renal function, fluid balance is difficult to achieve. Uraemia impairs platelet function, but the effect can be reversed using desmopressin (DDAVP). Clearance of narcotics is poor and postoperative narcosis should be reversed by the opiate antagonist naloxone, which should be given as a bolus and must be followed by an extended infusion, since the half-life of naloxone is much shorter than that of opiate analgesia. Venous access should be carefully chosen since such patients may have, or may require, arteriovenous dialysis fistulas. In patients with chronic renal failure, avoid using the arm with a fistula *in situ*, and avoid using either cephalic vein. Similarly, central lines should be placed in the internal jugular veins rather than the subclavian veins, since a resultant subclavian vein stenosis could prevent satisfactory fistula function.

Operative factors influencing preoperative management

Nature of the surgery

Some operations require special preparation of the patient, such as bowel preparation prior to colonic surgery or preoperative localization of an impalpable mammographic abnormality prior to breast surgery. Different degrees of fitness are acceptable for different procedures. So, a patient with severe angina might be a candidate for removal of a sebaceous cyst under a local anaesthetic but not for a complex incisional hernia repair under a general anaesthetic. When the surgery will correct the comorbidity, different criteria apply; thus, the same patient with angina would be a candidate for a general anaesthetic if it was given to enable myocardial revascularization with aortocoronary bypass grafts.

Urgency of the surgery

When patients present with life-threatening conditions, the risk–benefit balance often changes in favour of surgical intervention even if there is significant risk attached, but the alternative is probable death; a good example is a patient presenting with a ruptured aortic aneurysm, in whom death is often an immediate alternative to urgent surgery, and there is little time for preoperative preparation.

Objective operative risk assessment

The American Society of Anesthesiologists (ASA) has produced a grading scheme to estimate comorbidity (Table 3.1). Half of all elective surgery will be in patients of grade 1, i.e. normal fit individuals with a minimal risk of death. As the patient's grade increases, reflecting increased comorbidity, the postoperative morbidity and mortality increases. Alternative predictive scoring schemes exist, both in general and tailored for specific operations. The Acute Physiology And Chronic Health Evaluation (APACHE) score looks at different physiological variables (e.g. temperature, blood pressure, heart rate, respiratory rate) to derive a measure of how ill someone is. It is of most use in an ITU setting, and is less useful as a preoperative risk estimation tool. In contrast, the Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM) was developed as a predictive scoring system for surgical mortality and combines information regarding the patient's physiological status and the operative procedure (Table 3.2). A subsequent refinement resulted in P-POSSUM, which is now widely used as an audit tool to compare estimated mortality with actual mortality.

Table 3.1 The ASA grading system

ASA grade	Definition	Typical mortality (%)
I	Normal healthy person, no comorbidity	<0.1
II	Mild systemic disease that does not limit activity	0.3
III	Severe systemic disease that limits activity, but is not incapacitating	2–4
IV	Incapacitating systemic disease which is constantly life-threatening	20–40
V	Not expected to survive 24 hours, with or without surgery	>50

Table 3.2 Factors involved in the estimation of risk using P-POSSUM

Physiological parameters	Operative parameters
Age	Operation severity, e.g. minor, moderate, major
Cardiac disease, e.g. heart failure, angina, cardiomyopathy	Number of procedures
Respiratory disease, e.g. degree of exertional dyspnoea	Operative blood loss
ECG, e.g. presence of arrhythmia	Peritoneal soiling
Systolic blood pressure	Presence of malignancy
Heart rate	Urgency, e.g. elective, urgent, emergency
Leucocyte count	
Haemoglobin concentration	
Urea concentration	
Sodium concentration	
Potassium concentration	
Glasgow coma score	

4

Postoperative complications

Learning objectives

- ✓ To know the common postoperative complications.
- ✓ In particular, to be aware of measures to limit the occurrence of complications, including the principles of antimicrobial prophylaxis and commonly encountered resistant micro-organisms.

Classification

Any operation carries with it the risk of complications. These can be classified according to the following:

1 Local or general complication.
   - *Local* – involving the operation site itself.
   - *General* – affecting any of the other systems of the body, e.g. respiratory, urological or cardiovascular complications.

2 Time of occurrence postoperatively.
   - *Immediate* – within the first 24 hours.
   - *Early* – within the first 30 days.
   - *Late* – any subsequent period, often long after the patient has left hospital.

   In addition, when considering the factors contributing to any postoperative complication the following classification should be used:
   - *Preoperative* – factors already existing before the operation is carried out.
   - *Operative* – factors that come into play during the operation itself.
   - *Postoperative* – factors introduced after the patient's return to the ward.

A useful table of postoperative complications following abdominal surgery is presented in Table 4.1. This scheme can be modified for operations concerning any other system.

Wound infection

The incidence of wound infection after surgical operations is related to the type of operation. The common classification of risk groups is as follows:

1 *Clean* (e.g. hernia repair) – an uninfected operative wound without inflammation and where no viscera are opened. Infection rate is 1% or less.
2 *Clean contaminated* – where a viscus is open but with little or no spillage. Infection rate is less than 10%.
3 *Contaminated* – where there is obvious spillage or obvious inflammatory disease, e.g. a gangrenous appendix. Infection rate is 15–20%.
4 *Dirty or infected* – where there is gross contamination (e.g. a gunshot wound with

Table 4.1 Postoperative complications following abdominal surgery

Time	Local	General
	Reactionary haemorrhage	Asphyxia → Obstructed airway; Inhaled vomit
0–24 hours	Anatomical injury, e.g. ligation of ureter during pelvic surgery	
2nd day to 3 weeks	Paralytic ileus	Pulmonary → Collapse; Bronchopneumonia; Embolus
	Infection → Wound; Peritonitis; Pelvic; Subphrenic	Urinary → Retention; No production (acute tubular necrosis)
	Secondary haemorrhage	Deep venous thrombosis
	Dehiscence → Wound; Anastomosis	Enterocolitis
	Obstruction due to fibrinous adhesions	Bed sores
Late	Obstruction due to fibrous adhesions	After extensive resections or gastrectomy → Anaemia; Vitamin deficiency; Steatorrhoea and/or diarrhoea; Dumping syndrome; Osteoporosis
	Incisional hernia	
	Persistent wound sinus	
	Recurrence of original lesion (e.g. malignancy)	

devitalized tissue), or in the presence of frank pus or gross soiling (e.g. a perforated large bowel). Anticipated infection rate up to 40%.

In pre-antibiotic days, the haemolytic *Streptococcus* was feared most, but now, as this is still usually penicillin sensitive, the principal causes of wound infection are the penicillin-resistant *Staphylococcus aureus*, together with *Streptococcus faecalis*, *Pseudomonas*, coliform bacilli and other bowel bacteria including *Bacteroides*. With continued use of antibiotics, more resistant strains of the organisms are appearing, such as the meticillin-resistant *Staphylococcus aureus* (MRSA) and the vancomycin-resistant *Enterococcus* (VRE).

Preoperative factors

1 *Local factors* – pre-existing infection, e.g. a perforated appendix or an infected compound fracture.

2 *General factors* – nasal carriage of staphylococci; concurrent skin infection, e.g. a crop of boils; malnutrition, e.g. gastric carcinoma; immunosuppression.

Operative factors

These are lapses in theatre technique, e.g. failure of adequate sterilization of instruments, the surgeon's hands or dressings. There may be nasal or skin carriers of staphylococci among the nursing and surgical staff. Wound infections are especially common when the alimentary, biliary or urinary tract is opened during surgery, allowing bacterial contamination to occur. Wounds placed in poorly vascularized tissue, such as an amputation stump, are also prone to infection, in particular gas gangrene from anaerobic clostridial contamination, since necrotic tissue is a good medium for bacterial growth.