College of Pharmacy – Baghdad University – Department of Clinical Pharmacy

Manual of Surgery

خاص بتدريب طلبة كلية الصيدلة | المرحلة الخامسة | ردهة الجراحية

أعداد: -
فرع الصيدلة السريرية
2016

جميع الأدوات المستخدمة اليوم في الطب والجراحة في كل أنحاء العالم صنعت لأول مرة في القرن 15 على يد العالم المُسلم "أبو القاسم الزهراوي" حيث تمكن من تصميمها انذاك بمهام معرفي شخصي الزهراوي يعتبر من أكثر العلماء والأطباء خدمه للبشرية على الإطلاق.
1-1 Language of Surgery (1)
Abdominal area

1-Right upper quadrant (RUQ) or hypochondrium
2-Epigastrium
3-Left upper quadrant (LUQ) or hypochondrium
4-Right flank or loin
5-Peri-umbilical or central area
6-Left flank or loin
7-Right iliac fossa (RIF)
8-Suprapubic area
9-Left iliac fossa (LIF)

-ectomy  Cutting something out.
-gram     A radiological image.
-pexy     Anchoring of a structure to keep it in position.
-plasty   Surgical refashioning in order to regain good function.
-scopy    Procedure with instrumentation for looking into the body.
-stomy    An artifical union between a conduit and the outside world or another conduit (for
-tomy     Cutting something open to the outside world.
-tripsy   Fragmentation of an object

<table>
<thead>
<tr>
<th>angio-</th>
<th>Tube or vessel</th>
<th>lith-</th>
<th>Stone</th>
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<tbody>
<tr>
<td>appendic-</td>
<td>Appendix</td>
<td>mast/mammo</td>
<td>Breast</td>
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<tr>
<td>chole-</td>
<td>Relating to gall/bile</td>
<td>meso-</td>
<td>Mesentery</td>
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<tr>
<td>colp-</td>
<td>Vagina</td>
<td>Nephr-</td>
<td>Kidney</td>
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<tr>
<td>cyst-</td>
<td>Bladder/ fluid-filled sac</td>
<td>Orchid-</td>
<td>Testicle</td>
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<tr>
<td>-doch-</td>
<td>Ducts</td>
<td>oophor-</td>
<td>Ovary</td>
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<tr>
<td>enter-</td>
<td>Small bowel</td>
<td>Phren-</td>
<td>Diaphragm</td>
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<tr>
<td>eschar-</td>
<td>Burn</td>
<td>pyloromy-</td>
<td>Pyloric sphincter</td>
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<tr>
<td>gastr-</td>
<td>Stomach</td>
<td>pyel-</td>
<td>Renal pelvis</td>
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<tr>
<td>hepat-</td>
<td>Liver</td>
<td>proct-</td>
<td>Anal canal</td>
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<tr>
<td>Hyster-</td>
<td>Uterus</td>
<td>salping-</td>
<td>Fallopian tube</td>
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<tr>
<td>lapar-</td>
<td>Abdomen</td>
<td>splen-</td>
<td>Spleen</td>
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<td></td>
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<td>thoraco-</td>
<td>Chest</td>
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<tr>
<th>epi-</th>
<th>Upon</th>
<th>Per-</th>
<th>Going through</th>
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<tr>
<td>End-</td>
<td>Inside</td>
<td>peri-</td>
<td>Around</td>
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<td>mega-</td>
<td>Enlarged</td>
<td>Sub-</td>
<td>Beneath</td>
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<td>Pan-</td>
<td>Whole</td>
<td>trans-</td>
<td>Across</td>
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<tr>
<td>para-</td>
<td>Alongside</td>
<td></td>
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<tr>
<td>abscess</td>
<td>A cavity containing pus. For different types consult the index. Remember the aphorism: if there is pus about, let it out.</td>
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<tr>
<td>fistula</td>
<td>An abnormal connection between two epithelial surfaces. Fistulae often close spontaneously, but will not do so in the presence of malignant tissue, distal obstruction, foreign bodies, chronic inflammation, and the formation of a muco-cutaneous junction (e.g., stoma).</td>
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<tr>
<td>hernia</td>
<td>Any structure passing through another and so ending up in the wrong place.</td>
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<tr>
<td>ileus</td>
<td>Used in this book as a term for adynamic bowel.</td>
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<tr>
<td>sinus</td>
<td>A blind-ending tract, typically lined by epithelial or granulation tissue, which opens to an epithelial surface.</td>
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<tr>
<td>stent</td>
<td>An artificial tube placed in a biological tube to keep it open.</td>
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<tr>
<td>stoma</td>
<td>An artificial union between conduits or a conduit and the outside.</td>
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<tr>
<td>ulcer</td>
<td>An abnormal break in an epithelial surface.</td>
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<tr>
<td>volvulus</td>
<td>Twisting of a structure around itself. Common GI sites include the sigmoid colon and caecum, and more rarely the stomach.</td>
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References:

1-2 Surgical Antibiotic Prophylaxis

**Definition:**
1-Antibiotics administered prior to contamination of previously uninfected tissues or fluids are considered prophylactic. The goal for prophylactic antibiotics is to prevent a surgical-site infection (SSI) from developing (1).

**Common surgical pathogens**
*The predominant organisms causing SSIs after clean procedures are skin flora, including S. aureus and coagulase-negative staphylococci (e.g., Staphylococcus epidermidis)*

*In clean-contaminated procedures, including abdominal procedures and heart, kidney, and liver transplantations, the predominant organisms include gram negative rods and enterococci in addition to skin flora (5)*

**Microbiology:**
1-The choice of the prophylactic antimicrobial depends on the type of surgical procedure, most likely pathogenic organisms, safety and efficacy of the antimicrobial (1).

2-Typically, gram-positive coverage is included in the choice of surgical prophylaxis, because organisms such as S. aureus and Staphylococcus epidermidis are common skin flora (1). (1)

3-First-generation cephalosporins (particularly cefazolin) are the preferred choice, particularly for clean surgical procedures (1).

4-In cases where broader gram-negative and anaerobic coverage is desired, the antianaerobic cephalosporins such as cefoxitin, or cefotetan, are appropriate (1).
1-3 Types of Surgical Operations
Surgical operations are classified as clean, clean-contaminated, contaminated, or dirty. Antimicrobial prophylaxis is appropriate for clean, clean-contaminated, and contaminated operations. Dirty operations take place in situations of existing infection and antimicrobials are used for treatment, not prophylaxis (2). (Table 1).

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
<th>SSI risk</th>
<th>Antibiotics</th>
</tr>
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<tbody>
<tr>
<td>Clean</td>
<td>An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage.</td>
<td>Low</td>
<td>Not indicated unless high-risk procedure</td>
</tr>
<tr>
<td>Clean-contaminated</td>
<td>Operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in techniques encountered .also when Clean procedures performed emergently or with major technique breaks.</td>
<td>Medim</td>
<td>Prophylactic antibiotics indicated</td>
</tr>
<tr>
<td>Contaminated</td>
<td>Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from the gastrointestinal tract and incisions in which acute, nonpurulent inflammation is encountered are included in this category. Technique break during clean-contaminated procedure.</td>
<td>High</td>
<td>Prophylactic antibiotics indicated</td>
</tr>
<tr>
<td>Dirty</td>
<td>Obvious preexisting infection present (abscess, pus, or necrotic tissue present).</td>
<td>______</td>
<td>Therapeutic antibiotics required</td>
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</tbody>
</table>
Principles of Antimicrobial Prophylaxis

1-Route of Administration
Intravenous administration is preferred because it produces a more reliable and predictable serum and tissue concentration than intramuscular administration (3). Oral administration is also used in some bowel operations. Non-absorbable compounds like erythromycin base and neomycin are given up to 24 hours prior to surgery to cleanse the bowel. Note that oral agents are used adjunctively and do not replace IV agents (2).

2-Timing of First Dose
Correct timing of antibiotic administration is imperative to preventing SSI. It is recommended to start infusing antimicrobials for surgical prophylaxis within 60 minutes of the first incision (2). (A single dose of antibiotic should be administered within 30 minutes to one hour before incision (3) (They are given 15-60min prior to the procedure) (4). ) Exceptions to this rule are fluoroquinolones and vancomycin, which can be infused 120 minutes prior to avoid infusion-related reactions. Beginning the infusion after the first incision is of little value in preventing SSI (2).

3-Dosing and Redosing
The goal of antimicrobial dosing for surgical prophylaxis is to maintain antibiotic concentrations above the MIC of suspected organisms for the duration of the operation (2). Guidelines suggest that if an operation exceeds two half-lives of the selected antimicrobial, then another dose should be administered. Repeat dosing has been shown to lower rates of SSI. For example, cefazolin has a half-life of about 2 hours, thus another dose should be given if the operation exceeds 4 hours. The clinician should have extra doses of antibiotic ready in case an operation lasts longer than planned (2).

4-Duration
Evidence suggest that the continuation of antimicrobial prophylaxis beyond wound closure is unnecessary. Studies have not shown benefit for additional doses of antibiotic and the duration of antimicrobial prophylaxis should not exceed 24 hours (2). There is little evidence to support the practice of administering antibiotics until all drains are removed. Continuing the antibiotic does not necessarily reduce the infection rate. Moreover, it can encourage proliferation of resistant micro-organisms and subject patients to increased antibiotic-associated morbidity. Prolonged prophylaxis using antibiotics is also unnecessarily expensive (3). Longer durations of antibiotic prophylaxis are advocated by some guidelines (2).
# TABLE 2. Most Likely Pathogens and Specific Recommendations for Surgical Prophylaxis

<table>
<thead>
<tr>
<th>Type of Operation</th>
<th>Likely Pathogens</th>
<th>Recommended Prophylaxis Regimen&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal</td>
<td>Enteric gram-negative bacilli, gram-positive cocci, oral anaerobes</td>
<td>Cefazolin 1 g x 1 (see text for recommendations for percutaneous endoscopic gastrostomy)</td>
<td>High-risk patients only (obstruction, hemorrhage, malignancy, acid suppression therapy, morbid obesity)</td>
</tr>
<tr>
<td>Biliary tract</td>
<td>Enteric gram-negative bacilli, anaerobes</td>
<td>Cefazolin 1 g x 1 for high-risk patients Laparoscopic: None</td>
<td>High-risk patients only (acute choledocholithiasis, common duct stones, previous biliary surgery, jaundice, age &gt; 60, obesity, diabetes mellitus)</td>
</tr>
</tbody>
</table>
| Colorectal              | Enteric gram-negative bacilli, anaerobes                                         | PO: Neomycin 1 g + erythromycin base 1 g at 1 P.M., 2 P.M., and 11 P.M., 1 day preop plus mechanical bowel prep.  
IV: Cefoxitin or cefotetan 1 g x 1 | Benefits of oral plus IV is controversial except for colostomy reversal and rectal resection           |
| Appendectomy            | Enteric gram-negative bacilli, anaerobes                                         | Cefoxitin or cefotetan 1 g x 1                                                                            | A second intraoperative dose of cefoxitin may be required if procedure lasts longer than 3 hours     |
| Urologic                | E. coli                                                                          | Cefazolin 1 g x 1                                                                                      | Generally not recommended in patients with sterile pre-op urine cultures                           |
| Cesarean section        | Enteric gram-negative bacilli, anaerobes, group B streptococci, enterococci     | Cefazolin 2 g x 1                                                                                      | Give after cord is clamped                                                                       |
| Hysterectomy            | Enteric gram-negative bacilli, anaerobes, group B streptococci, enterococci     | Vaginal: Cefazolin 1 g x 1 Abdominal: Cefotetan 1 g x 1 or Cefazolin 1 g x 1                            | Antibiotic prophylaxis should not exceed 24 hours                                                 |
| Head and neck           | S. aureus, streptococci oral anaerobes                                          | Cefazolin 2 g or clindamycin 600 mg at induction and q8h x 2 more doses                                | Addition of gentamicin to clindamycin is controversial                                            |
| Cardiothoracic          | S. aureus, S. epidermidis, Corynebacterium, enteric gram-negative bacilli       | Cefazolin 1 g q8h x 48h                                                                                | Second-generation cephalosporins also have been advocated In areas with high prevalence of S. aureus resistance, vancomycin should be considered |
| Vascular                | S. aureus, S. epidermidis, enteric gram-negative bacilli                         | Cefazolin 1 g at induction and q8h x 2 more doses                                                       | Abdominal and lower extremities have the highest infection rates                                  |
| Orthopedic              | S. aureus, S. epidermidis                                                        | Joint replacement: Cefazolin 1 g x 1 preop, then q8h x 2 more doses                                      | Open fractures assumed contaminated with gram-negative bacilli; aminoglycosides often used—see text |
| Neurosurgery            | S. aureus, S. epidermidis                                                        | Hip fracture repair: Same as above except continue for 48 hours                                        |                                                                                                    |

<sup>a</sup>One-time doses are optimally infused at induction of anesthesia except as noted. Repeat doses may be required for long procedures. See text for references.
1-4 Thromboprophylaxis

Deep venous thrombosis (DVT) is most common in patients over 40 years of age who undergo major surgery. A postoperative increase in platelets coupled with venous endothelial trauma and stasis all contribute. If no prophylaxis is given, 30% of these patients will develop DVT and 0.1-0.2% will die from pulmonary thromboembolism (PTE) \(^{(1)}\).

**Types of thromboprophylaxis** \(^{(1)}\).

1-Mechanical devices : Thromboembolic deterrent stockings (TEDS).

2-Drugs acting on the clotting cascade : Heparin and Low molecular weight heparin (LMWH).

**Regimen** :

**heparin** 5000U SC 2h pre-op, then every 8-12h SC for 7d or until ambulant. **Low molecular weight heparin (LMWH)** may be better (less bleeding, no monitoring needed). eg enoxaparin 20mg/d SC, increased to 40mg/d in major-risk surgery \(^{(2)}\).

**Fondaparinux** (a factor Xa inhibitor) and **ximelagatran** may be better than LMWH \(^{(2)}\).

**Risk groups** \(^{(1)}\).

All patients are at risk of developing deep vein thrombosis just as is the general population. Certain factors increase this risk and warrant specific interventions. It is usual to divide patients according to estimated risk.

**1-Low risk (TEDS only)**

Day case surgery, minor orthopaedic procedures, and surgery after which patients mobilize immediately.

**2-Medium risk (TEDS and prophylactic dose LMWH)**

Examples include minor surgery where mobilization is expected to be slow; abdominal, thoracic, upper limb orthopaedic surgery; low risk procedures with associated comorbid risk factors (diabetes, obesity, cardiorespiratory disease, malignancy, oral contraceptive pill, previous history of thromboembolic disease).

**3-High risk (TEDS and treatment dose LMWH or IV heparin)**

Examples include pelvic surgery, major lower limb orthopaedic procedures, surgery for malignancy, medium risk procedures with associated comorbid risk factors (diabetes, obesity, cardiorespiratory disease, malignancy, oral contraceptive pill, previous history of thromboembolic disease).

**References** :

1-5: Preoperative prophylaxis against aspiration pneumonia

Obesity, DM, pregnancy, peptic ulcer, stress, elderly, pediatric, trauma and emergency surgery are risk factors which may lead to delayed gastric emptying, increase gastric volume, and decrease esophageal sphincter result in regurgitation and aspiration of gastric contents causing potentially fatal condition called aspiration pneumonitis, therefore such patient require special pharmaceutical care to prevent aspiration by:

A- Antacid agents: they should be given as a single dose 30 ml approximately 15-30 min before induction of anesthesia, antacids has two major advantages:
   1-Rapid onset of action.
   2-Effective on the fluid already present in the stomach.

The major disadvantages are:
   1-Their effect may not last as long as the surgical procedure.
   2-Their administration adds fluid volume to the stomach.

B- Gastric motility stimulants (prokinetic agents)

They act by promoting gastric emptying therefore reducing gastric volume, these agents should be given 60min before induction of anesthesia when given orally, 30min when given IV.

C- H2 receptor antagonists

They act by reducing gastric acidity and volume by inhibition of gastric secretion. H2 blockers has no action on gastric contents already present in the stomach therefore oral dose of H2 blockers is given at the evening before surgery followed by an oral or parenteral dose on the morning of surgery, these agents do not produce an immediate effect.

D- Proton pump inhibitors

They are effective in suppressing acid secretion.

1-6 Preoperative bowel preparation:

A-Elective colon operation:

The human colon and distal small intestine contain a numerous reservoir of aerobic and anaerobic bacteria that are excluded from the body by a mucous membrane barrier, if this barrier is disturbed by disease, trauma, or if the colon is opened to the peritoneal cavity during operation, bacteria may escape into adjacent tissues and causes serious infection, this risk can be minimized by two ways:

1-Mechanical preparation:

This is done by one or both of the following procedures:

A-Whole gut lavage with an electrolyte solution, mannitol 10%, or poly ethylene glycol the day before surgery.

B-Standard mechanical cleansing, which utilizes dietary restriction, catheters, and sometimes enemas 1-2 days before the operation.

2-Antibiotic preparation:

Either oral or parenteral antibiotic.

Two oral regimens are now used:

A-An aminoglycoside with erythromycin base.

B-An aminoglycoside with metronidazole.

Parenteral regimen that is now used is cefoxitin IV before induction of anesthesis.

Combination of parenteral and oral antibiotics show low incidence of infection.
B-Emergency colon preparation:
The following is recommended:
1-Intraoperative lavage performed by introducing of saline in the colon through balloon catheter.
2-Parenteral antibiotic, they should be given IV shortly before operation and continues for 1-7 days postoperatively.

1-7 Intravenous fluid therapy
If fluids cannot be given orally, they are normally given intravenously. However, remember that all cannulas carry a risk of infection (1).

Three principles of fluid therapy
1-Maintain normal daily requirements: About 2500mL fluid containing roughly 100mmol sodium and 70mmol potassium per 24h are required. A good regimen is 2L of 5% dextrose and 1L of 0.9% saline every 30h with 20-30mmol of potassium per litre of fluid. Post-operative patients may need more fluid and more saline depending on operative losses. If the serum sodium is rising, then more dextrose and less saline is required (1).

2-Replace additional losses: The amount and type of fluid lost is a guide. Remember that febrile patients have increased insensible losses. In practice, the problem is usually whether to give saline or dextrose. Most body fluids (eg vomit) contain salt, but less than plasma, and thus replacement will require a mixture of saline and dextrose. Shocked patients require resuscitation with saline, or a colloidal plasma expander, eg Dextran®, but not dextrose (caution in liver failure, see below). Note that Dextran® interferes with platelet function and may prolong bleeding. Patients with acute blood loss require transfusion with packed cells or whole blood. As a holding measure, colloid or saline may be used while blood is being cross-matched. If more than 1L is required then group O-negative or group-specific blood should be used (1).

3-Special cases Patients with heart failure and the elderly are at greater risk of pulmonary oedema if given too much fluid. They also tolerate saline less well since Na+ retention accompanies heart failure. If IV fluids must be given, use with care. Patients with liver failure, despite being oedematous and often hyponatraemic, have increased total body sodium, and saline should not be used in resuscitation; salt-poor albumin solution or blood should be given. Fluid maintenance for children is calculated as: 100mL/kg for the first 10kg; 50mL/kg for the next 10kg; and 20mL/kg thereafter-all per 24hrs. Usually given as dextrose-saline (4% dextrose 0.18% saline) (1).

Types of fluid according to isotonicity
A- Isotonic: Isotonic crystalloids have a tonicity equal to the body plasma. When administered to a normally hydrated patient, isotonic crystalloids do not cause a significant shift of water between the blood vessels and the cells. Thus, there is no (or minimal) osmosis occurring (4).

B-Hypertonic: crystalloids have a tonicity higher than the body plasma. The administration of a hypertonic crystalloid causes water to shift from the extravascular spaces into the bloodstream, increasing the intravascular volume. This osmotic shift occurs as the body attempts to dilute the higher concentration of electrolytes contained within the IV fluid by moving water into the intravascular space (4).

C-Hypotonic: crystalloids have a tonicity lower than the body plasma. The administration of a hypotonic crystalloid causes water to shift from the intravascular space to the extravascular space, and
eventually into the tissue cells. Because the IV solution being administered is hypotonic, it creates an environment where the extravascular spaces have higher concentrations of electrolytes. \(^{(4)}\)

# Types of fluid

**A-Crystalloids:** Resuscitation fluids that are composed of dissolved electrolytes \(^{(3)}\).

1. **0.9% saline (normal saline)**
   Has about the same sodium content as plasma (150mmol/L) and is isotonic with plasma \(^{(1)}\).

2. **5% dextrose**
   Is isotonic, but only contains 278mmol/L glucose, i.e. 50g/L (dextrose is glucose), and is a way of giving water, since the liver rapidly metabolizes all the glucose leaving only water. It provides little energy. 5% once DW enters the body, the cells rapidly consume the glucose. This leaves primarily water and causes IV fluid to become hypotonic in relation to the plasma surrounding the cells. Accordingly, the now hypotonic solution causes an osmotic shift of water to and from the bloodstream and into the cells.

More concentrated glucose solutions exist, and may be used in the treatment of hypoglycemia. They are hypertonic and irritant to veins. Therefore, care in their use is needed, and infusion sites should be inspected regularly, and flushed with saline after use \(^{(1)}\).

3. **Dextrose-saline (one-fifth normal saline)**
   Is also isotonic, containing 0.18% saline (30mmol/L of sodium) and 4% glucose (222mmol/L). It has roughly the concentration of saline required for normal fluid maintenance, when given 10 hourly \(^{(1)}\).

   *Intravenous 0.18% saline/4% glucose solution (‘hypotonic saline’) in children: reports of fatal hyponatraemia – do not use in children aged 16 years or less, except in specialist settings under expert medical supervision such as renal, cardiac, liver, high dependency and intensive care units.\(^{(5)}\)*

4. **Hartmann's solution** contains: Na\(^+\) 131mmol/L, Cl\(^-\) 111mmol/L, lactate 29mmol/L, K\(^+\) 5mmol/L, HCO\(_3\) \(29\) mmol/L, and Ca\(^{2+}\) 2mmol/L. Some consider it more "physiological" \(^{(1)}\).

5. **Ringer's lactate solution:** technically the closest fluid to serum composition although theoretical advantages are of limited practical value \(^{(2)}\). Lactated Ringer's solution is often used for fluid resuscitation after a blood loss due to trauma, surgery, or a burn injury. \(^{[4]}\) It has been used to induce urine output in patients with renal failure. \(^{[4]}\)

Lactated Ringer's solution is used because the by-products of lactate metabolism in the liver counteract acidosis, which is a chemical imbalance that occurs with acute fluid loss or renal failure. \(^{[4]}\). Lactated Ringer's solution should also not be used in patients with a pH level above 7.5 (alkalosis) and in anuria or renal failure due to accumulation of K \(^{[4]}\).

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**Note:**

1. The maximum concentration of K\(^+\) that is safe to infuse via a peripheral line is 80mmol/L, at a maximum rate of 40mmol/h. Higher concentrates risk phlebitis, and faster rates dysrhythmias. Give more concentrated solutions via a central line \(^{(1)}\).

**B-Colloids:** Resuscitation fluids that restore and/or increase the intravascular oncotic pressure \(^{(3)}\).

Colloids (especially blood) produce a more lasting expansion of intravascular volume than crystalloid, which rapidly enters the interstitial tissues \(^{(2)}\):

1. **Gelofusine** is succinylated gelatin (a bovine collagen), which has a half-life of about 2h in plasma, and is associated with increased bleeding times in postoperative patients.

2. **Dextran** is a glucose polymer mixture that has a plasma half-life of about 2h: it has been associated with anaphylactic reactions and profound coagulopathy.
**3-HES** preparations are derived from hydroxyethyl starch: they have widely differing plasma half-lives and effects on plasma expansion.

**4-Albumin** is a naturally occurring plasma protein, sterilized by ultrafiltration: 5% albumin is isotonic; 20% albumin is hypertonic. Indications for use of albumin as a volume expander are very limited.

**5-Blood, platelets, FFP (fresh Frozen Plasma), and cryoprecipitate.**

**Intravenous Fluid Packaging**
Most IV fluids are packaged in soft plastic or vinyl bags of various sizes (10, 50, 100, 250, 500, 1,000, 2,000, and 3,000 milliliters).

**IV fluids on the surgical ward**
**Notes:**
1* Fluid required = pre-existing deficit + normal maintenance + ongoing losses

2* In the prehospital setting, LR and NS are commonly used for fluid replacement because of their immediate ability to expand the volume of circulating blood. However, over the course of about 1 hour, approximately two-thirds of these IV fluids eventually leave the blood vessels and move into the cells. Some authorities recommend that for every 1 liter of blood lost, 3 liters of an isotonic crystalloid be administered for replacement. This is only a guide, and the volume of IV fluid administered should be based on medical direction or local protocol, as well as the patient’s clinical response to fluid administration. (^4^)

3* Too many fluids can lead to (^4^):
- Lungs stiffer - > gas exchange impaired
- Cardiac failure
- Peripheral oedema-
- Inhibition of wound healing

4* Not enough fluid can lead to:
- Renal damage
- Cardiovascular damage
- Tissue hypoperfusion

**What fluids to use**

1-**Haemorrhagic/hypovolaemic shock:**
Insert 2 large IV cannulae, for fast fluid infusion. Start with crystalloid (eg 0.9% saline) or colloid (eg Gelofusine®) until blood is available. The advantage of crystalloids is that they are cheap but they do not stay as long in the intravascular compartment as colloids, as they equilibrate with the total extracellular volume (dextrose is useless for resuscitation as it rapidly equilibrates with the enormous intracellular volume). In practice, the best results are achieved by combining crystalloids and colloids. Aim to keep the haematocrit at ~0.3, and urine flowing at >30mL/h. Monitor pulse and BP often (^1^).

2- **Septicaemic shock:** e.g. Gelofusine like substance

3- **Heart or liver failure:**
Avoid sodium loads: use 5% dextrose (^1^) Or one-fifth normal saline (^4^)

4- **Excessive vomiting:**
Use 0.9% saline: replace losses, including K+ (^1^)/.
Complications of I.V Fluid Therapy:

1-Infection: infection of I.V is usually local causing easily visible redness, and fever. The bacteria may spread via blood stream causing life threatening septicemia.

2-Phlebitis is an irritation of vein that is not caused by infection but from the presence of foreign body (the I.V catheter, the fluid, or medication). Symptom are swelling, pain and redness around the vein site.

3-Infiltration: this occurs when the tip of the I.V catheter withdraws from the vein or pokes through the vein into surrounding tissue or when the vein wall becomes permeable and leaks fluid. It requires replacement of the I.V catheter at different location.

4-Fluid overload: this occurs when fluids are given at higher rate or in larger volume than the system can absorb or excrete. Possible consequences includes: Hypertension, CHF, and pulmonary edema.

5-Emboli: A blood clot or other solid mass, or an air bubble can delivered into the circulation through an I.V line and end up with blocking vessel. Peripheral I.V have a lower risk of embolism than the central I.V line.

References:
5- Drug safety update. Volume 6, Issue 3 October 2012

1-8 : Blood transfusion and blood products(1)

Products

1-Whole blood:
Rarely used e.g. for exchange transfusion: use crossmatched blood if possible, but if not, use universal donor group (O Rh-ve blood) changing to crossmatched blood as soon as possible. Blood >2d old has no effective platelets.

2-Red cells:
(packed to make haematocrit ~70%) Use to correct anaemia or blood loss. 1U ↑ Hb by 1-1.5g/dL. In anaemia, transfuse until Hb ~8g/dL.

3-Platelets:
Not usually needed if not bleeding or count is >20 x 10^9/L. 1U should ↑ platelet count by >20 x 10^9 /L. Failure to do so suggests refractoriness.

4-Fresh frozen plasma (FFP):
Use to correct clotting defects: e.g. DIC (disseminated intravascular coagulation); warfarin overdosage where vitamin K would be too slow; liver disease; thrombotic thrombocytopenic purpura. It is expensive and carries all the risks of blood transfusion. Do not use as a simple volume expander.
5- Human albumin solution
is produced as 4.5% or 20% protein solution and is for use as protein replacement. 20% albumin can be used temporarily in the hypoproteinaemic patient (eg liver disease; nephrosis) who is fluid overloaded, without giving an excessive salt load. Also used as replacement in abdominal paracentesis.

6- Others
Cryoprecipitate (a source of fibrinogen); coagulation concentrates (self-injected in haemophilia); immunoglobulin (anti-D).

Complications of transfusion:

1- Acute haemolytic reaction (eg ABO incompatibility):
Agitation, ↑temperature (rapid onset), ↓BP, flushing, abdominal/chest pain, oozing venepuncture sites, DIC (disseminated intravascular coagulation).

2- Anaphylaxis
Bronchospasm, cyanosis, ↓BP, soft tissue swelling.

3- Bacterial contamination
↑temperature (rapid onset), ↓BP, and rigors.

4- Non-haemolytic febrile transfusion reaction
Shivering and fever usually 1-½h after starting transfusion.

5- Fluid overload:
Dyspnoea, hypoxia, tachycardia, ↑JVP & basal crepitations.

Transfusing patients with heart failure
If Hb ≤ 5g/dL with heart failure, transfusion with packed red cells is vital to restore Hb to safe level, eg 6-8g/dL, but must be done with great care. Give each unit over 4h with furosemide (eg 40mg slow IV/PO; don't mix with blood).

References

1-9: The control of pain (1)
Guidelines for success:
1- Give regular doses rather than on an as required basis.
2- Choose the best route: PO, PR, IM, epidural, SC, inhalation, or IV.

A- Non-narcotic (simple) analgesia
Paracetamol 0.5-1.0g/4h PO (up to 4g daily): Caution in liver impairment.
NSAIDs, eg ibuprofen 400mg/8h PO or diclofenac 50mg/8h PO, or 100mg PR/IM: these are good for musculoskeletal pain and renal or biliary colic.
CI: peptic ulcer, clotting disorders, anticoagulants. Cautions: asthma, renal or hepatic impairment, pregnancy, and the elderly. Aspirin is contraindicated in children due to the risk of Reye's syndrome.

B- Opioid drugs for severe pain
Morphine (eg 10-15mg/2-4h IV/IM) or diamorphine (5-10mg/2-4h PO, SC, or slow IV, but you may need much more) are best.

Side-effects of opioids: These include nausea (so give with an antiemetic, eg prochlorperazine 12.5mg stat IM), respiratory depression, constipation, cough suppression, urinary retention, and...
sedation (do not use in hepatic failure or head injury). Dependency is rarely a problem. Naloxone may be needed to reverse the effects of excess opioids.

C-Epidural analgesia
Opioids and anaesthetics are given into the epidural space by infusion or as boluses.

D-Adjuvant treatments e.g.
1-Anticonvulsants, antidepressants, gabapentin or steroids for neuropathic pain.
2-Antispasmodics, eg hyoscine butylbromide (Buscopan20-10 mg/8h PO/IM/IV) for intestinal, renal tract colic.

References

1-10 : Nausea and vomiting (1)
This affects up to 75% of patients. It predisposes to increased bleeding, incisional hernias, aspiration pneumonia, absorption of oral medication, poor nutrition, and K+.

Causes include:
Prolonged surgery; anaesthetic agents, bowel obstruction; constipation; gastric reflux; peptic ulceration or bleeding; and medications.

Classification of antiemetics
Combining two different types of antiemetic increases efficiency.

A-Antidopaminergic agents
1-Good against opioid nausea and vomiting, sedative, extrapyramidal side-effects
2-e.g. prochlorperazine 12.5mg IM, metaclopramide 10mg IV/IM/PO tds.

B-Antihistamines
1-Sedation, tachycardias, hypotension with IV injection
2-e.g. cyclizine 50mg IM/IV/PO tds

C-Anticholinergics
1-Active against emetic effect opioids, sedation, confusion, dry mouth
2-e.g. hyoscine (scopolamine) 0.3-0.6mg IM

D-Antiserotonergics
1-Lowest side-effect profile of all antiemetics
2-Ondansetron 1-8mg PO/IV/IM tds, granisetron 1mg PO/IV tds

1-11 : Constipation
Failure to pass stool is common. Caused by immobility, pain from wounds or anal fissures, dehydration, poor nutrition, opiates, iron supplements, and spinal anaesthesia.

Treat with:
1-Bulking agents, e.g. Fybogel 1 sachet PO bd.
2-Stool softeners, e.g. sodium docusate 30-60mg od PO.
3-Osmotic agents, e.g. lactulose 5-10mL bd.
4-Stimulants, e.g. senna 1 tablet bd PO, bisacodyl 5-20mg nocte PO.
2-1: Peri-operative care and diabetes

Surgery causes considerable stress in patients. In response, the neuro-endocrine system stimulates glycogenolysis (breakdown of glycogen to glucose) and gluconeogenesis (glucose synthesis from non-carbohydrate sources) via counter-regulatory hormones such as catecholamines, cortisol, growth hormone and glucagon. These hormones can antagonise the effects of insulin and cause insulin resistance (1). Also, this stress decreases the absorption of oral hypoglycemic drugs.

A-Patients treated with Oral Antidiabetic drugs:

1- Second-generation sulfonylureas should be discontinued 1 day before surgery, with the exception of chlorpropamide, which should be stopped 2–3 days before surgery (2).

2- Other oral agents can be continued until the operative day. Although metformin has a short half-life of 6 h, it is prudent to temporarily withhold therapy 1–2 days before surgery, especially in sick patients and those undergoing procedures that increase the risks for renal hypoperfusion, tissue hypoxia, and lactate accumulation (2).

3- At a minimum, blood glucose should be monitored before and immediately after surgery in all patients.

4- For minor surgery, perioperative hyperglycemia (>200 mg/dl) can be managed with small subcutaneous doses (4–10 units) of short-acting insulin.

5- The recommended treatment for patients undergoing major surgery and for those with poorly controlled type 2 diabetes is intravenous insulin infusion, with glucose, using one of two standard regimens (see below) (2).

Note: In general if the diabetic patient is well controlled have no infection or complication and undergo minor surgery we can convert him to an appropriate iv regimen - e.g., an infusion consisting of glucose, insulin and potassium (referred to as GLIK or sometimes ) or a sliding-scale insulin regimen (1) but if the patient is not well controlled with many complication related to poor glycemic control or have infection like diabetic foot we have to ensure tight glycemic control by converting him to intensive insulin therapy.

Intravenous Insulin, Glucose, Potassium, and Fluids:-

1- Insulin
Two main methods of insulin delivery have been used: either combining insulin with glucose and potassium in the same bag (the GIK regimen) or giving insulin separately with an infusion pump (2). (which is called sliding scale insulin regimen (2)

2- Glucose
Adequate glucose should be provided to prevent catabolism, starvation ketosis, and insulin-induced hypoglycemia. The physiological amount of glucose required to prevent catabolism in an average nondiabetic adult is 120 g/day (or 5 g/h). With preoperative fasting, surgical stress, and ongoing insulin therapy, the caloric requirement in most diabetic patients averages 5–10 g/h glucose. This can be given as 5 or 10% dextrose.
3- Potassium
The infusion of insulin and glucose induces an intracellular translocation of potassium, resulting in a risk for hypokalemia. In patients with initially normal serum potassium, potassium chloride, 10 mEq, should be added routinely to each 500 ml of dextrose to maintain normokalemia if renal function is normal. Hyperkalemia (confirmed with repeat measurement and electrocardiogram) and renal insufficiency are contraindications to potassium infusion (2).

Diabetic foot
Approximately 25% of diabetic patients report a history of skin and soft tissue infection and 5%-15% of diabetic patients undergo limb amputation.

Etiology:
1--Poor glycemic control lead to an increase in blood viscosity which becomes a good media for the growth of bacteria, the causative agent include one or more of the following bacteria: Staphylococcus aureus, Staphylococcus epidermis., Enterococcus faecalis., Bacteroid species. Pseudomonas aerogenosa., and Klebseilla species.
2--Peripheral vascular disease which decreases blood flow to extremities.
3--Somatic neuropathy: which decreases pain perception.
4--Autonomic neuropathy: which decreases sweating, and subsequently dry, scaly skin.

Management :
A-Non-pharmacological:
1-Inspect feet for cuts, blisters, or scratches.
2--Wash feet daily in taped water and dry thoroughly.
3--Apply lotion to the feet to prevent calluses and cracking.
4--Ensure shoes fit properly.
5--Trim nails regularly.
6--Do not use chemical agents to remove corns or callus.

Pharmacological:
A-Tight glycemic control:
This can be achieved by intensive insulin therapy as follows:
Starting dose of insulin is 1-1.5U/kg/day which is given as follows:
¼ of total daily dose before each meal as soluble insulin SC.
¼ of total daily dose at 11pm as intermediate insulin SC.
Monitor therapy by making FBS which should be less than 120mg/dl.
If the patient develops morning hyperglycemia, the patient should be asked about signs of hypoglycemia at 2:00-3:00am and measure glucose level at this time.
If this reveals hypoglycemia, the morning hyperglycemia is rebound type (Somogi effect) which can be managed by ensuring that the patient take intermediate insulin at the specified time and reduce the dose of intermediate insulin.
If this reveals hyperglycemia, the morning hyperglycemia is due to down phenomena, and can be managed by increasing the dose of intermediate insulin.
Make 2h. Postprandial glucose level and the result should be less than 180mg/dl, if we did not get this target, give 2U soluble insulin IV for each 50mg/dl of glucose above the goal.
If the patient stabilize on this regimen, we can convert him to a less frequent regimen, and on discharge, the following regimen is given:
3/2of total daily dose is given before breakfast as 30% soluble insulin and 70% of intermediate insulin.
3/1of total daily dose is given before dinner as 30% soluble insulin and 70% of intermediate insulin.

B-Antibiotic therapy:
Effective combination should cover most potential pathogens (G+ve, G-ve, and anaerobes). This can be achieved by giving:
- Clindamycin 600mg q 8h + gentamicin 2mg/kg q 8h.
- In patients with poor renal function, gentamicin could be replaced by:
  - 1A quinolone (ciprofloxacin 200mg IV infusion q 12h), or
  - 2A 3rd generation cephalosporine (cefotaxim 1g q 8h, or cefotriaxone 1g q 24 h)
  - 3Piperacillin 1g q 6hr, or 2g q 4hr in severe cases.
  - 4Cefazoline 1g q 6h + metronidazole 500mg q 8h IV infusion.

The treatment should continue for 3-4 days after all signs of infection are absent. Drainage and surgical debridment of necrotized tissue are essential, also it is necessary to change dressing twice daily.

References

2-2-1-Perioperative medication management:

In general, one should stop any medication that may prove harmful around the time of surgery e.g., (MAO inhibitors, anticoagulants), continue any medications that are necessary for the patient's health (e.g., steroids, anti-arrhythmic agents, beta-blockers, transplant meds).

Common drugs that have been associated with withdrawal symptoms when discontinued preoperatively include selective serotonin reuptake inhibitors (SSRIs), beta-blockers, clonidine, statins, and corticosteroids.

In general, most nonsteroidal anti-inflammatory drugs should be stopped at least 3 days before surgery. Herbal medications should be stopped at least 7 days before surgery, owing to the uncertainty over their actual contents. (1)

2-2-2: Peri-operative medication in patients with cardiovascular disease (2)

When a patient with cardiovascular disease (CVD) is to undergo surgery, we need to consider whether or not any of the drugs used to treat his or her cardiovascular problems need to be stopped.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Day Before Surgery</th>
<th>Day of Surgery</th>
<th>During Surgery</th>
<th>After Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitroglycerin</td>
<td>Usual dose</td>
<td>Usual dose</td>
<td>IV infusion if frank ischemia</td>
<td>Continue IV dose if needed or until medication can be taken PO</td>
</tr>
<tr>
<td>Beta-blockers</td>
<td>Usual dose</td>
<td>Usual dose plus beta-blocker protocol</td>
<td>Usual dose plus beta-blocker protocol</td>
<td>Usual dose plus beta-blocker protocol</td>
</tr>
</tbody>
</table>
### Table 2. Perioperative Drug Management for Patients With Hypertension

<table>
<thead>
<tr>
<th>Drug</th>
<th>Day Before Surgery</th>
<th>Day of Surgery</th>
<th>During Surgery</th>
<th>After Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta-blockers</td>
<td>Usual dose</td>
<td>Usual dose on morning of surgery with sip of water</td>
<td>IV bolus or infusion (usually not required)</td>
<td>Continue IV dose until medication can be taken PO</td>
</tr>
<tr>
<td>Calcium channel blockers</td>
<td>Usual dose</td>
<td>Usual dose on morning of surgery with sip of water</td>
<td>IV bolus or infusion (usually not required)</td>
<td>Continue IV dose until medication can be taken PO</td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>Stop day before</td>
<td>Do not take day of surgery</td>
<td>IV formulations (usually not required)</td>
<td>Continue IV dose until medication can be taken PO</td>
</tr>
<tr>
<td>Diuretics</td>
<td>Stop day before</td>
<td>IV beta-blockers/IV calcium channel blockers</td>
<td>Restart when patient on oral liquids</td>
<td></td>
</tr>
<tr>
<td>Potassium supplements</td>
<td>Stop day before; consider checking potassium level</td>
<td></td>
<td>Restart when patient on oral liquids</td>
<td></td>
</tr>
<tr>
<td>Central-acting sympatholytics</td>
<td>Usual dose</td>
<td>Usual dose on morning of surgery with sip of water</td>
<td>Transdermal clonidine/IV methyldopa</td>
<td>Restart when patient on orals liquids</td>
</tr>
<tr>
<td>Peripheral sympatholytics</td>
<td>Usual dose</td>
<td>Usual dose on morning of surgery with sip of water</td>
<td>Any IV formulation (usually not required)</td>
<td>Restart when patient on oral liquids</td>
</tr>
<tr>
<td>Alpha-blockers</td>
<td>Usual dose</td>
<td>Usual dose on morning of surgery with sip of water</td>
<td>Any IV formulation (usually not required)</td>
<td>Restart when patient on oral liquids</td>
</tr>
<tr>
<td>Vasodilators</td>
<td>Usual dose</td>
<td>Usual dose on morning of surgery with sip of water</td>
<td>IV formulation (usually not required)</td>
<td>Continue IV dose until medication can be taken PO</td>
</tr>
</tbody>
</table>
Anticoagulant therapy

Although anaesthesia and surgery are not contraindicated in patients taking anticoagulants, major surgery poses an increased risk of haemorrhagic complications. There is good evidence that surgery increases the risk of venous thromboembolisms (VTE) and so, for most patients (especially those at high-risk of thromboembolism), some form of anticoagulant therapy should continue for most of the peri-operative period.

Pre-operative management

The key principles of peri-operative anticoagulant management are summarised in table-1:

| 1 | Discontinue oral anticoagulant |
| 2 | Start unfractionated heparin or low molecular weight heparin (LMWH) |
| 3 | Ensure that the international normalised ratio (INR) falls to the desired level before surgery |
| 4 | Discontinue unfractionated heparin or LMWH just before surgery |
| 5 | Restart unfractionated heparin or LMWH after surgery |
| 6 | Restart oral anticoagulant |
| 7 | Discontinue heparin when INR returns to within the desired range. |

1-Warfarin is usually discontinued three to four days before surgery to allow the international normalised ratio (INR) to fall below 1.5 "a level considered safe for most types of surgery to be performed ". Vitamin K can be used to reverse the anticoagulant effect if there is insufficient time to allow the INR to fall to a desired level, but it should be noted that this can interfere with the effect of warfarin for many days. In an emergency, administration of clotting factors or fresh frozen plasma may be warranted.

2-As the INR falls, intravenous unfractionated heparin (UH), or low molecular weight heparin (LMWH) is started. The dose used depends on the risk of thromboembolism. All patients considered as high-risk for VTE must be considered for a “treatment” dose of UH.

3-UH or LMWH are discontinued for a few hours pre-operatively to provide the surgical team with a short period when the patient has little systemic anticoagulation and it is safest to operate. The short half-life of heparin allows surgery to proceed within four to six hours of its discontinuation, hence minimising the period of "non-anticoagulation". Due to their longer duration of action, LMWHs must be stopped at least 12 hours before surgery. In an emergency, the effect of UH may be cautiously reversed using protamine sulphate. The disadvantage of using an LMWH is that it is not possible to reverse anticoagulation rapidly if bleeding occurs.

It should be noted that intramuscular injections administered to patients receiving full anticoagulant doses of heparin or warfarin, may cause painful haematoma and abscess formation.

Post-operative management

If full anticoagulation is required post-operatively, UH can be restarted about 12 hours after surgery (when haemorrhage risk is reduced) with close monitoring of activated partial prothrombin time, usually six-hourly.

Warfarin can be restarted as soon the patient is able to tolerate oral medication and the risk of bleeding has passed (e.g. when all drains have been removed). Heparin treatment is continued until the desired INR is reached once more (usually two or three days after recommencing warfarin). Different hospitals adopt different warfarin loading dose regimens depending on for how long the warfarin has been discontinued.

References:
Nafisa K Kuwajerwala, MD; Chief Editor: William A Schwer, MD. Perioperative Medication Management. Nov 11, 2015
2-3: Surgery in those on steroids

Patients on steroid therapy need extra cover to cope with the stress of surgery—their endogenous adrenal hormone levels will be suppressed, even for a period after cessation of a course of treatment. The amount of extra cover needed depends on the extent of the surgery and the pre-op dose of steroids. For routine surgery, aim to reduce the dose of steroid as much as possible. Consider steroid cover for anyone who has had high-dose glucocorticoid therapy in the last year.

**A-Major surgery:**
Typically give hydrocortisone 50-100mg IV with the pre-med and then every 6-8h IV/IM for 3d, then wean to previous medication.

**B-Minor surgery:**
Prepare as for major surgery except that hydrocortisone is given for 24h only. The major risk with adrenal insufficiency is hypotension, so if this is encountered without an obvious cause, it may be worthwhile giving a STAT dose of 50mg hydrocortisone IV. See BNF section 6.3 for steroid dose equivalences.

**References:**

2-4 : Surgery and the contraceptive pill

Oestrogen-containing contraceptive pills increase the risk of thromboembolic disease in women taking them prior to surgery. Progesterone-only contraceptives appear to pose little or no additional risk and may be continued during surgery. The increase in risk is related to the size of the operative procedure and the existing co-morbidity; the advice is adjusted accordingly.

**1-Low risk procedures:** dental, day case, minor laparoscopic. Oestrogen-containing contraceptive pills may be continued.

**2-Medium risk:** abdominal, orthopaedic, major breast surgery.

A- Oestrogen-containing contraceptive pills should be discontinued at least 1 month prior to elective surgery.

B- Urgent or emergency surgery should be conducted with full thromboprophylaxis

**3-High risk:** pelvic, lower limb orthopaedic surgery, cancer.

A- Oestrogen-containing contraceptive pills should be discontinued at least 1 month prior to elective surgery.

B- Urgent or emergency surgery should be conducted with extended thromboprophylaxis

**References:**

3-1: Acute appendicitis

This is the most common surgical emergency, in which gut organisms invade the appendix wall.
Clinical features
A- Symptoms (2).
1- malaise, anorexia, and fever;
2- diarrhoea common and may be mistaken for acute (gastro)enteritis.
3- abdominal pain starts centrally and localizes to the right iliac fossa.
4- abdominal pain caused by coughing and moving.
B- Signs (2).
1- fever, tachycardia; 2- abdominal tenderness.
C- Investigations may be normal and none are diagnostic or exclusive (2).

Establish a diagnosis
The diagnosis is a clinical one in all but exceptional cases and investigations are usually unnecessary (2).

Complications (1)
1- Perforation.
2- Appendix mass May result when an inflamed appendix becomes covered with omentum.
3- Appendix abscess May result if an appendix mass fails to resolve.

Management
A- Acute appendicitis
1- Appendicectomy (2).
2- IV antibiotics are only indicated for perforation.

B- Appendix mass or appendix abscess (2).
1- IV antibiotics (e.g. cefuroxime 750mg tds + metronidazole 500mg tds),
2- If symptoms settle: delayed (interval) appendicectomy after 6 weeks,
3- If symptoms fail to settle: may need acute appendicectomy.
4- Appendix abscess may be amenable to drainage.

References

3-2: Gallstones:
Pathological features (1)
Bile has three major constituents:
1- bile salts (primary: cholic and chenodeoxycholic acids; secondary: deoxycholic and lithocholic acids).
2- Phospholipids (90% lecithin).
3- cholesterol.

Bile containing excess cholesterol relative to bile salts and lecithin is predisposed to gallstone formation.

Types of gallstones (1)
1- Pure cholesterol (10%). Often solitary, large (> 2.5cm), round.
2-Pure pigment (bile salts; 10%). Pigment stones are of two types:
A-black (associated with haemolytic disease);
B-brown (associated with chronic cholangitis and biliary parasites).
3-Mixed (80%). Most common; usually multiple.

**Predisposing conditions** (1)
1-Increasing age.
2-Female (pregnancy and use of the oral contraceptive).
3-Obesity.
4-Multiparity.
5-Chronic haemolytic disorders (only for pigment stones).

**Clinical features (common presentations)**(1)

**A-Biliary colic**
Intermittent severe epigastric and right upper quadrant; usually associated with nausea and vomiting. Resolves after a few hours.

**Acute cholecystitis**(1)
Severe continuous right upper quadrant pain; often radiates to right flank and back; associated with anorexia and pyrexia.

**Complications of acute cholecystitis include** (1)
1-formation of an empyema or abscess of the gallbladder (rare)
2-perforation with biliary peritonitis (very rare);
3-jaundice due to compression of the adjacent common bile duct by swelling.

**Chronic cholecystitis** (1)
A mucocele of the gallbladder or infection producing an empyema.

**Diagnosis and investigations**(1,2,3)
1-WCC  
2-ultrasound (Ultrasonography is the method of choice for diagnosing gallstones)  
3-Abdominal x-ray (AXR) only shows ~10% of gallstones.

**Treatment:**
Asymptomatic gallstones found incidentally are not usually treated because the majority will never give symptoms. Symptomatic gallstones are best treated surgically(3).

**A-Surgical treatment**

**Cholecystectomy**
This is the treatment of choice for all patients fit for GA (general anesthesia)(1). If delayed, relapse occurs in 18% and may be associated with more complications, so early surgery is generally recommended(2).

**B-Non-surgical treatments**(1,3)
1-Dissolution therapy (chenodeoxycholic or ursodeoxycholic):
a-Rarely used. Requires a functioning gallbladder, small stones.
b-Problems: requires prolonged treatment, less than 70% response, high rate of recurrence of stones, toxicity of medication.

2-Extra corporeal shock wave lithotripsy (ESWL)(1)
Hardly ever used. Risk of visceral injury and high risk of stone recurrence.
3-3: Common bile duct stones

Key facts
Types of stones as per gallbladder stones. Common bile duct (CBD) stones about 10% of patients with gallstones. Most pass from the gallbladder into the CBD (secondary duct stones). Rarely form within the CBD (primary duct stones); almost always associated with partial duct obstruction.

Clinicopathological features
1- May be Asymptomatic:
Usually found incidentally on ultrasound for gallbladder stones.

2-Obstructive jaundice:
Usually due to CBD stone causing obstruction; rarely due to stone-induced CBD stricture.
   - Anorexia, nausea, itching.
   - Dark urine and pale stools.
   - Epigastric pain and fever due to bile infection.

3- Cholangitis (bile duct infection)
4- Acute pancreatitis

Diagnosis and investigations
1- (↑ WCC in cholangitis and pancreatitis),
   - LFTs (↑ conjugated bilirubin and alkaline phosphatase), serum amylase (↑ in pancreatitis).

2- The most convenient method of demonstrating obstruction to the common bile duct is by ultrasonography (2).

Management
Cholangitis requires analgesia, intravenous fluids and broad-spectrum antibiotics such as cefuroxime and metronidazole. Patients require urgent stone removal. Endoscopic stone extraction is the treatment of choice, particularly in patients over the age of 60, and is successful in about 90% of patients. Less commonly used techniques include extracorporeal lithotripsy (2).

Surgical treatment of choledocholithiasis is performed less frequently than ERCP because it carries higher morbidity and mortality (2).

References:
3-7: Thyroidectomy

The surgical removal of part or all of the thyroid gland, thyroidectomy allows treatment of hyperthyroidism, respiratory obstruction from goiter, and thyroid cancer.

**Subtotal thyroidectomy**, used to correct hyperthyroidism when drug therapy fails or radiation therapy is contraindicated, reduces secretion of thyroid hormone. It also effectively treats diffuse goiter. After surgery, the remaining thyroid tissue usually supplies enough thyroid hormone for normal function.

**Total thyroidectomy** may be performed for certain types of thyroid cancers, such as papillary, follicular, medullary, or anaplastic neoplasms. After this surgery, the patient requires lifelong thyroid hormone replacement therapy.

**Indications:**
Pressure symptoms, hyperthyroidism, carcinoma, cosmetic reasons \(^{(1)}\).

**1-Thyroid surgery for hyperthyroidism**

**A-If severe**, give carbimazole until euthyroid. Arrange operation date and 10-14d before this, start aqueous iodine oral solution (Lugol's solution), 0.1-0.3mL/8h PO well diluted with milk or water. Continue until surgery \(^{(1)}\).

**B-Mild hyperthyroidism**
Start propranolol 80mg/8h PO and Lugol's solution as above at the 1\(^{st}\) consultation. Stop Lugol’s solution on the day of surgery but continue propranolol for 5d post-op \(^{(1)}\).

**2-Non-thyroid surgery**
Thyroxine has a long \(t_{1/2}\) (~7d) so omitting a dose while nil by mouth will not have any major effects \(^{(1)}\).

**Complications** \(^{(1)}\).

**1-Early:**
Hoarseness, haemorrhage, hypoparathyroidism; thyroid storm (symptoms of severe hyperthyroidism - treat by propranolol PO or IV, antithyroid drugs, and iodine, ).

**2-Late:**
Hypothyroidism; recurrent hyperthyroidis .

**References:**
3-8 Bowel Obstruction:

*A blockage prevents the contents of the intestines from passing normally through the digestive tract. The problem causing the blockage can be inside or outside the intestine. Inside the intestine, a tumor or swelling can fill and block the inside passageway of the intestine. Outside the intestine, it is possible for an adjacent organ or area of tissue to pinch, compress or twist a segment of bowel.

*A bowel obstruction can occur in the small bowel (small intestine) or large bowel (large intestine or colon). Also, a bowel obstruction can be total or partial, depending on whether any intestinal contents can pass through the obstructed area.

* In the small intestine, the most common causes of bowel obstruction are:
  1- Adhesions—Adhesions develop on the outside of injured intestine or pelvic organs as they heal after surgery or infection. Gynecological surgeries and surgery involving the appendix or colon are particularly likely to result in adhesions.
  2- Hernia
  3- Tumors – Cancerous tumors

*In the large intestine, the most common causes of bowel obstruction are:*

1- Colorectal cancer
2- Volvulus – Volvulus is an abnormal twisting of a segment of bowel around itself. This twisting motion typically produces a closed loop of bowel with a pinched base, leading to intestinal obstruction. In Western countries, volvulus is most common among people over age 65, and these patients often have a history of chronic (long-lasting) constipation.
3- Diverticular disease – In the large bowel, diverticula are small, balloon-shaped pouches that protrude from the wall of the intestine. If diverticula become infected this is called diverticulitis. During healing from infection, scars may form in the wall of the colon as it.

**Symptoms**

Symptoms of small-bowel obstruction can include:
1- Cramping abdominal pain, generally coming in intense waves that strike at intervals of five to 15 minutes and sometimes center either on the navel or between the navel and rib cage (Pain that becomes constant may be a symptom of bowel strangulation)
2- Nausea and vomiting
3- No gas passing through the rectum
4- A bloated abdomen, sometimes with abdominal tenderness
5- Rapid pulse and rapid breathing during episodes of cramps

Symptoms of large-bowel obstruction can include:
1- A bloated abdomen
2- Abdominal pain, which can be either vague and mild, or sharp and severe, depending on the cause of the obstruction
3-Constipation at the time of obstruction, and possibly intermittent bouts of constipation for several months beforehand

**Exams and Tests**
Tests that show obstruction include:
- Abdominal CT scan
- Abdominal x-ray
- Ultrasound

**Treatment**

Treatment involves placing a tube through the nose into the stomach or intestine to help relieve abdominal swelling (distention) and vomiting. Volvulus of the large bowel may be treated by passing a tube into the rectum. Surgery may be needed to relieve the obstruction if the tube does not relieve the symptoms, or if there are signs of tissue death.

**References**

### 3-9 Pancreatitis

Pancreatitis is an inflammation of the pancreas. It has several causes and symptoms and requires immediate medical attention. It occurs when pancreatic enzymes (especially trypsin) that digest food are activated in the pancreas instead of the small intestine. It may be **acute**—beginning suddenly and lasting a few days, or **chronic**—occurring over many years. **Chronic pancreatitis can lead to diabetes or pancreatic cancer.**

**Causes:** It can be initiated by several factors, including gallstones, alcohol, trauma, infections and hereditary factors. About 75% of pancreatitis caused by gallstones or alcohol. (1, 2)

**Symptoms**

The most common symptoms of pancreatitis (2)

1-Severe upper abdominal burning pain radiating to the back,

2- Nausea, and vomiting that is worsened with eating.

3-Blood pressure may be elevated by pain or decreased by dehydration or bleeding.

4- Heart and respiratory rates are often elevated.
5-The abdomen is usually tender but to a lesser degree than the pain itself. The abdomen may be distended with intraperitoneal fluid.

6-Fever or jaundice may be present.

7- Unexplained weight loss may occur from a lack of pancreatic enzymes hindering digestion.

**Diagnosis:**

1-Characteristic abdominal pain since acute pancreatitis typically presents with severe upper abdominal pain which may radiate through to the back and be associated with nausea and vomiting. On physical examination, the patient may show tachycardia, tachypnea, hypotension, *note:- Cholecystitis, perforated peptic ulcer, bowel infarction, and diabetic ketoacidosis can mimic pancreatitis by causing similar abdominal pain and elevated enzymes. The diagnosis can be confirmed by ultrasound and/or CT.

2-Blood amylase or lipase will be 4-6 times higher than the normal variations, but this will be dependent on the laboratory that is testing the blood.

3-Computed Tomography Scan (CT): Currently the best method to stage the acute pancreatitis is CT. A CT allows identification of pancreatic edema, fluid or cysts, and the severity of pancreatitis.

4-Ultrasound: Abdominal ultrasound (US) examination is the best way to confirm the presence of gallstones in suspected biliary pancreatitis.

**Treatment**

The treatment of pancreatitis is supportive and depends on severity. Gallstones are the most common cause of acute pancreatitis worldwide. According to the physical examination, radiological findings and laboratory results the etiology of the acute pancreatitis is diagnosed as biliary or non-biliary.

The most important initial treatment of biliary pancreatitis is conservative intensive care with the goals of control of pain and oral food and fluid restriction, replacement of fluids and electrolytes parenterally as assessed by central venous pressure and urinary excretion.

After stabilizing the patient, specific treatment and timing of the intervention have to be planned. The issue of when to intervene for clearance of gallstones is controversial. General consensus is either urgent intervention (cholecystectomy) within the first 48 to 72 hours of admission, or briefly delayed intervention (after 72 hours, but during the initial hospitalization) to give an inflamed pancreas time to recover. Cholecystectomy and common duct clearance is the best treatment of biliary acute pancreatitis.

**Reference**


4-Luis Rodrigo. ACUTE PANCREATITIS. Sebastian Kaulitzki, 2011. Used under license from Shutterstock.com
3.10 Hernia

- A hernia occurs when an organ or fatty tissue squeezes through a weak spot in a surrounding muscle or connective tissue called fascia. The most common types of hernia are inguinal (inner groin), incisional (resulting from an incision), femoral (outer groin), umbilical (belly button), and hiatal (upper stomach).

- In an **inguinal hernia**, the intestine or the bladder protrudes through the abdominal wall or into the inguinal canal in the groin. About 96% of all groin hernias are inguinal, and most occur in men because of a natural weakness in this area.

- In an **incisional hernia**, the intestine pushes through the abdominal wall at the site of previous abdominal surgery. This type is most common in elderly or overweight people who are inactive after abdominal surgery.

- A **femoral hernia** occurs when the intestine enters the canal carrying the femoral artery into the upper thigh. Femoral hernias are most common in women, especially those who are pregnant or obese.
• In an **umbilical hernia**, part of the small intestine passes through the abdominal wall near the navel. Common in newborns, it also commonly afflicts obese women or those who have had many children.

• A **hiatal hernia** happens when the upper stomach squeezes through the hiatus, an opening in the diaphragm through which the esophagus passes.

![Hiatal Hernia Diagram]

**Causes of Hernias:**

Ultimately, all hernias are caused by a combination of pressure and an opening or weakness of muscle or fascia; the pressure pushes an organ or tissue through the opening or weak spot. Sometimes the muscle weakness is present at birth; more often, it occurs later in life.

Anything that causes an increase in pressure in the abdomen can cause a hernia, including:

- Lifting heavy objects without stabilizing the abdominal muscles
- Diarrhea or constipation
- Persistent coughing or sneezing

In addition, obesity, poor nutrition, and smoking, can all weaken muscles and make hernias more likely.

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**3-11 Guidelines on Parenteral Nutrition in Surgery**

Parenteral nutrition is a way of delivering, in the form of intravenous infusion, the nourishments necessary for the maintenance of life, such as amino acids—a source of proteins, glucose, and lipids—a supply of energy; and water, electrolytes, microelements, and vitamins.

*Central Parenteral Nutrition: often called Total Parenteral Nutrition (TPN); delivered into a central vein
*Peripheral Parenteral Nutrition (PPN): delivered into a smaller or peripheral vein

*Inadequate oral intake for more than 14 days is associated with a higher mortality.

*Compounding Methods

**A- Total nutrient admixture (TNA) or 3-in-1**

Dextrose, amino acids, lipid, additives are mixed together in one container.

Lipid is provided as part of the PN mixture on a daily basis and becomes an important energy substrate.
B- 2-in-1 solution of dextrose, amino acids, additives
Typically compounded in 1-liter bags
Lipid is delivered as piggyback daily or intermittently as a source of EFA

Table 9 - Parenteral nutrition solutions.

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Central vein</th>
<th>Peripheral vein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose 50%</td>
<td>400 mL</td>
<td>100-150 mL</td>
</tr>
<tr>
<td>Amino acids 10%</td>
<td>200 mL</td>
<td>150 mL</td>
</tr>
<tr>
<td>Sodium acetate (10%)</td>
<td>40 mL</td>
<td>40 mL</td>
</tr>
<tr>
<td>Magnesium sulphate (20%)</td>
<td>5 mL</td>
<td>5 mL</td>
</tr>
<tr>
<td>Potassium chloride (19.1%)</td>
<td>8 mL</td>
<td>8 mL</td>
</tr>
<tr>
<td>Potassium acid phosphate (25%)</td>
<td>10 mL</td>
<td>10 mL</td>
</tr>
<tr>
<td>Calcium gluconate (10%)</td>
<td>20 mL</td>
<td>20 mL</td>
</tr>
<tr>
<td>Folic acid (0.1%)</td>
<td>5 mL</td>
<td>5 mL</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>0.2 mg</td>
<td>0.2 mg</td>
</tr>
<tr>
<td>Vitamin B</td>
<td>1 amp</td>
<td>1 amp</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>250 mg</td>
<td>250 mg</td>
</tr>
<tr>
<td>Distilled water to</td>
<td>1000 mL</td>
<td>1000 mL</td>
</tr>
<tr>
<td>Osmolarity (mOsm/L)</td>
<td>1800 mOsm/L</td>
<td>650-700 mOsm/L</td>
</tr>
<tr>
<td>N/CAL ratio</td>
<td>1/250</td>
<td>1/100 to 1/150</td>
</tr>
</tbody>
</table>

Uses: Parenteral nutrition is used primarily in therapies of gastrointestinal patients after stomach resection, with short bowel syndrome, intestinal fistula, bowel obstruction, and absorption disorders (Crohn’s disease, acute pancreatitis) and as perioperative treatment in malnourished or depleted patients with extensive burns, and those in shock and during chemo- and radiotherapy

The role of the pharmacist should ensure the therapeutic safety of parenteral nutrition in all its aspects including parenteral nutrition mixture preparation, choice of an appropriate administration route and drug form for the ongoing medication, implementation of alternative treatment methods, monitoring therapeutic and toxic effects, and instructing the medical and nursing staff about possible interactions of drugs with parenteral nutrition.

Type of formula
The commonly used formula of 25 kcal/kg ideal body weight furnishes an approximate estimate of daily energy expenditure and requirements. Under conditions of severe stress requirements may approach 30 kcal/kg ideal body weight.

*The Protein: Fat: Glucose caloric ratio should approximate to 20:30:50%
Note: In well-nourished patients who recover oral or enteral nutrition by postoperative day 5 there is a little evidence that intravenous supplementation of vitamins and trace elements is required. After surgery, in those patients who are unable to be fed via the enteral route, and in whom total or near total parenteral nutrition is required, a full range of vitamins and trace elements should be supplemented on a daily basis.

Complications

1-infections
TPN requires a chronic IV access for the solution to run through, and the most common complication is infection of this catheter. Infection is a common cause of death in these patients, with a mortality rate of approximately 15% per infection, and death usually results from septic shock.

2-Blood clots
Chronic IV access leaves a foreign body in the vascular system, and blood clots on this IV line are common.[6] Death can result from pulmonary embolism wherein a clot that starts on the IV line but breaks off and goes into the lungs. Patients under long-term TPN will typically receive periodic heparin flush to dissolve such clots before they become dangerous.

3-Fatty liver and liver failure
Fatty liver is usually a more long term complication of TPN. The pathogenesis is due to using linoleic acid (an omega-6 fatty acid component of soybean oil) as a major source of calories.

Reference:

(Review of Antibacterial Agents)

Antibiotic Overview
Questions to ask before selecting an antibiotic:
Host factors:
1. Normal or abnormal immune status?
2. Underlying disease that will affect selection &/or dosing? (e.g. renal failure)
3. Seriousness of the infection?

Pathogen factors:
4. What are the most likely bugs based on the infection site?
5. Where was the infection acquired? (community or hospital setting?)
6. Local susceptibility patterns?

Drug factors:
7. Bioavailability at infected site? (e.g. blood-brain barrier)
8. Broad or narrow spectrum?
9. Bacteriocidal or bacteriostatic?
10. Side effect profile?

General Principles:
1. Be elegant. Use the antibiotic with the narrowest spectrum that covers the pathogen.
2. Be smart. If a patient is very sick or immunocompromised, it’s OK to cover broadly for the first 1-3 days while you identify the pathogen as long as you narrow your choice as soon as possible.
3. Follow the 3 day rule: Broad spectrum antibiotics markedly alter the normal host flora about 3 days into therapy AND cultures should be back in 3 days so always reassess your antibiotic choices and narrow it when possible.
4. New isn’t always better. When several antibiotics have similar coverage, select the least expensive.

**Antibiotic Classes by Coverage:**

**Gram positive coverage:**
1. Penicillins (ampicillin, amoxicillin) penicillinase resistant (Dicloxacillin, Oxacillin)
2. Cephalosporins (1st and 2nd generation)
3. Macrolides (Erythromycin, Clarithromycin, Azithromycin)
4. Quinolones (gatifloxacin, moxifloxacin, and less so levofloxacin)
5. Vancomycin (MRSA)
6. Sulfonamide/trimethoprim*(Increasing resistance limits use, very inexpensive)
7. Clindamycin
8. Tetracyclines
9. Chloramphenicol (§causes aplastic anemia so rarely used)
10. Other: Linezolid, Synercid (VRE)

**Pseudomonas coverage**

Ciprofloxacin
Aminoglycosides
Some 3rd generation cephalosporins
4th generation cephalosporins
Broad spectrum penicillins

**Gram negative coverage:**
1. Broad spectrum penicillins (Ticarcillin-clavulanate, piperacillin-tazobactam)*
2. Cephalosporins (2nd, 3rd, and 4th generation)*
3. Aminoglycosides* (renal and ototoxicity)
4. Macrolides (Azithromycin)*
5. Quinolones (Ciprofloxacin)*
6. Monobactams (Azetreonam)*
7. Sulfonamide/trimethoprim*
8. Carbapenems (Imipenem)
9. Chloramphenicol

**Anaerobic coverage:**
1. Metronidazole
2. Clindamycin
3. Broad spectrum penicillins
4. Quinolones (Gatifloxacin, Moxifloxacin)
5. Carbapenems
6. Chloramphenicol

**Atypical coverage:**
1. Macrolides (Legionella, Mycoplasma, chlamydiae)
2. Tetracyclines (rickettsiae, chlamydiae)
3. Quinolones (Legionella, Mycoplasma, Chlamydia)
4. Chloramphenicol§ (rickettsiae, chlamydiae, mycoplasma)
5. Ampicillin (Listeria)
- Cephalosporins  
- 4 generations based on coverage with improving gram negative coverage as generation number increases  
- 1st generation (Cefazolin and Cephalexin): Good gram positive coverage, inexpensive, and used primarily to treat skin and soft tissue infections.  
- 2nd generation (Cefuroxime): Some gram positive and gram negative coverage, expensive, and rarely used as 1st line therapy.  
- 3rd generation (Ceftiraxone, cefotaxime, cefoperazone, cefpodoxime): Good gram negative coverage except pseudomonas, long half-life (q24 hr dosing), crosses blood-brain barrier, biliary and renal clearance.  
- 4th generation (Cefipime): Good gram positive (except MRSA) and gram negative coverage, including pseudomonas, crosses blood-brain barrier, good for nosocomial infections.  

The Carbapenems  
A. imipenem antimicrobial activity – broad spectrum  
   a) Works well against anaerobes  
   b) Works well against Pseudomonas  
B. meropenem and ertapenem - same as imipenem but do not require cilastatin  
C. aztrean (a monobactam) antimicrobial activity for B& C  
   a) Only active against G- bacteria, including Pseudomonas  
   b) Not effective against anaerobes  

2-Tetracyclines  
Tetracyclines are bacteriostatic antibiotics. They have unique roles in the treatment of Rickettsia, Chlamydia and Mycoplasma infections. Their general use is limited because of widespread resistance among more common bacterial pathogens.  
Tetracycline (250-500 mg PO q6h).  
Doxycycline (100 mg PO/IV q12h) is the most commonly used tetracycline.  

4-Aminoglycosides  
These include amikacin, gentamicin, neomycin, netilmicin, streptomycin, and tobramycin. All are bactericidal and active against some Gram-positive and many Gram-negative organisms. Amikacin, gentamicin, and tobramycin are also active against Pseudomonas aeruginosa; streptomycin is active against Mycobacterium tuberculosis and is now almost entirely reserved for tuberculosis.  
Dosing and Administration  
Traditional dosing of aminoglycosides involves standard divided daily dosing of Aminoglycosides.  
Extended-interval dosing of Aminoglycosides (once daily dosing) is an alternative method of administration and is more convenient than traditional dosing for most indications.  
Specific agents  
A-Gentamicin By IM or by slow I.V injection over at least 3 minutes or by intravenous infusion, 3–5 mg/kg daily (in divided doses every 8 hours).  
B-Tobramycin Tobramycin has similar activity to gentamicin. It is slightly more active against Ps. aeruginosa but shows less activity against certain other Gram-negative bacteria.  
Dose: By IM or by slow I.V injection injection or by intravenous infusion, 3 mg/kg daily in divided doses every 8 hours, in severe infections up to 5 mg/kg daily in divided doses every 6–8 hours (reduced to 3 mg/kg as soon as clinically indicated).  
C-Amikacin  
Amikacin is more stable than gentamicin to enzyme inactivation. Amikacin is used in the treatment of serious infections caused by gentamicin-resistant Gram-negative bacilli.  
D-Streptomycin is most commonly used for treating drug-resistant tuberculosis and enterococcal endocarditis. Other indication for streptomycin is brucellosis.
Adverse effects.
Nephrotoxicity is the major adverse effect of aminoglycosides. Nephrotoxicity is reversible when detected early but can be permanent. Aminoglycosides should be used cautiously or avoided, if possible, in patients with decompensated kidney disease (2).

Ototoxicity (vestibular or cochlear) is also possible and requires weekly hearing tests with extended therapy (>14 days). Streptomycin is unique in that it causes more ototoxicity with a lower risk of nephrotoxicity. Concomitant administration of aminoglycosides with other known nephrotoxic agents should be avoided if possible (2).

5-Macrolide Antibiotics
A-Erythromycin
Erythromycin (250-500 mg PO qid or 0.5-1.0 g IV q6h) has an antibacterial spectrum that is similar but not identical to that of penicillin; it is thus an alternative in penicillin-allergic patients. Erythromycin is also active against chlamydia and mycoplasmas (1).

B-Clarithromycin It has slightly greater activity than the parent compound. It is given twice daily (250-500 mg PO bid or 1,000 mg XL PO once daily). It is an important component of regimens used to eradicate Helicobacter pylori (2). clarithromycin causes fewer gastro-intestinal side-effects than erythromycin (1).

Azithromycin is a macrolide with slightly less activity than erythromycin against Gram-positive bacteria but enhanced activity against some Gram-negative organisms including H. influenzae. It has a long tissue half-life and once daily dosage is recommended. Azithromycin causes fewer gastro-intestinal side-effects than erythromycin (1).

6-Quinolones
Nalidixic acid and norfloxacin (400 mg PO q12h) are effective in uncomplicated urinary-tract infections (1).

Ciprofloxacin (250-750 mg PO q12h or 500 mg PO daily [Cipro XR] or 200-400 mg IV q8-12h) (2), is active against both Gram-positive and Gram-negative bacteria. It is particularly active against Gram-negative bacteria, including salmonella, shigella, and pseudomonas (1).

Levofloxacin, moxifloxacin, and gemifloxacin are newer fluoroquinolones with improved coverage of aerobic Gram-positive bacteria (streptococci, staphylococci) and atypical respiratory pathogens (Chlamydia pneumoniae, Mycoplasma, Legionella) but less Gram-negative activity (especially against P. aeruginosa) than ciprofloxacin (2).

8-Others:
A-Sulfamethoxazole, and Trimethoprim
Sulfamethoxazole (sulphamethoxazole) and trimethoprim are used in combination (as co-trimoxazole) because of their synergistic activity. However, co-trimoxazole is associated with rare but serious side-effects (e.g. Stevens-Johnson syndrome and blood dyscrasias, notably bone marrow depression and agranulocytosis) (1). The combination has a broad spectrum of activity but typically does not inhibit P. aeruginosa, anaerobes, or group A streptococci (2).

B-Chloramphenicol
Chloramphenicol Chloramphenicol is a potent broad-spectrum antibiotic; however, it is associated with serious haematological side-effects when given systemically and should therefore be reserved for the treatment of life-threatening infections, particularly those caused by Haemophilus influenzae (1).

C-Metronidazole and Tinidazole:
Metronidazole (250-750 mg PO/IV q6-12h) is only active against anaerobic bacteria and some protozoa. Protozoal infections that are routinely treated with metronidazole include Giardia, Entamoeba histolytica, and Trichomonas vaginalis (2). Tinidazole is similar to metronidazole but has a longer duration of action (1).

D-Clindamycin
Clindamycin (150-450 mg PO tid-qid or 600-900 mg IV q8h) (2) is active against Gram-positive cocci, including streptococci and penicillin-resistant staphylococci, and also against many anaerobes, especially Bacteroides fragilis. It is well concentrated in bone (1). Clindamycin has been associated with antibiotic-associated colitis which may be fatal (1).

E-Vancomycin and teicoplanin
The glycopeptide antibiotics vancomycin and teicoplanin have bactericidal activity against aerobic and anaerobic Gram-positive bacteria including multi-resistant staphylococci (1). Vancomycin has a relatively long duration of action and can therefore be given every 12 hours (2). Teicoplanin is very similar to vancomycin but has a significantly longer duration of action allowing once-daily administration. Unlike vancomycin, teicoplanin can be given by intramuscular as well as by intravenous injection; it is not given by mouth (1).

F-Fusidic acid
The only indication for their use is in infections caused by penicillin-resistant staphylococci, especially osteomyelitis, as they are well concentrated in bone; they are also used for staphyloccocal endocarditis (1).

G-Nitrofurantoin
Nitrofurantoin is a bactericidal oral antibiotic that is useful for uncomplicated UTIs except those caused by Proteus, P. aeruginosa, or Serratia (2). Although it was commonly used in the past for UTI prophylaxis, this practice should be avoided, as prolonged therapy is associated with chronic pulmonary syndromes that can be fatal (2). Nitrofurantoin should not be used for pyelonephritis or any other systemic infections (2). Adverse effects. Nausea is the most common adverse effect, and the drug should be taken with food to minimize this problem. Patients should be warned that their urine may become brown secondary to the medication. Furthermore, it should not be used in patients with an elevated serum creatinine, as the risk for development of treatment-associated adverse effects is increased (2).

References
The Sanford Guide to Antimicrobial Therapy.