DRUGS USED IN ICU

DR. AMITESH GUPTA
DEPTT.OF CHEST & TB

ANTICOAGULANTS

- **General principle**
- All patients on systemic anticoagulation must have an APTT, INR and CBP performed daily.

- **Indications**

♦ Proven venous or arterial thromboembolism

♦ Acute coronary syndromes: as sole therapy or following TNK

♦ Prosthetic heart valves:

a. Prior to commencement of oral anticoagulants

b. During an acute illness, where oral anticoagulation is relatively C/I

- AF in patients complicated by emboli < 70 years.
- AF for more than 48 hours, in which cardioversion is being considered.
- AF for more than 48 hours, in which cardioversion is being considered
- Extracorporeal circuits e.g. CVVHDF, ECMO
- IABP

ANTICOAGULANTS

Drug	Infusion / Dose
Warfarin	▪ Variable dose ∝ INR ▪ See age-adjusted Warfarin loading protocol below ▪ Daily INR
Heparin (infusion)	▪ 25000u/50ml = 500u/ml ▪ See below: titrate against APTT: ▪ Cease 4-6 hours prior to surgical procedures
Heparin (subcut)	▪ 5000 u subcut bd <70 kg ▪ 5000 u subcut 8 hrly >70 kg or high risk DVT
Enoxaparin (Clexane®)	▪ Prophylaxis: 40mg subcut daily 20mg subcut daily if Creat clearance < 30ml/min ▪ "High risk" 20mg mane 40mg nocte ▪ Treatment: 1mg/kg subcut bd - lean body mass

ANTICOAGULANTS

Prostacyclin (infusion)	▪ Dose: 0.2-0.6 µg/kg/hr ▪ 500µg (+10ml diluent): add to 40ml NSal = 10µg/ml solution ▪ Start at 2ml/hr and monitor platelet count ▪ May cause hypotension
Danaparoid sodium (Orgaran®) Infusion	▪ IV loading dose: < 60kg 1500 U 60-75 kg 2250 U 75-90 kg 3000 U > 90 kg 3750 U ▪ Infusion: 2250^{U} of danaparoid in 250ml 5% dextrose: 44 ml/hr (400 U/hr) x 4 hours 33 ml/hr (300 U/hr) x 4 hours 22 ml/hr (200 U/hr) ▪ Adjust dose to anti-Xa levels (target 0.5-0.8 anti-Xa U/ml) ▪ Long half life (25 hrs): cease early if changing to oral anticoagulants
Danaparoid (subcut)	▪ 750 U 8-12 hourly

Table: Heparin Infusion Protocol

Weight (kg)	45-55	56-65	66-75	76-85	86-95	>95
Bolus (U)	3,500	4,200	4,900	5,600	6,300	7,000
Infusion (U/hr)	900	1,100	1,250	1,400	1,600	1,800

Infusion adjustment

APTT	IV bolus	Stop Infusion	Rate Change	Repeat APTT
< 37	5,000 units		↑ 400u/hr	6 hrs
38-64			↑ 200u/hr	6 hrs
65-110			No change	Daily
111-130			↓ 50u/hr	6 hrs
131-140		30 min	↓ 100u/hr	6 hrs
141-150		60 min	↓ 150u/hr	6 hrs
>150		120 min or APTT < 150	↓ 200u/hr	2 hrs

Note: Infusion: 25,000 units in 50ml syringe = 500U/ml
Check first APTT 6 hrs after bolus dose

ENDOCRINE DRUGS

INSULIN

- *Indications:*

i) Diabetic emergencies – DKA and hyperosmolar coma

ii) Treatment of hyperkalaemia

♦ 50% dextrose 50ml, plus Actrapid 10U

iii) Perioperative diabetic patients (both insulin and non-insulin dependent)

iv) General ICU patients

- Hyperglycaemia ≥ 10 mmol/l or glycosuria in acute illness:

a. Maintaining BGL ≤ 10mmol/l using an insulin infusion is recommended for ***all critically ill patients.***

b. Majority of ICU patients will require insulin using this protocol.

♦ Subcutaneous sliding scale insulin:

a. No longer recommended by the RAH Endocrine Unit.

b. May be used in a small number of less critically ill patients with a limited need for insulin and for recovering patients in whom IV access is not available.

c. A regular dose of s/c insulin,adjusted according to BGL is also suitable.

Flowchart: Blood Glucose Management in ICU

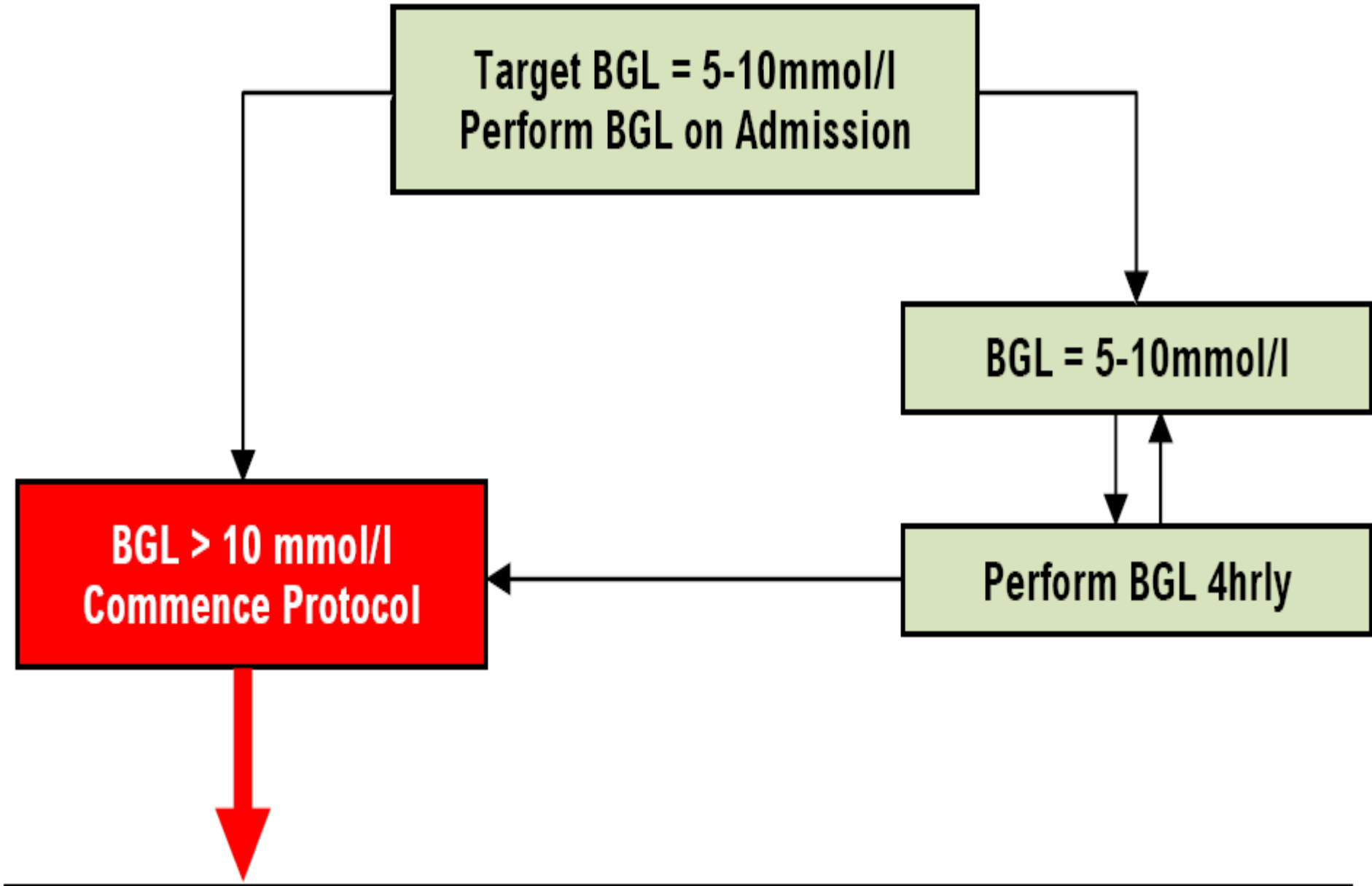
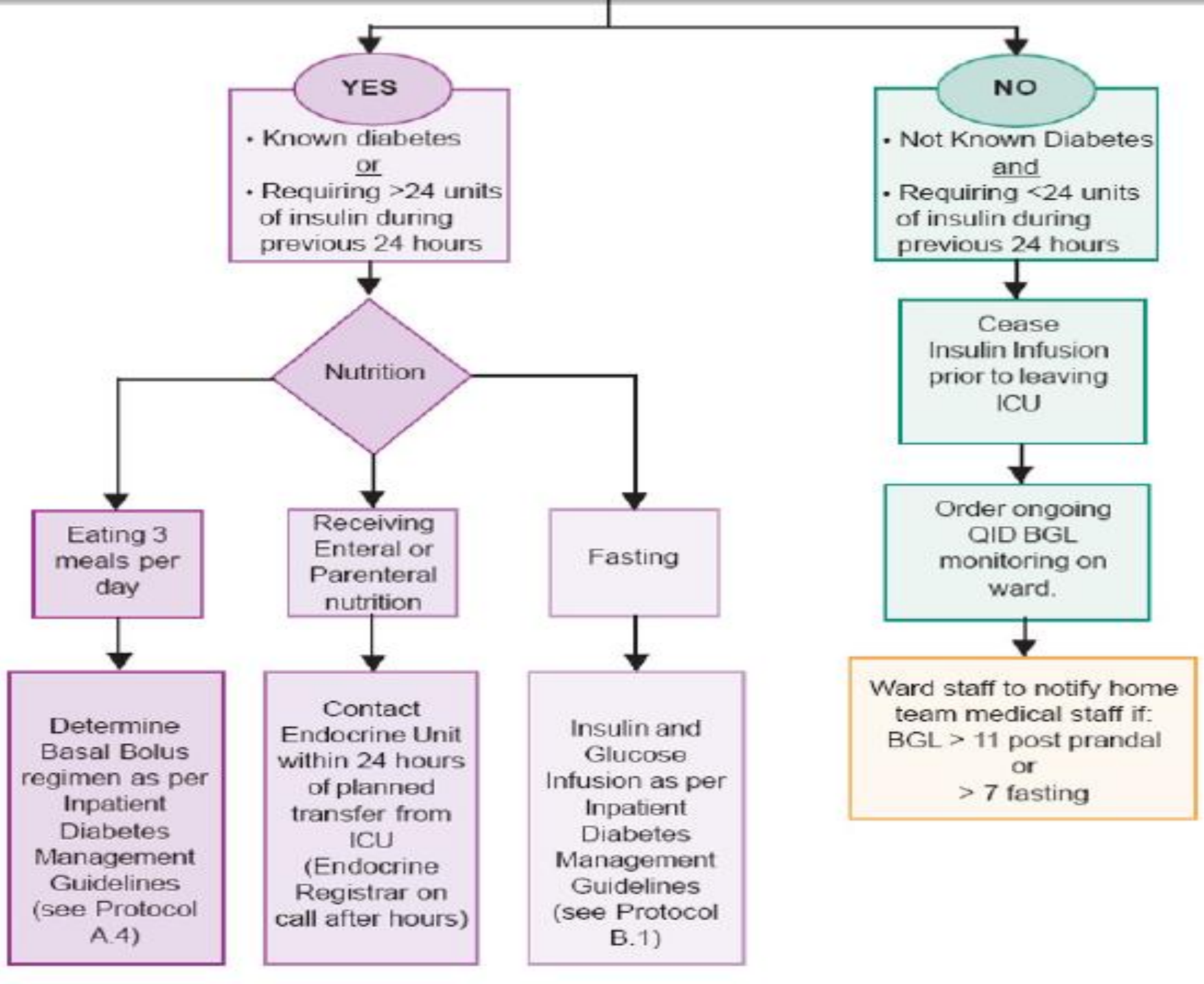


Table: Insulin Infusion Protocol

BGL	Bolus	Starting infusion	Subsequent infusion	Repeat BGL
mmol/l	Units IV	Units/hr	Units/hour	Hours
>15	2	2	Increase by 1	1
10.1-14.9	1	1	Increase by 1	1
8-10	0	0	If BGL dropping continue current rate. If static or rising increase by 0.5	1
5-7.9	0	0	Continue current rate If BGL dropping for 2 consecutive hrs decrease rate by 0.5.	1 (2hrly if BGL stable for 6 hrs)
3.5-4.9	0	0	Cease	1 (4hrly if off insulin>6hrs)
<3.5	Call MO	0	Cease	1


YES
• Known diabetes
or
• Requiring >24 units of insulin during previous 24 hours
NO
• Not Known Diabetes
and
• Requiring <24 units of insulin during previous 24 hours
Nutrition
Eating 3 meals per day
Receiving Enteral or Parenteral nutrition
Fasting
Determine Basal Bolus regimen as per Inpatient Diabetes Management Guidelines (see Protocol A.4)
Contact Endocrine Unit within 24 hours of planned transfer from ICU (Endocrine Registrar on call after hours)
Insulin and Glucose Infusion as per Inpatient Diabetes Management Guidelines (see Protocol B.1)
Cease Insulin Infusion prior to leaving ICU
Order ongoing QID BGL monitoring on ward.
Ward staff to notify home team medical staff if:
BGL > 11 post prandal
or
> 7 fasting

STEROIDS

- INDICATIONS

i) Pre-existing steroid therapy:

♦ Wide variety of indications, doses and durations of therapy.

♦ The need to continue steroids, with or without dose adjustment, should be assessed.

- ii) A number of conditions present within the ICU where steroid therapy may be beneficial. In the majority of these supporting data is variable and the decision to administer steroids should be made on a case-by-case basis.

- Adult meningitis - esp. pneumococcal & ***prior to antibiotics***
- Septic shock - non-responders to a SST
- ARDS - fibro-proliferative phase + negative cultures
- Anaphylaxis
- Post-extubation laryngeal oedema / stridor

RENAL DRUGS

DIURETICS

- **General principles**

a) Oliguria in acutely ill patients is frequently a manifestation of:

i) Hypovolaemia – relative or absolute

ii) Decreased cardiac output

iii) Direct renal toxicity, or

iv) A combination of these factors.

b) Therapy should be directed toward causative factors and not maintenance of urine output by the administration of a diuretic agent.

c) Urine output, in the absence of diuretic use, represents one of the best markers of end-organ perfusion and is a useful guide to clinical management.

d) Diuretics should never be used to treat oligo/anuria, they are only a treatment for fluid overload.

- **Indications**

a) Symptomatic fluid overload

i) Pulmonary oedema

ii) Congestive cardiac failure: cor pulmonale

b) Hyperaldosterone states: ascites

c) Clinical fluid overload

d) Chronic renal failure (maintenance)

- **Contraindications**

a) Hypovolaemic and/or Na+-depleted states

b) Known drug hypersensitivity (esp. sulphonamide group)

- **Complications**

a) Hypovolaemia

b) Hyperosmolal states due to In appropriate diuresis in hypovolaemia

c) Potentiation of renal failure - 2° to hypovolaemia

d) Electrolyte disturbance

e) Natriuresis and kaliuresis will alter urine electrolytes and osmolality for 24-48hrs post dose.

Drug	Infusion/dose	Clinical uses
Frusemide	40-250 mg/day IV / oral	▪ First line, potent loop diuretic ▪ Doses may be increased in diuretic dependence ▪ ↓ K^+, Mg, PO_4, metabolic alkalosis common
Acetazolamide	250-500 mg IV tds	▪ Carbonic anhydrase inhibitor ▪ Alkaline diuresis with HCO_3^- excretion ▪ Used for severe metabolic alkalosis *after* correction of hypovolaemia: ↓ K^+, Mg, PO_4 ▪ May be useful in weaning COPD from ventilation with post hypercapnic alkalosis
Spironolactone	25-100 mg oral bd	▪ Potassium sparring diuretic ▪ Often given with loop and thiazide diuretics ▪ Indicated as part of diuretic treatment regime for left ventricular failure ▪ Use in ascites especially if secondary hyperaldosteronism
Mannitol	20% solution / 200 mg/ml Dose 100 ml prn (20g) (0.5g/kg is too much!!)	▪ Potent osmotic diuretic ▪ May cause initial hypervolaemia, then late hypovolaemia and hyperosmolal states. ▪ Causes an osmolal gap (measured-calculated osmolality). ▪ Maintain *measured* osmolality < 300 mosmol/l ▪ **Limited** role in suspected acute life-threatening intracranial hypertension as a bridge to definitive surgical therapy. ▪ Limited (unproven) roles in rhabdomyolysis, transfusion reactions, myoglobinuria for renal protection

GASTROINTESTINAL DRUGS

Stress ulcer prophylaxis

a) Routine stress ulcer prophylaxis is *not indicated.*

i) Low prevalence of clinically significant bleeding due to stress ulceration

ii) No evidence of survival benefit

iii) Possible increased incidence of VAP

b) High risk stress-ulcer patients

i) Prophylaxis - ranitidine 50mg iv tds

ii) Reduce dose in renal compromise

c) Patients on pre-existing therapy should be continued

d) Patients with known or clinically suspected GI bleeding should commence on a PPI

e) Enteral feeding should be commenced as soon as possible

Acute GI bleeding

a) *Definition*

i) Overt bleeding

- Blood in the NGT
- Haematemesis or malaena

ii) ***Plus either:***

- ↓ MAP > 20 mmHg
- ↓ Hb ≥ 20 g/L in 24 hours
- Required 2+ units blood transfusion in 24 hrs

Metoclopromide	10 mg IV 6 hrly, prn	▪ Persistent vomiting, nausea ▪ Large gastric aspirates (in combination with erythromycin)
Erythromycin	100 mg IV bd	▪ Large gastric aspirates (in combination with metoclopramide)
Droperidol	0.625 mg IV prn	▪ Potent, effective antiemetic ▪ Minimal side effects
Tropisetron	2 mg IV / oral daily	▪ Third line antiemetic after metoclopramide and droperidol ▪ Use if anticholinergic side effects are to be avoided.
Ondansetron	4 mg IV prn / 12 hrly	▪ Second line, antiemetic (not available at RAH)
Ranitidine	50 mg 8hrly IV 150-300 mg daily po	▪ Peptic ulcer disease ▪ First-line stress ulcer prophylaxis ▪ Does not prevent acute rebleeding ▪ Reduce dose in renal failure.
Pantoprazole	Acute Rx: 40 mg IV bd/tds Maint. Rx: 40 mg daily	▪ Refractory peptic ulcer, ulcerative oesophagitis ▪ First line Rx for peptic ulceration ▪ Z-E syndrome ▪ Upper GI bleeding
Octreotide	Bolus: 50 μg IV Varices: 50 μg / hr Fistulae: 100-200 IV / sc 8-hrly	▪ Variceal bleeding (as effective as sclerotherapy) ▪ Enteric, pancreatic fistulae ▪ Sulphonylurea overdose ▪ Severe secretory diarrhoea, e.g. post-chemo

ANTIBIOTICS

- **Policy**

a) Prescription of antibiotics must conform to RAH guidelines.

b) The over-prescription and irrational use of antibiotics is associated with the development of bacterial resistance, nosocomial infection and drug related morbidit.

c) All antibiotics must be reviewed daily and where appropriate, discussed with Infectious Diseases or Clinical Microbiology.

- **Principles of antibiotic prescription**

a) *The treatment of infection consists of (in order of priority)*

i) Adequate resuscitation

ii) Surgical drainage of infected collections where indicated

iii) Relevant samples for microbiological and/or histological analysis

iv) Standard cultures:

- Blood - ***2 sets at different times from venous stabs***
- Urine
- Sputum
- Any other suspicious site

v) Rational prescription of empiric antibiotics

vi) **Prompt administration of culture-directed antibiotics**

- *General indications for antibiotics:*

i) Prophylaxis for invasive procedures and operations

♦ Proven indications

a. Abdominal surgery which involves a breach of the colonic mucosa (traumatic or elective), or draining an infected cavity

b. Selected obstetrical and gynaecological procedures:

i. Caesarean section with ruptured fetal membranes

ii. Vaginal hysterectomy

c. Insertion of a prosthetic device

d. Compound fractures

e. Amputation of gangrenous limb

♦ Unproven but recommended

a. Lacerations penetrating into periosteum or into joint cavities

b. Crush injuries

c. Insertion of a neurosurgical shunt

d. Cardiac valve replacement

e. Arterial prosthesis

ii) Empirical antibiotics where infection is likely prior to definitive bacteriological diagnosis:

- ♦ Obtain as many cultures as possible before antibiotics commenced.
- ♦ In sick patients "best guess" antibiotics should be commenced prior to results
- ♦ When gram stain or culture results return, antibiotic cover should be rationalised to specific treatment for isolated organisms.
- iii) Specific infections where the organisms is known

- *Complications of antibiotics*

i) Antibiotic effect related

♦ Bacterial resistance

♦ Nosocomial infection

♦ Pseudomembranous colitis

ii) Systemic reactions

- Skin rashes
- Anaphylactoid / anaphylactic reactions

iii) Specific organ toxicities, e.g.

- Interstitial nephritis, ATN
- Seizures
- Marrow suppression, thrombocytopaenia
- QT prolongation

- **Ventilator associated pneumonia**

a) Significant cause of mortality and morbidity in ICU.

b) Clinical diagnosis based on combination of some of the following

i) New CXR infiltrates (hard to see in patients with ARDS)

ii) New clinical chest signs

iii) Increasing oxygen requirement

iv) Increased purulent sputum

- Treatment

i) Sputum culture

ii) Commence antibiotics immediately

♦ Tazocin 13.5g/24hrs (or 3 divided doses) &

♦ Gentamicin 5mg/kg on day 1, then as per levels

♦ If gentamicin contraindicated, ciprofloxacin 200-400mg b.d.

- In patients with known MRSA or ICU stay > 5days

a. Add vancomycin.

b. Stop if no gram positive organisms seen.

Table: Empirical Antibiotics

Infection	Type / Comment	Antibiotics
Pneumonia	▪ Community acquired ▪ Immunocompetent ▪ Admitted to ICU / HDU (i.e. respiratory failure)	▪ Azithromycin 500mg IV daily, ***plus*** *Ceftriaxone 1 IV daily ▪ For treatment failure, consider Moxifloxacin 400mg IV daily ± Flucloxacillin 1g 6h (if high suspicion of *S.aureus*)
	▪ *Default ICU therapy differs from the RAH standard protocol (penicillin + gentamicin) due to the wide variability in renal function in ICU patients and the inability to use baseline creatinine as a marker of renal function.	
	▪ Ventilator associated ▪ Hospital acquired	▪ Tazocin 4.5g IV 8 hrly or 13.5g/day + Gentamicin 5 mg/kg IV daily ▪ Consider Vancomycin 1g b.d. IV ▪ See above
	▪ Immunocompromised host	▪ Contact ID
Aspiration	▪ No antibiotics ***without*** evidence of proven infection.	
	▪ With proven infection	▪ Benzyl penicillin 1.2g IV 6 hrly, plus metronidazole 500 mg IV 12 hrly
Exacerbation of COPD	▪ No clinical signs of pneumonia	▪ Treat as community acquired pneumonia
Epiglottitis	▪ Usually *H. influenzae*	▪ Ceftriaxone 1 g IV daily
Meningitis/ encephalitis	▪ Suspected bacterial ▪ Usually: meningococcus pneumococcus, or H. influenzae	▪ Ceftriaxone 2g IV 12 hrly, *plus* Penicillin 1.8g to 2.4g IV 4 hrly ▪ Dexamethazone 10mg IV before or with the first dose of antibiotic then 6hrly for 4 days
	▪ Not definitely bacterial	▪ Consider Acyclovir 10mg/kg IV 8hrly

Urinary tract infection	▪ Without systemic sepsis in patients with a urinary catheter	▪ No treatment. ▪ Remove / change catheter
	▪ With systemic sepsis	▪ Amoxycillin 2g IV 6 hrly, plus gentamicin 5mg/kg IV daily, or ▪ Ceftriaxone 1gm IV daily if unable to tolerate gentamicin
Intra-abdominal sepsis	▪ Faecal peritonitis ▪ Perforated viscus	▪ Amoxycillin 2 gm IV 6 hrly + Gentamicin 5 mg/kg IV daily + Metronidazole 500 mg IV bd x 7 days
	▪ Recurring intra-abdominal sepsis or failed Rx with above	▪ Consult ID/Clinical Microbiology
Pancreatitis	▪ No CT evidence of necrosis	▪ No antibiotics
	▪ Significant CT necrosis	▪ Tazocin 4.5g IV 8 hrly
Biliary sepsis	▪ Acute cholecystitis ▪ Ascending cholangitis	▪ Amoxycillin 1 g IV 6 h + Gentamicin 5 mg/kg/d IV x 7 days ▪ Amoxycillin 2 gm IV 6 h + Gentamicin 5 mg/kg/d IV
	▪ Previous biliary tract surgery or known biliary obstruction	▪ add Metronidazole 500mg IV BD x 7 days

Gynae sepsis	▪ Septicaemia secondary to PID	▪ Amoxycillin 2g IV 6 h + Gentamicin 5 mg/kg IV dly + Metronidazole 500 mg IV bd x 5 days
	▪ Suspected *S. aureus* infection	▪ Lincomycin 1.2g IV bd + Gentamicin 5 mg/kg IV dly x 7 days
Suspected Bacterial Endocarditis	▪ Community acquired	▪ Benzyl penicillin 1.8 g IV 4 h + Gentamicin 1 mg/kg IV tds ± Flucloxacillin 2g IV qid
	▪ Hospital acquired ▪ Prosthetic valve, or ▪ Penicillin allergic	▪ Vancomycin 1g IV bd + Gentamicin 1 mg/kg IV tds
	▪ 3 sets of blood cultures, and review at 48 hrs ▪ Manage pre-dose trough levels for gentamicin <1 mg/L to avoid toxicity	
Fungal Septicaemia	▪ Suspected candidiasis	▪ Amphotericin 0.5-1 mg/kg/day, ***or*** ▪ Fluconazole 400 mg IV daily (in non-neutropaenic patients)
	▪ Suspected aspergillosis	▪ Voriconazole IV/oral 6mg/kg BD loading for 24 hours, then 4mg/kg BD ***or*** ▪ Caspofungin 70mg IV daily loading for 24 hours, then 50mg daily
	1. Consult ID for ***all*** proven fungaemias 2. Remove ***all*** potential sources of infection (lines, catheters, etc) 3. Monitor renal / hepatic function during the course of antifungal therapy. 4. Adjust the amphotericin dose in renal insufficiency, or consider the use of fluconazole if appropriate 5. Voriconazole levels can be monitored for toxicity and clinical responses. 6. IV voriconazole is contraindicated in patients with CrCl < 30mL/min due to accumulation of the excipient	

Burns	***No antibiotics*** without evidence of bacterial infection	
Cutaneous infections	▪ Wound infection + signs of systemic sepsis	▪ Benzylpenicillin 1.8 g IV 4 h + Flucloxacillin 1-2 g IV 6 h ***or*** ▪ Cefazolin 1g IV 8h
	▪ Synergistic gangrene ▪ Necrotising fasciitis ▪ In addition to ***surgery*** ± hyperbaric oxygen	▪ Meropenem ***plus*** ▪ Lincomycin 600 mg IV 8 hrly, ***or*** Clindamycin 600 mg IV 8 hrly ▪ Consider IV-Ig 2.0g/kg total dose (3 days)
	▪ Severe oral infections	▪ Penicillin 1.2 g IV 4-6 hourly + Metronidazole 500 mg IV bd
Line sepsis	▪ Patient not overtly septic	▪ Remove unnecessary, old or clinically suspect lines & send for culture. ▪ Blood cultures by venipuncture ▪ No antibiotics
	▪ Patient overtly septic ▪ Prosthetic valve / arterial graft ▪ High risk patient	▪ Vancomycin 1 g IV BD until blood culture results available

Table: Antibiotics for Specific Organisms

Organism	1st choice	2nd choice
Pneumococcus	Benzyl penicillin 1.2g IV 4-6 h	Ceftriaxone 1 IV dly
Staphylococcus aureus	Flucloxacillin 2 gm IV 6 h	Vancomycin 1gm IV bd ***or*** Cefazolin 1-2g IV 8h
Meningococcus	Benzyl penicillin 1.2g IV 4-6 h	Ceftriaxone 1g IV dly
Meningococcus contacts	Ciprofloxacin 500mg po x 1dose	Rifampicin 600mg po bd x 2 days
MRSA	Vancomycin 1g IV bd	Consult ID
Enterococcus	Amoxycillin 1-2 g IV 6 h (+ Gentamicin 5 mg/kg if SBE)	Vancomycin 1g IV dly (+ Gentamicin 5mg/kg if SBE)
Gp A Strep. With Shock	Benzylpenicillin 1.8g 4 hrly IV + Lincomycin 1.2g IV bd + Intragam 2.0g/kg total dose (3 days)	Consult ID Cease IG when pt. improves
Haemophilus influenzae	Ceftriaxone 1g IV daily	Amoxycillin 1-2 g IV 6 h (if sensitive)
H. influenzae contacts (meningitis)	Rifampicin 600 mg oral bd x 4 days	Ceftriaxone 1g IM dly x 2 doses
E. Coli	Gentamicin 5 mg/kg IV dly	Ceftriaxone 1g IV dly
Enterobacter	Gentamicin 5 mg/kg IV dly	Meropenem 500mg IV 8h
Klebsiella	Gentamicin 5 mg/kg IV dly	Ceftriaxone 1g IV dly

Pseudomonas aeruginosa	Piperacillin 4 g IV 8 hrly + Gentamicin 5-7 mg/kg IV dly	Choice based on sensitivity results: Ceftazidime 2g IV 8hrly ***or*** Tazocin 4.5g IV 8hrly ***PLUS*** Gentamicin 5-7 mg/kg IV daily ***or*** Ciprofloxacin 400mg IV bd
Legionella spp.	Moxifloxacin 400mg IV daily	Azithromycin 500mg IV daily
Mycoplasma pneumoniae	Erythromycin 1g IV 6h	
Pneumocystis jurovecii	Co-trimoxazole 15-20 ml IV 6 h + methylpred 40mg bd x 5d, methylpred 40mg die x 5d, methylpred 20mg die x 11d,	Pentamidine isethionate 4 mg/kg/day IV + methylprednisolone 40mg 6 hrly x 7days
Clostridium difficile: 1. Mild / moderate 2. Severe, or relapse post R_X	Cease antibiotics 1. Metronidazole 400 mg o tds (or 500mg IV if npo) x 7-10 days 2. Repeat above	Consult ID or Clinical Micro. Treatment options are: Bacitracin 25,000^{u} 6hrly 7-10d or Vancomycin 125mg po 6hrly 7-10d
Clostridial infection (Polymicrobial Infection)	Benzylpenicillin 1.8g IV 4 hrly + Gentamicin 5 mg/kg IV dly + Metronidazole 500 mg IV bd + surgical debridement ± hyperbaric oxygen	Lincomycin 600 mg IV 8 hrly + Gentamicin 5 mg/kg IV daily

FLUIDS & ELECTROLYTES

- **Principles of Fluid Management in Intensive Care**

1. All fluids, infusions are reviewed daily and

a) Rewritten on the ICU flowchart .

b) In the IV Fluid chart in the ward folder.

2. Assessment of volume status and fluid balance involves all of the following:

a) Clinical markers

i) Skin turgor, mucous membranes, capillary refill, peripheral perfusion

ii) HR, BP, Urine output

iii) CVP, PAOP

iv) PiCCO catheter - GEDI, ELWI, stroke volume variability.

v) CXR, interstitial oedema

vi) Echo – IVC distensibility index, LVOT- VTI variability)

- Biochemical markers

i) Serum Na+, Cl-, osmolality

ii) Urea / creatinine (± ratio)

iii) Bicarbonate

iv) Haematocrit

c) Charted fluid balance

i) Total intake including drug/infusion volumes

ii) Total output including urine output, drains, NG losses, blood loss

iii) Insensible losses due to pyrexia, transcellular shifts, etc

3. Fluids should be considered in two components:

a) Maintenance fluids

i) Usually crystalloids:

- ♦ 4% dextrose + 1/5 N.Saline
- ♦ 5% dextrose / N.Saline
- ♦ Hartmann'sii)
- Usual volumes: 25-30 ml/kg/day → 80-120 ml/hr

b) Replacement / resuscitation fluids

i) N.saline should be used for most fluid resuscitation.

- Equivalent to 4% albumin for resuscitation
- Better for patients with head trauma.

ii) Colloid (4% albumin, gelofusine) may be considered for fluid resuscitation in selected patients. Greater cost, no demonstrable advantage.

iv) Crystalloid replacement is usually used for excessive renal, enteric and burns losses.

v) Hyperchloraemia may be harmful so consider the use of fluids with other anions, e.g. Hartmann's.

. **Composition of commonly used fluids** (1000ml solution):

Solution	Na^+	K^+	Cl^-	Ca^{++}	Lact.	Gluc.	Osm.	Prot.
N Saline	150		150				300	
N/2 Saline	75		75				150	
N/5 Sal. + 4% Dex.	30		30			40 g	282	
5% Dextrose						50 g	278	
Hartmann's	131	5.0	111	2	29		280	
Gelofusine (500ml)	77		60				274	20g
Albuminex 4% (500ml)	70		62.5					25g

PARENTRAL NUTRITION

General principles

i) TPN may be harmful in critically ill patients.

ii) ***Enteral nutrition is preferred and TPN should only be considered for patients*** in whom this is not possible.

- *Indications for TPN in the patient who cannot be fed enterally are:*

i) GIT Failure > 7-10 days and expected duration of support > 5-7 days.

♦ Prolonged post operative ileus

♦ Enteric fistulae

ii) Short GIT syndrome following major intestinal resection.

- *Complications of TPN:*

i) Depression of immune function, esp. in cancer patients

ii) Gut villous atrophy

iii) Metabolic imbalance

iv) Fluid imbalance

v) Trace element and vitamin deficiencies

vi) Central venous access complications


Thank You