Intensive Care Unit

Guidelines for Clinical Management

(Developed for the Colonial War Memorial Hospital ICU)

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Admission Protocol

The Intensive Care Unit at the CWM functions as an Open Unit. This means many medical staff visit and advise on aspects of the patient care, often at separate times to other teams involved. Therefore the following points need to be clarified*:*

- **The ultimate responsibility for patient management and care rests with the admitting medical or surgical team headed by the MOH medical or surgical consultant.**
    - Unless the patient is already under a team, the admitting consultant will be the team on call for the day of ICU admission.
    - If the patient is already in hospital under a team then they remain under that team unless formal handover to another team occurs eg surgical to medical.
    - Admitting team must do an ICU ward round review at least once per day.
    - Admitting team should be involved in any major changes to patient care and should be informed of significant changes in patient condition.
- **Under no circumstances does a patient get admitted to ICU under anaesthesia**.
- **The anaesthesia staff act in a coordination and facilitative role with the following duties:**
    - Coordinating and communicating between various treating teams eg surgical, medical, renal
    - Reviewing, accepting and clerking admissions,
    - staffing the ICU throughout the day,
    - coordinating care and providing technical skills for procedures in ICU eg intubation and ventilatory control,
    - reviewing and stabilising new referrals
    - liasing with admitting teams over any *new issues.*
- **New referrals** for admission to ICU should be made to the registrar on call for ICU.
    - If admission is appropriate and bed is available then the registrar should organise admission and inform on call consultant/senior registrar for ICU as soon as practicable or earlier if assistance is needed.
    - If **appropriateness of admission to ICU requires discussion** eg unlikely to change patient outcome, then ICU registrar should involve both admitting consultant and ICU consultant/senior registrar and family in discussions and a consensus should be reached.
- Senior registrar to coordinate with ICU charge sister about bed availability. The Patient cannot come to ICU until nursing staff and bed are ready**.**
- **Postoperative booked ICU admissions:** OT staff must liase with ICU sister in charge and/or ICU registrar regarding bed availability **PRIOR** to commencing surgery.

Basic Nursing Care

Hygiene:

- Full sponge every morning (for male patients include shave). Dress patient in ward gown if discharge to ward expected.
- Perianal wash bd/PRN
- Hair wash PRN (NB. Hair washing is contraindicated in patients who have an ICP monitor or EVD insitu)

Eye Care:

Sedated/Paralysed Patient:

- Clean with N/Saline every 2 hours.
- Apply artificial tears or Nsaline drops every 2 hours & PRN
- Secure eyes closed if sclera at risk of exposure

Conscious Patient (frequency of cares will depend on patient's ability to blink regularly):

- Clean with N/Saline PRN
- Apply artificial tear drops PRN

Mouth Care:

Patients with an artificial airway:

- Brush teeth (if possible) TDS and PRN using tap water and toothpaste
- Rinse with tap water 2/24 hourly and PRN
- Apply paraffin ointment PRN
- Change Yankeur sucker daily
- Change mouth care tray weekly

Endotracheal tube care

- Document ETT measurement at lips at intubation, every shift change and PRN
- Measure ETT cuff pressure at intubation, every shift change and PRN. ETT cuff pressure should be </= 20 mmHg.
- Suction ETT every 1-2 hours and PRN.
- Change HME daily and PRN.

Pressure Area Care:

- Turn patient 2-3 hourly unless contraindicated
- Inspect skin at each turn for evidence of development of pressure areas
- Ensure monitoring lines/cables are not causing any pressure
- Reposition oximeter probe (ear/nose) 2-3 hourly and PRN
- Complete and document Waterlow score once per shift
- Utilise appropriate pressure relieving mattress as required
- Document pressure area risk assessment findings in patient notes – if pressure area discovered, complete pressure area incident form

Sitting Out of Bed:

- Aim to sit out of bed daily and PRN if possible.
- Ensure sufficient persons assisting to maintain patient and staff safety
- Utilise physiotherapists to assist in sitting patient's out for the first time and at other times when required

IDC Care:

- Record urine output 1-4 hourly
- Clean perianal area bd and PRN
- Change urinary catheter and collection bag every 30 days or PRN

NGT/OGT Care:

- Ensure tubing is secured appropriately:
    - NGT – secure to nose using adhesive tape
    - OGT – secure to ETT if present or tape to cheek as above
- Change tapes daily/PRN
- Check tube position following insertion, each shift and prior to commencement of feeding
- Aspirate every four hours (document in fluid balance)

Central venous line care:

- Document CVP measures on observation chart.
- Write the figure obtained when reading the manometer. Document PEEP at the time of CVP measurement nearby BUT do not alter the CVP number for PEEP.
- For routine care of CVP line see infection control protocol.

FASTHUG Admission Checklist

This pneumonic is a reminder of important ICU oriented aspects of supportive patient care that need to be addressed for each patient. These are covered in more detail in the information which follows.

Reference: Vincent, J.L. Give your patient a fast hug (at least) once a day. Crit Care Med 2005. 33(6): 1225-1229

Feeding and fluids

Analgesia

Sedation

Thromboprophyllaxis

Head up 30- 45 degrees for each patient unless specific contraindication

Stress Ulcer prophyllaxis

Glucose control- insulin infusion to control sugar to above 4mmol/l and below 10mmol/l

Routine postoperative ventilation

Initial ventilator settings

Mode: SIMV volume controlled with PSV/CPAP

- Tidal volume= 8mls/kg (to nearest 50mls)
- Rate= 12-15/minute
- FiO2= 1.0 intially (range 0.3-1.0). Reduced rapidly titrated to saturation. Aim Fio2<0.6
- PEEP= 5 cmH20 (range 5-15 cmH20)
- Pressure support= 10 cmH20 (range 8-20 cmH20)
- Flow-by on base flow=5 flow sensitivity=3
- Insp/exp time ie I:E ratio at 1:2
    - VELA ventilator Set Peak inspiratory flow rate (PIFR) 40-60 L/min
    - SERVO 300 set insp% -25% (green), insp plateau-10% (green) and CMV rate
    - SERVO marquet/ BAIR ventilator set I:E ratio directly
- Plateau/insp pause=0

Titration of ventilator settings

1. Target range Spo2 is 90-95% (Po2 on ABGS >60mmHg).
    - Initially patients should be ventilated on 100% oxygen.
    - When monitoring has been established, and adequacy of ventilation checked clinically and with pulse oximetry then Fi02 should be rapidly reduced to achieve target Spo2.
    - Blood gases should be checked on admission and when Fio2 reduced to target.
    - If FiO2 cannot be reduced to <0.6 whilst achieving target Spo2 then PEEP may need to be increased.
    - If Spo2 drops below 90% at any time, increase the Fio2 again until target is reached.

2. Adjust the rate of ventilation (keeping TV at 8mls/kg) to achieve target Pco2 of 35-45mmHg.

When to ask for help

The above approach to ventilation is intended for patients with relatively normal lungs eg postoperative patients, head injury patients etc.

It is important to recognise when significant lung pathology is present this may not be adequate and help from consultant or senior registrar should be sought.

Findings which should alert you to a problem which needs discussion include:

- Requirement of fio2 >0.6 to maintain Sop2 >90% (as above)
- Peak inspiratory pressure(PIP)>35cmH20 to achieve target TV or target TV not achieved due high PIP (Pneumonthorax and RMB intubation etc should be excluded (see high PIP/patient not ventilating protocol); PIFR will need to be reduced or I:E ratio changed so that this peak pressure not exceeded- exception ASTHMA, see ventilation of the asthma patient protocol)

Intravenous fluid therapy

This should be combination of background maintenance fluids and fluid loads prn.

Maintenance fluids

Standard maintenance fluids of 1.5mls/kg/hr (100 mL-150mls/hour) of Glucose 3.3% Saline 0.3% is administered to most patients.

Exceptions to this routine include:

1. **Cardiac cases, Congestive cardiac failure or volume overload** – may need to **restrict fluid**- start at 1ml/kg/hr
2. Patients with **cerebral edema from any cause** ie post neurosurgical, Head injury, meningitis or hypoxic / ischaemic brain injury – **use 0.9% saline at 1.5mls/kg/hr instead** of dextrose/Saline
3. Diabetic ketoacidosis- use NSaline until sugars better controlled

Patients being fed enterally– reduce IV fluids to maintain total intake at desired level- write a target total volume of fluids/hour in notes and allow nursing staff to titrate IV to this dependant on NG absorbtion. For example: total volume 125mls/hr, 100mls NG and 25mls IV.

K^+ is measured on arrival in ICU

1. If $K^+ < 4.5$ mmol/L then add 20 mmol of KCl to IV fluids if renal function normal..
2. If $K^+ > 4.5$ mmol/L then fluid without potassium is used. If at any time the $K^+ > 5.0$, medical staff should be notified.

If additional KCl supplementation is required, it may be given as an intravenous infusion via a central venous catheter or a peripheral line as specified in the potassium administration guideline.

Fluid increments- Normal Saline

If goals for urine output, peripheral perfusion or blood pressure are not fulfilled, **Crystalloid (0.9% Saline) or** colloid are given as rapid infusions. The volume administered is **250 - 1000mL** of crystalloid or 100 - 500mL of colloid, the amount depending on the clinical status of the patient.

Urine output

Urine output in the range of 0.5 to 2 mL/kg/hour is acceptable in most patients.

Target Blood pressure

Unless otherwise specified, target MAP (mean arterial pressure) for most patients is MAP > 65-70 mmHg.

Exceptions when a higher target may chosen:

- Known hypertensive patients
- Traumatic brain injury and other causes of raised intracranial pressure
- Patients with acute renal impairment

Enteral Nutrition Feeding Regimen

Enteral nutrition is preferable to parenteral nutrition if adequate feeding can be achieved. It can be administered by a variety of routes including oral, nasogastric, orogastric, nasojejunal, gastrostomy, and jejunostomy feeding tubes. Almost all ICU patients can be fed adequately by one of these routes.

1. For nasogastric or orogastric feeding, a wide bore (14 Fr.) 'nasogastric' tube is inserted.
2. Gastrostomy feeding tubes may be placed surgically, or via an endoscope (Percutaneous Endoscopic Gastrostomy= PEG). If surgically placed, check with surgical team prior to commencing feeds.
3. Nasojejunal feeding tubes may be placed with an endoscope or during laparotomy.
4. Percutaneous jejunostomy tube may be placed during surgery. It should be flushed with 20 mls water 6 hrly.

The position of all tubes should be confirmed by Xray prior to feeds commencing

The patient should be 15-30 degrees head up the majority of the time unless there is a contraindication to being head up (eg unstable spine).

The standard feed in this unit is prescribed by the dietician and supplied from the kitchen. It is a mixture of blended foods and feeding supplement (complan). The content is adjusted so 100mls/hour supplies daily caloric intake.

- Commence feeding at 40mL per hour.
- Increase by 20mL per hour every four hours, up to a maximum of 100mL per hour.
- Feeding may be as continuous infusion or hourly boluses.
- The nasogastric tube is aspirated every 4 hours using multiple syringes if necessary. If the gastric aspirate is:
    - < 150mL the aspirate is returned and feeding continues;
    - 150 to 250mL the aspirate is discarded and feeding continues;
    - > 250 ml, then feeding should be stopped for two hours, then restarted at 40 ml/hr
- In the absence of contraindications, a gastric aspirate > 200 ml should be treated with metoclopramide 10 mg IV QID, and consideration given to adding erythromycin 250 mg IV Q8H if subsequent aspirates are > 200 ml. If this does not improve the problem, consideration should be given to jejeunal feeding.
- Enteral feeding associated diarrhoea should be reported to a medical officer and managed as per The ANZICS CTG feeding investigators guideline (see appendix)
- Change the tubing connected to the feeding tube (NGT or NJT) every 24 hours

Signs that a patient is not tolerating feeds include:

1. Progressive abdominal distension
2. Reflux of significant volumes of feeds into the stomach

If these signs develop then stop feeding and inform medical officer.

Stopping feeds:

- Feeds should be stopped 4-6 hours prior to planned extubation. In addition NG tube should be aspirated just prior to ETT removal.
- In a patient with a definitive airway (endotracheal tube or tracheostomy tube) there is no indication to stop feeds before a trip to theatre **unless** the intended surgery involves manipulation of the airway or a procedure related to the face, oropharynx or neck.

TPN (total parenteral nutrition)

Total parenteral nutrition is rarely required if the methods of feeding described under the section on enteral nutrition are used appropriately. TPN should not be started in ICU unless this has been discussed with the ICU consultant and surgical team. Patients on TPN at the time of ICU admission should continue on TPN until reviewed by above.

ICU TPN administration

- This regimen will give approximately 30-35 kCal/kg/24 hours of non-protein energy, and 1.5g amino acids/kg/24 hours (=0.2 grams nitrogen/kg/day).
- TPN should be infused via a dedicated lumen on a central venous catheter.
- TPN can be infused with insulin and intralipid. Insulin is generally required to maintain a normal blood sugar whilst on TPN even in patients who do not normally require it (see below).
- TPN prescription involves reviewing the available solutions and prescribing the correct volume of these to achieve:

    1. Target calories as above (usually carbohydrate: lipids ratio 60-70%;30-40%)
    2. 1.5 g amino acids/kg/24 hours as above.
    3. Maintenance water 1.5mls/kg/hr and electrolytes (Na 1-2mmol/kg/day, K+ 0.5-1mmol/kg/day, Magnesium and calcium) achieved but not exceeded (may need additional crystalloid solution if large fluids requirement)
    4. Vitamins and trace element requirements met (usually separate prescription needed)

- Seek help writing the prescription.
- Clinical situations that may require adjustment of the standard ICU TPN regimen include renal failure, hepatic failure, cardiac failure, volume overload.

Risks and Precautions

1. An infusion of actrapid insulin is often required to maintain blood glucose at an acceptable level (see Insulin Protocol). This should be run as an infusion as a piggyback on the TPN infusion. If more than 10 u/hour is required to maintain the blood glucose at this level, then the amount of glucose being infused should be reduced (again discuss this with the ICU consultant).

   If TPN is stopped for any reason, there is a risk of hypoglycaemia. Intravenous Glucose needs to be continued in some form. This can be as an infusion of Glucose / saline if run at more than 80 ml/hr or an infusion of 50 % Glucose at a lower volume (20 – 40 ml/hr). Don't forget to stop the insulin and measure the blood sugar hourly for at least 6 hours. The Insulin infusion may need to be restarted if the blood sugar is elevated (see Insulin Protocol). **While on TPN, blood glucose should be measured at least 4 hourly** as per Insulin Protocol.

2. Daily blood tests should include an ELFTs, full blood count and coagulation profile.

3. **Re-feeding syndrome** can occur after prolonged starvation and may cause severe hypokalaemia, hypomagnesaemia , hypophosphataemia and rarely Wernicke's encephalopathy. If the patient is at risk TPN must be commenced more slowly with careful monitoring.
4. Patients with large ongoing GI losses such as diarrhoea or fistulas should receive additional zinc; 10 mg for each litre of intestinal fluid lost. This should be charted given as an infusion over 1 hour.

Analgesia

All patients in pain must be assessed. Pain can be a symptom of a problem that needs specific therapy e.g. inadequate immobilisation of fractures, compartment syndrome, or perforated viscus.

Methods of analgesia that are commonly used in intensive care include:

- **Intravenous opioid infusion.** Add 30 mg of morphine to normal saline to make 30 ml (1mg/ml); run at 0 to 10 ml per hour. Use boluses of morphine to achieve good analgesia prior to commencing the infusion.

  In patients with renal impairment, after consultation with the senior registrar or consultant, fentanyl may be used instead of morphine; add fentanyl 600 mcg to normal saline to make a volume of 30 ml (20 mcg/ml); run at 0 to 10 ml per hour.

- **Nurse controlled intravenous opioid analgesia** Add 10 mg of morphine to normal saline to make 10 ml (1 mg/ml); nurse titrates boluses of 0.5 to 5 ml (0.5 to 5 mg) morphine to achieve good analgesia.

  In patients with renal impairment, after consultation with the senior registrar or consultant, fentanyl may be used instead of morphine; add fentanyl 200 mcg to normal saline to make 10 ml (20 mcg/ml); nurse titrates boluses of 0.5 to 5 ml (10 to 100 mcg) fentanyl.

  Common complications of opioid analgesia

  - Nausea and vomiting should initially be treated with metoclopramide 10-20 mg Q6H prn IV.
  - Severe itch should be treated with phenergan.
  - Respiratory depression may be treated with naloxone 40 mcg increments to a maximum on 400 mcg; a naloxone infusion at 40-80 mcg/hr may be required as the respiratory depression often recurs when the naloxone wears off. Bag mask ventilation or intubation may be required.

- **Paracetamol and panadiene** Given orally, rectally, via nasogastric or intravenously in a dose of 1 g Q6H. Do not use in liver disease.

- **Epidural analgesia and patient controlled analgesia(PCA)** These may also be used in ICU patients. Patients with an epidural insitu are kept in ICU/HDU for observation until epidural is removed. There is a separate guideline on epidural analgesia and PCA in the appendix.

  PLEASE NOTE:

- **Non-steroidal anti-inflammatory drugs & Tramadol : Not to be used.** There is a very high risk of stress ulceration and acute renal failure if these agents are used in critically ill patients.

Sedation

- Sedation has the potential to cause respiratory depression.
    - If the patient is on invasive mechanical ventilation (via an endotracheal tube or tracheostomy), respiratory depression is easily managed, and is often desirable.
    - If the patient is not on invasive mechanical ventilation, respiratory depression may be life-threatening.
    - For this reason, the approach to these two groups is different and dealt with separately. However, in both cases the use of a **Sedation-Agitation Scale** is indicated **to manage therapy (see below)**.
- Sedation may cause hypotension, particularly in the elderly. It is preferable to use small doses titrated to effect when the patient is at risk of hypotension.

Sedation-Agitation Scale

The Riker Sedation-Agitation-Scale (SAS) can be used.

3	Unrousable	Minimal or no response to noxious stimuli, does not communicate or follow comands
2	Very sedated	Rouses to physical stimuli but does not communicate or follow commands, may move spontaneously
1	Sedated	Difficult to rouse, awakens to verbal stimuli or gentle shaking but drifts off again, follows simple commands
0	Calm and cooperative	Calm, awakens easily, follows commands
-1	Agitated	Anxious or mildly agitated, attempting to sit up, calms down to verbal instructions
-2	Very agitated	Does not calm, despite frequent verbal reminding of limits; requires physical restraints, biting ET tube
-3	Dangerous agitation	Pulling at ET tube, trying to remove catheters, climbing over bed rail, striking at staff, thrashing side to side

1. The sedation-agitation score should be measured hourly.

2. **All orders for sedative therapy must be accompanied with the target sedation-agitation score**. This **may range from zero to three** depending on the clinical situation. The administration of sedative drugs should be titrated to achieve this target. **Over-sedation** is a significant problem that **prolongs ICU and hospital stay**. The **minimum amount** of sedative drug **that achieves the target** sedation-agitation score **should be used**.

3. If at all possible, **patients should be woken daily** in order to reduce over-sedation. Sedation should be ceased at 7am prior to ward round, unless there is an exception to waking (see below: patients in whom higher sedation scores targeted). Sedation is restarted when or if medical and nursing staff deem necessary (see Kress et al, NEJM).

The patient who is on invasive mechanical ventilation

While a patient is mechanically ventilated, sedation is usually given intravenously. Generally a combination of a sedative agent (midazolam or propofol), and a narcotic (morphine or fentanyl) is used.

Standard sedation

Standard sedation for ventilated ICU patients will be morphine and midazolam as follows:

Mix 60mgs morphine with 30mg midazolam (ratio 2:1) with normal saline to total volume 30mls. Solution will be 2mg/ml morphine and 1mg/ml midazolam.

If the patient has renal failure then usually fentanyl and midazolam will be used instead as follows:

Mix 600mcg fentanyl with 30mg midazolam with normal saline to total volume 30mls. Solution will be 20mcg/ml fentanyl and 1mg/ml midazolam.

Standard target sedations core is 0-1 on above scale. In these patients if sedation score is above (at 2 or 3) then sedation is then ceased until sedation-agitation score is at the target value again.

Exceptions to this rule when a target sedation score 2-3 might be chosen by the consultant include:

1. Patients with known or suspected intracranial hypertension
2. Patients who are paralysed with neuromuscular blocking drugs.
3. Patients with severe respiratory failure who are asynchronous with the ventilation (fighting the ventilator).

Propofol sedation

When available propofol sedation is sometimes used as a separate infusion either instead of standard narcotic/benzodiazepeine combination or as an adjunct. IT SHOULD ONLY BE USED WITH CONSULTANT APPROVAL and MAXIMUM DOSE of 20ml/hour SHOULD NOT BE EXCEEDED, because of the risk of propofol syndrome in ICU. (max dose =4mg/kg/hr)

Use undiluted propofol (10 mg/ml); run at 0-20 ml/hr. In addition Boluses of 1 to 5 ml (10 to 50 mg) may be used to gain control of dangerous agitation, but repeated administration of boluses is not appropriate: either the rate of infusion should be changed or sedative drug changed to midazolam.

Propofol is short acting drug which does not accumulate even in renal and liver failure. It is therefore used when a rapid wakeup is required when the sedation is turned off for example:

- routine postoperative patients;
- head injuries without ICP monitoring (mild-moderate head injury)where anticipated duration of ventilation is < 24 hours).

Propofol may cause significant hypotension and should be used with great care particularly in head injured patients when CPP maintenance is priority.

Sedation should not be used for the treatment of hypertension, unless it is clear that inadequate sedation is the cause.

Stopping sedation

1. When sedation is stopped, patients with painful conditions will still need analgesia. The narcotic component should be titrated to provide appropriate analgesia.

2. When agitation occurs while ventilation is being weaned, it may be managed with restarting the sedation infusion, or by using any of the options outlined below for management of sedation in patients not on invasive mechanical ventilation.

Night sedation

Occasionally night sedation may be required to restore the normal sleep-wake cycle. Temazepam 10-20 mg nocte prn is the preferred drug. This is preferable to Excessive sedation of patients on night duty should be avoided. It prolongs ICU and hospital length of stay.

The patient who is not on invasive mechanical ventilation

If the patient is agitated they should be assessed prior to sedation for underlying medical causes such as:

- pain,
- hypoxia,
- hypercapnia,
- full bladder,
- constipation or a need to open bowels.

Specific therapy for identified medical causes should be initiated.

In the patient who is not on invasive mechanical ventilation the target sedation score will normally be prescribed as zero.

Drug therapy for the treatment of agitation in non-ventilated patients

1. Haloperidol is the preferred drug of treatment of agitation.

    - **Enteral administration:** The initial oral/NG dose of haloperidol is 0.5 to 5 mg (use small doses in the elderly, and patients at risk of respiratory depression or hypotension). Assess the patient after one hour, and repeat the dose as required. When the effective dose for that patient has been established, this may be given as a single daily dose
    - **Intravenous administration:** The initial IV dose of haloperidol is 0.5 to 5 mg (use small doses in the elderly, and patients at risk of respiratory depression or hypotension). Assess the patient after 15 minutes, and repeat the dose as required. When the effective dose for that patient has been established, consider using the enteral route. The same daily dose is required for IV or oral administration.
    - **Contraindications:** Parkinson's disease, previous adverse reactions to haloperidol, and Lewy body dementia. Benzodiazepines are preferred in alcohol or benzodiazepine withdrawal.
    - **Precautions:** 100 mg per day should not be exceeded, and is rarely required. Prolongation of the QT interval and torsades may occur in high doses.

2. Risperidone (if available) is an alternative to haloperidol for the treatment of agitation. It is useful in agitated patients with head injuries. It is available as an oral/NG preparation. The dose is 0.25 – 2.0 mg bd, incremented slowly. Full clinical effect requires several days of therapy. Dose incrementation should be at 48 hour intervals.

3. Diazepam is the preferred agent for treatment of alcohol or benzodiazepine withdrawal. The dose is 1 to 5 mg tds. It may also be used for other forms of agitation, when haloperidol alone is not effective.

4. Temazepam 10-20 mg nocte prn is the preferred drug for night sedation. Night sedation is best avoided in patients with borderline respiratory function.

DVT and PE Prophylaxis

All patients in ICU should be assessed for venous thromboembolism (DVT/PE) risk on admission and have appropriate thrombo-prophylaxis. All ICU patients should be considered moderate to high risk.

A. Mechanical Prophylaxis

Indications: Ideally, In the absence of contraindications, **all** patients in ICU should have TED stockings or if available sequential calf compression devices applied on admission.

Contraindications to the application of TED stockings and sequential compression devices are:

- lower limb ischemia or advanced peripheral vascular disease
- lower limb injury, wound or ulcer. If unilateral, TED can be used on the uninjured limb.
- established DVT is a contraindication to sequential compression devices but not to TED stockings.

B. Pharmacological Prophylaxis

In addition to mechanical prophylaxis, **all** patients in ICU should have pharmacological prophylaxis unless there are specific contraindications.

Options:

1. **Subcutaneous Heparin 5000u bd** is indicated for elective surgical postoperative patients having a short stay in ICU. Heparin is commenced on the first postoperative night for neurosurgical patients.

2. **Subcutaneous Heparin 5000u tds** is indicated for the remainder of ICU patients. For ICU patients having surgical procedures, subcutaneous heparin should be continued on the morning of surgery except for specific high-risk procedures (eg spinal / neurosurgery). Heparin should be withheld 6hr prior to removal of epidural catheter. Use of heparin prior to percutaneous tracheostomy is at consultant discretion.

3. **Subcutaneous Enoxaparin 40mg daily** is the preferred alternative to subcutaneous heparin for:
   - patients who have had elective hip or knee surgery
   - patients with spinal cord injury in the post-acute period (following definitive stabilisation).
   - patients with lower limb or pelvic fracture, but risk of bleeding from other injuries must be taken into consideration.

   Use of enoxaparin should involve input from the ICU consultant and relevant surgical teams. **Enoxaparin should not be used in patients with renal impairment**.

Contraindications to pharmacologic prophylaxis include:

- indication for therapeutic anticoagulation eg pulmonary embolism, unstable angina
- coagulopathy (INR > 2)
- thrombocytopenia (platelet count < 60 x 10^9/L)
- ongoing bleeding (traumatic, gastrointestinal or post-surgical); or

- high risk of hemorrhage (eg active peptic ulcer disease or ulcerative colitis)
- intracranial hemorrhage (traumatic or otherwise). Pharmacological prophylaxis is not commenced until the CT scan is clear. Patients with traumatic brain injury but no intracranial blood can commence heparin at 24hrs post injury.

Stress Ulcer Prophylaxis

1. Patients who were receiving treatment for upper GI inflammation or ulceration prior to ICU admission should continue on this treatment (oral / NG / IV as appropriate).
2. Patients who are admitted because of upper GI ulceration (eg. perforated or bleeding ulcer) require specific therapy for this condition.
3. Patients in the ICU at high risk for stress ulceration, may be treated with Ranitidine 50mg IV tds. High risk patients include:
    - severe head injury,
    - severe sepsis,
    - septic shock,
    - anticipated ventilation for > 48 hrs,
    - high dose steroids,
    - renal failure requiring dialysis,
    - significant coagulopathy, (including therapeutic anticoagulation)
4. Ranitidine dose adjustment is required for patients with renal failure (see BNF).
5. Stress prophylaxis must be stopped when the patient is discharged from ICU unless there is a valid reason to continue.

Bleeding from stress ulceration is suggested by:

- bloody nasogastric aspirates, or
- by an unexplained fall in haemoglobin of > 2 g/dl in 24 hours.

If there is evidence of bleeding from stress ulceration, then treatment with omeprazole 40 mg IV daily should be started. Upper GI endoscopy or other investigations may be required.

HEAD –UP tilt

Head up tilt of 30-45 degrees is targeted for all stable ICU patients, unless some contraindication exists, for example:

- hypotension requiring resuscitation- -bed horizontal (not head down)
- Patients who are immobilised awaiting spinal clearance- in this case the patient is kept flat on their back and the whole bed tilted to achieve head up tilt.

Insulin infusions

1. Make up intravenous infusion as Actrapid 1 unit per mL in Normal Saline

2. If patient is on TPN then run Insulin infusion as a piggyback on the TPN infusion.

3. Target range for blood glucose is 6-10 mmol/L.

4. Titrate insulin infusion range 0-10 units/hr to achieve target range. If insulin requirement exceeds 10 units/hr a medical officer must be notified.

5. Blood sugar must be checked routinely in all patients.

    - At least 1 -2 hourly in sick patients and on initiation of insulin.
    - Once patients are stable BSLs should be checked at least 4 hourly in patients being given insulin.
    - When nutrition (either NG feeds or TPN) is stopped, the blood glucose may fall. Measurements of blood glucose should be made hourly as the insulin may need to be reduced
    - When nutrition is stopped the risk of hypoglycaemia increases. To minimise this risk patients should be on 3% Dextrose and 0.3% Normal saline unless there is a good clinical reason to do otherwise.

6. If the blood glucose is < 3.5 mmol/L institute treatment for hypoglycaemia as given below and inform a medical officer .

7. Neuro obs must be performed 4 hrly on patients on insulin

8. In patients who have had an operation, oral hypoglycaemic drugs should not be restarted until adequate intake of oral nutrition has commenced.

9. For a sample guideline for insulin infusion rates see PA Hospital insulin algorithms

Management of Hypoglycaemia:

If the blood glucose is < 3.5 mmol/L

1. The insulin infusion must be stopped
2. 50mL of 50% glucose should be given as an IV push and the blood glucose rechecked
3. Patients may need a repat dose of 50mls of 50% dextrose. Dextrose infusion (eg 1litre 5% dextrose over 2-4 hours or 10 % at 50mls/hour) is advisable if this is the case.
4. A medical officer must be informed
5. Blood glucose checked every 15 mins till stable
6. Neurological observations must be charted hourly for 4 hrs and then 4 hrly
7. Restart insulin at a lower rate.

Princess Alexandra Hospital, Brisbane, Australia - Insulin therapy dosage protocols

THE PROTOCOLS

NIDDM or Non-diabetic "stressed" patient - eg adrenalin infusion, TPN, Sepsis These patients are at very low risk of ketoacidosis.They should start on algorithm 1. The insulin may be stopped if the blood glucose is in the target range (4-10 mmol/L)

Protocol 2 IDDM, or NIDDM who were on insulin before ICU
These patients have a high risk of diabetic ketoacidosis if insulin is stopped. These patients should always start on Alg 2. Do not reduce the infusion below 0.5 units/hr unless the blood glucose is < 4 mmol/L.

Patients admitted with diabetic ketoacidosis, or other forms of diabetic coma Management of these patients is not covered by these guidelines and must be treated on an individual basis.

INITIATING INSULIN INFUSION AS PER ALGORITHMS

1. Most patients will start on Alg 1, including NIDDM patients not previously on insulin.
2. If a patient is an IDDM or a NIDDM **already on insulin** then they must start on Alg 2.
3. Move to Alg 2,3 and 4 if BSLs are not controlled in the target range of 4-10 mmol/l using the insulin doses in the previous algorithm.
4. Move to a lower algorithm if BSLs drop under 4 on two occasions
5. Target BSL 6 – 10 mmol/l

		Insulin Infusion Rate units/hour			
BSL in mmol/l		Alg 1	Alg 2 **(Start IDDM or NIDDM on insulin here)**	Alg 3	Alg 4
<3.5	Treat as Hypoglycaemia				
3.5 – 4	Monitor BSL every 15 mins till levels >4				
4 to 6		0	0.5	1	1.5
6.1 to 6.5			1	2	3
6.6 to 8			1	3	5
8.1 to 10			2	4	7
10.1 to 11.5		1	3	5	9
11.6 to 13		2	4	6	12
13.1 to 15		3	5	8	16
15.1 to 16.5		3	6	10	20
16.6 to 18		4	7	12	24
18.1 to 20		5	8	14	28
>20		6	12	16	28

Consider moving to previous algorithm
If second consecutive reading above 10, move to higher algorithm
Notify medical officer

Neuromuscular blocking drugs

Neuromuscular blocking drugs are seldom required in the Critically Ill and carry a risk of prolonging ICU stay. Suxamethonium(for intubation only) and Vecuronium are used if needed. Indications include:

- To facilitate tracheal intubation or other procedures
- Management of severe head injury with refractory intra-cranial hypertension
- Management of severe respiratory failure with difficulty synchronising with mechanical ventilation with patients respiratory efforts.
- Initial stabilation (only) of the severe asthmatic
- Transportation around the hospital (only some)

Remember neuromuscular blockade can be fatal in inexperienced hands.

Suxamethonium

Dose is 1mg/kg (100mg in average patient) once only.

Contraindicated because of the risk of hyper-kalaemia in these ICU patients:

- Burns >24 hours following injury
- Spinal cord injury >24 hours following injury
- Other forms of denervating injury eg guillian barre syndrome
- Pre-existing hyperkalaemia (K+ >6.0mmol/l)
- A variety of myopathies and muscular dystrophies

Other contraindications include:

- Hypersensitivity
- Malignant hyperpyrexia
- Open eye injury (relative contraindication)

Vecuronium

Initial dose is 0.12mg/kg bolus IV (6-10mg in an average patient)

If further relaxation required use either:

- Increments of 2-4mg prn
- Infusion 0-10mg/hour and titrate to achieve 1-2 twitches on TOF.

Vasoactive infusions

- Vasopressor drugs should be run on a line separate to other infusions.
- For occasions where multiple vasoactive drugs are administered, check drug compatibilities.
- Lines and pumps are to be labelled.

When a drug is to be titrated against effect. The dose range and the target level (eg target MAP, target cardiac index) should be part of the drug orderNursing staff should record all vasoactive infusions. Usual mixtures for ICU include:

- Adrenaline is made up as 6 mg in 100 mL (5% dextrose). 1ml/hour=1 mcg/min.
- Noradrenaline is made up as 6 mg in 100 mL (5% dextrose) 1ml/hour=1 mcg/min
- Dopamine is made up as 400 mg in 100 mL (5% dextrose) 1ml/hour=66.7 mcg/min
- Dobutamine is made up as 500 mg in 100 mL (5% dextrose) 1ml/hour=83.3 mcg/min
- GTN is made up as 50 mg in 500 mL (5% dextrose) 1ml/hour=8.3 mcg/min
- Nitroprusside is made up as 50 mg in 250 mL (5% dextrose) 1ml/hour=16.6 mcg/min
- Vasopressin is made up of 20 units in 100mL of 5% Dextrose or normal saline.
  The infusion rate is 0-0.04 units/min (0-12 mL./hr). This infusion rate should not be exceeded.
- Metaraminol (Aramine) for bolus use is drawn up 10mg in 20mL (ie 0.5mg/mL). Use 1-2ml boluses.
- Ephedrine for bolus use is drawn up 30mg in 10mls (ie 3mg/ml). Use 1-2ml boluses
- Salbutamol :
  - Bolus dose draw up 500mcg in 10mls and use 50-250mcg boluses (1-5mls)
  - For infusion use 2000mcg in 100mls (1ml/hour = 0.33 mcg.min)
    Infuse at 5-20mcg/min (ie 15-60mls/hour)

Renal Failure Protocol

Calculation of Glomerular filtration rate

When a patient has renal failure then doses of renally excreted drugs need to be altered according to the GFR.

GFR is calculated using the Cockcroft-Gault equation (see below). Once GFR is calculated drug doses must be altered accordingly using an appropriate guideline (eg BNF) to guide therapy.

Examples of ICU drugs needing altered dose in renal failure include:

- Almost all antibiotics (see below),
- Morphine (use fentanyl instead if possible)
- Ranitidine
- low molecular weight heparin (use unfractionated heparin instead)
- ACE Inhibitors

Cockcroft and gault equation

GFR (ml/min) = $\frac{\text{body weight(kg) X (140 – age (years))}}{\text{0.814 X serum creatinine (mcmol/l)}}$ subtract 15% for women

For example: 48year old, 70kg man with creatinine of 300 micromol/l

GFR= 70 X (140-48) / 0.814x300

= 26.4 ml/min

Dosing Drugs in Patients on dialysis

Intermittent dialysis: give drug dose after dialysis as recommended in BNF

Continuous dialysis: (eg CVVHD) approximate GFR whilst using dialysis is 20-40mls/min; adjust dose accordingly

Peritoneal dialysis: presume GFR minimal and dose accordingly

Dialysis

Patient selection

Haemodialysis and peritoneal dialysis will be available in the ICU at CMW hospital for suitable patients with the following considerations:

- They have one or more indication for renal dialysis(see below)
- The chances of surviving their illness would be reasonably high if dialysis is successful.
- They are hemodynamically stable enough to tolerate the procedure.
- Dialysis is very unlikely to be needed long term (ie renal function is expected to recover)

Suitable patients should be referred for discussion. The final decision as to whether dialysis is appropriate should be a consensus between:

1. ICU team
2. treating medical or surgical team
3. hospital renal physician/dialysis service.

Indications for dialysis in ICU:

Criteria:

- Oliguria (urine output <200ml/12hours)
- Anuria (urine output 0-50ml/12hours)
- Urea >35 mmol/l
- Creatinine >400mcmol/l
- Potassium >6.5 mmol/l or rapidly rising
- Pulmonary edema unresponsive to diuretics
- Severe metabolic acidosis (pH <7.1)
- Na<110mmol/l or >160mmol/l
- Temperature >40degrees celcius
- Uraemic complications (encephalopathy, neuropathy, pericarditis)
- Overdose of a dialysable agent (eg brake fluid)

If one criteria is present then dialysis should be considered.
If 2 or more criteria are simultaneously present then dialysis is strongly recommended.
(taken from chapter 39,Ohs intensive care manual,D berston, N soni and Teik E Oh, 5th edition, 2003)

Antibiotic therapy

Antibiotic therapy is commonly prescribed in ICU. It is important to know not only which antibiotics are likely cover to which organisms, but also local sensitivity patterns for each antibiotic as these may differ from textbook sensitivities outlined in antibiotic spectrum guide (appendix).

Most antibiotics need doses adjusted for renal dysfunction.

To calculate GFR use cobcroft-gault equation above.

The table below outlines BNF recommendations for dosage changes for antibiotics commonly used.

ANTIBIOTICS	Mild renal failure GFR 20-50ml/min Approx. Creat 150-300 mcmol/l	Moderate renal failure GFR 10-20ml/min Approx. Creat 300-700mcmol/l	Severe renal failure GFR <10ml/min Approx. Creat >700mcmol/min
Ampicillin			Reduce dose
Benzyl penicillin			Maximum 6.0 grams/day (neurotoxicity/convulsions if accumulates)
Cloxacillin			Reduce dose
Ciprofloxacin		Half normal dose	Half normal dose
Cephazolin			Maximum 500mg/day
Ceftriaxone			Reduce dose
Chloramphenicol			Avoid unless no alternative (due dose related bone marrow depression)
Clindamycin			
Erythromycin			Maximum 1.5 grams/day
Meropenum			
Rifampicin			
Piperacillin	Maximum 16gram/day if GFR 40-80ml/min Maximum 12grams/day if GRF 20-40ml/min	Maximum 8 grams/day	Maximum 8 grams/day
Sulphonamides	Ensure high fluid intake. Moderate risk of crystalluria.		
Tetracycline	Avoid from mild renal failure		
Vancomycin and Gentamicin	These antibiotics are **nephrotoxic** and need special mention (see below)		

Recommendations to allow administration of gentamicin and vancomycin in a safe and effective manner:

Gentamicin

Normal renal function

- Gentamicin is given every 24 hours, with the dose determined by blood levels.
- The initial dose is 5-7mg/kg.
- Blood levels should be measured 24 hours after the first dose, then daily just before the next dose is due.
- Blood levels should be taken immediately prior to the next dose of Gentamicin being given. Administration of that dose of Gentamicin should not be delayed until levels are available. Subsequent dose is adjusted based on the blood level.
- The target blood level is < 0.5mg/L.
- Patients receiving synergistic gentamicin for bacterial endocarditis can be dosed with once daily dosing as above.

Abnormal renal function

- The initial dose is 3mg/kg.
- Blood levels should be measured 24 hours after the first dose, then daily with the morning blood tests.
- The **next dose** (of 3mg/kg) should be **given when the blood level has fallen to < 0.5mg/L.** This means that that dose of **Gentamicin should not be given until the levels are available**.
- If it is **not possible to measure levels** then try to **use a nonrenal toxic alternative**, for example:
    1. ceftriaxone (gram positive and gram negative cover but not pseudomonads),
    2. ciprofloxacin (good gram negative and anti-pseudomonal activity but pneumococcus usually resistant)
    3. piperacillin (broad spectrum penicillin with gram positive, gram negative, antipseudomonal and some anaerobic cover
    4. meropenum

Vancomycin

Vancomycin is not commonly used at CWM but is useful for covering gram positive organisms and is the antibiotic of choice for MRSA septicaemia and for line sepsis secondary to coagulase negative staphlococcus (staph epidermidis).

Administration of Vancomycin

Dilute to 5mg/mL in a compatible fluid. Administer at a rate not more than 500mg/hour, in order to avoid adverse administration effects (Redman syndrome). For fluid restricted patients, may be diluted to 10mg/mL, but MUST be administered via central line for this concentration.

Patients not on renal replacement therapy

- Initial loading dose is 15 mg/kg (to the nearest 500 mg) regardless of renal function.
- Maintenance dose: Intermittent doses of 500 mg are used. The frequency of dosing may be up to 6 times per day (mane, bd, Q8H, Q6H, Q4H), aiming for a blood level of 15-20.
- GFR > 50 ml/min. Start with 500 mg Q6H. Measure levels daily, immediately prior to giving the morning dose. Do not wait for levels to give further doses.
- GFR 10-50 ml/min: Start with 500 mg bd (two times a day). Measure levels daily, immediately prior to giving the morning dose. Do not wait for levels to give further doses.
- GFR < 10 ml/min: Measure levels daily at 0800. Repeat dose of 500 mg only when level is < 20. On the medication order, it should be written up as a mane dose, but specified in the Physician instructions section “Measure levels daily at 0800. Do not give unless the level is known to be < 20”.

Patients on renal replacement therapy (CVVHDF or intermittent haemodialysis)

- Initial loading dose is 15 mg/kg (to the nearest 500 mg).
- Maintenance dose: Intermittent doses of 500 mg are used. The frequency of dosing may be up to 6 times per day (mane, bd, Q8H, Q6H, Q4H), aiming for a blood level of 15-20.
- Use an initial dose of 500 mg bd. Measure levels daily, immediately prior to giving the morning dose. Do not wait for levels to give further doses.
- If the CVVHDF is stopped for more than 12 hours, the vancomycin order should be changed to the GFR < 10 ml/min protocol.

TRAUMATIC BRAIN INJURY PROTOCOL for ICU

General Principles:
Primary Injury occurs at the time of impact. Focus of treatment is on (1) prevention/minimisation of secondary injury, (2) maintenance of CPP and (3)reducing ICP

(1) Avoid secondary injury, therefore avoid:

- Hypoxia (Po2 <60mmHg)
- Hypotension (SBP< (90 + agex2)mmHg in paed)
- hyperglycaemia, hypoglycaemia
- hyperthermia(any temp>38)
- high ICP (more than 25mmHg adults or 20mmHg in paed)
- high venous pressure-kinking or obstruction neck veins, sustained valsalva(fighting ventilator, coughing, straining)

(2) Maintain cerebral perfusion pressure and therefore MAP

CPP= MAP- ICP (CVP)

Need CPP of at least 60mmHg- aim CPP60-70mmHg

In Non head-injured patient Normal ICP 5-15mmHg, therefore MAP 65-75 will provide adequate CPP.

If traumatic brain injury Assume increased ICP likely; assume ICP 20-30mmHg

- to ensure CPP>60 therefore need Map 80-90mmHg
- maintain MAP with:
  - fluids +/-
  - noradrenalin or adrenalin

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(3)Reduce intracranial pressure If intracranial pressure is monitored then the following interventions have been shown to lower ICP (for further information see below):

- Sedation
- Paralysis
- Head up tilt
- Straightening head
- Osmotherapy (hypertonic saline)
- CSF drainage
- Reducing Pco2 to 35-40mmHg (though levels below 30mmol harmful if chronic)
- Hypothermia
- Decompressive craniectomy

Initial assessment

- Assessment, resuscitation and initial stabilisation of these patients is an urgent task.

Any period in the first few hours where the BP, PaO2, PaCO2, fluid status, head position or level of sedation is suboptimal may compromise long term outcome.

A systolic BP below 90mmHg or a PaO2 below 60mmHg at any time is associated with a worse outcome.

- Put together a full history from relatives, ambulance report and referring clinicians

- Conduct a head to toe examination (a full secondary survey) ; Identify any other injuries which have or have not previously been identified and ensure that there is a management plan.

- review all results and x-rays: Identify any further x-rays which are needed both immediately or the next working day.

- Classify severity of injury is based on Glasgow Coma Score (GCS):

    1. severe head injury is when GCS is 8 or less
    2. moderate head injury is when GCS between 9 and 12
    3. minor head injury is when GCS between 13 and 15.

- **CT scan of the head** is required for patients with any of the following:

    1. Extremes of age
    2. History suggestive of major trauma (associated spine or other long bone injuries)
    3. Intoxicated patient - drugs, alcohol
    4. Penetrating trauma
    5. Signs of increased ICP
    6. Signs of basal skull fracture
    7. Deterioration of GCS
    8. Open fracture/Depressed skull fracture
    9. Lateralizing signs
    10. focal or generalized post traumatic seizure.
    11. GCS less than 13
    12. Patients with minor head injuries : witnessed loss of consciousness, definite amnesia or witnessed disorientation in a patient with a GCS score of 13-15 and any one of the following:
        - GCS score less than 15 at 2 hrs after the injury
        - Suspected open or depressed skill fracture
        - Vomiting
        - Age greater than 65
        - amnesia before impact more than 30 minutes
        - dangerous mechanism

- **CT scan of the neck** is indicated **all ventilated brain trauma cases** as plain films are insufficient in these patients to confidently clear the cervical spine.

- All patients with GCS <or= 8 must be electively intubated and ventilated for CT head and cervical spine and then transferred to ICU.
- If patient has GCS above 8 following head injury but patient is combative restless or uncooperative and would require sedation to lie still for a CT scan, then patient must be electively intubated and ventilated using rapid sequence induction. **No head injured patient should be sedated for CT without airway protection and controlled ventilation.**

After CT Scan and transfer to ICU/HDU, patients with mild (GCS 13-15) and moderate (GCS 9-12) head injuries are normally woken and extubated as soon as feasible. This may take a few days if patients are too drowsy to cough or cooperate with chest therapy. Sedation of patients kept to the minimum required for care with ETT.

Patients with Severe head Injuries (GCS3-8 after correction of hypotension and hypoxia and which cannot be attributed to drugs or alcohol) are electively kept intubated and sedated and follow the protocol below. Ongoing management depends on CT findings, operative findings and consensus with ICU and surgical teams (see notes on When should the patient with severe brain injury be woken? below).

Important things to note in all traumatic brain injury cases for prognostication purposes:

1. Age (<60 years)
2. GCS (after resuscitation and without the effect of alcohol or sedative drugs)
3. Pupillary signs (after surgery in the absence of eye injury)
4. CT scan findings
5. Whether patient has suffered any secondary injury in particular hypotension or hypoxia

Please note:
Never assume that alcohol is the cause of drowsiness in a confused patient
Head or brain injury is never the cause of hypotension in the adult trauma patient

MANAGEMENT of Severe Traumatic Brain Injury in ICU:

On arrival in ICU:

- Review ABCDE (primary survey)including vital signs and effectiveness of resuscitation.
- Conduct head to toe examination (full secondary survey) to evaluate for any missed injuries.
- Review again all xrays and chase results of blood tests.

Initial management includes:

1. Head up tilt 30 degrees, head in the midline looking forward, neck not extended.

2. Ensure hard collar is not obstructing the venous return and remove or replace with sandbag as soon as safe. Check tracheal tube ties are not obstructing venous return.

3. Chart IV maintenance fluids. Use Normal saline only unless specific reason to chart alternative. Start at usual fluid requirement 1.5ml/kg /hour. Aim to replace early with enteral feeding as tolerated.

4. If serum Na+ < 140 mmol /L this should be corrected with hypertonic saline to sodium > 140 mmol/L . Use either:
   a. 20%Hypertonic saline ampoule i-ii prn or
   b. 3% Saline-100-250mls bolus prn.

5. Ventilate on Standard ventilator setting with SIMV (volume controlled) + PSV (as per routine postoperative ventilation protocol). Use:
   a. TV8ml/kg and Titrate RR so pCO2 35-40. Avoid pco2>40.
   b. Peep5 cmH2o and titirate Fio2 to keep saturation >95%
   c. Ensure that the peak airway pressure is <35cmH2O.

6. Sedate with morphine and midazolam for longer stay admission. If aiming to wake and reassess the next day use morphine and propofol (if available).

7. **Ensure CPP >60mmHg**. In patients with severe head injury (GCS3-8) , review CT scan. **If any changes in CT consistent with brain swelling then assume ICP elevated to 20-30mmHg and continue to target MAP of 80-90 mmHg as per initial management above**. To increment MAP if required use:
   a. Fluids- normal saline or hypertonic saline
   b. Vasopressors- adrenalin or noradrenalin (not dopamine unless adrenaline and noradrenaline not available)

8. Minimise relaxant use to prn- use if:
   a. for the intubation
   b. for co2 control if there is severe centrally driven hyperventilation
   c. if shivering and muscle rigidity is induced by active cooling to avoid hyper-thermia
   d. for ICP control if sedated and still has intra-cranial hypertension

9. Load with phenytoin if ventilated and paralysed hence seizures difficult to assess, there is a structural abnormality on CT or a history of fitting. Use Phenytoin load (15mg/kg over one hour) and 5 mg/kg daily IV. Cease if seizure free after 10 days.

10. Continually monitor for development of surgical complication and drain early any extradural, subdural collections or hydrocephalus. Repeat CT scan if unsure in any patient whose clinical status deteriorates unexpectedly or if new or unexplained ICP rises occur in patients whose ICPO is monitored.

11. Antibiotic prophyllaxis may be given according to surgical team for base of skull fractures or fractures extending into the sinuses. Give either:
    - IV ceftriaxone 1gram bd and IV metronidazole 500mg 12 hrly or
    - IV chloramphenicol alone 1gram qid

    Duration is for 48hours then cease unless evidence of infection. Continuation for prophylaxis after 48hour increases risk of nosocomial chest infection.

12. Ensure the patients temperature is less than 38^{o} C, actively cool to normo-thermia if required. Do not actively re warm unless temperature less than 35^{o} C.

13. Osmotherapy with Mannitol is not generally indicated in patients at CWM. It carries a serious risk of hypotension and hypovolaemia in ICU brain trauma cases and should only be used if great care is taken to monitor volume status and chase urine output, since protection of CCP is priority. It is indicated in the emergency setting eg enroute to surgical treatment in rapidly declining patients with signs of increasing ICP.

14. Monitor patient for development of polyuria (>3ml/kg/hour) and treat according to cause, for example:
    - Diabetes insipidus: usually sudden polyuria associated with rising serum sodium (and low urinary sodium if this can be measured). Treatment is urine chase with 4%dextrose and 1/5 nsaline with 10mmol KCL and DDAVP 0.5-1.0mcg tds prn IV

    - Cerebral salt wasting: : usually sudden polyuria associated with falling serum sodium (and high urinary sodium if this can be measured). Chase urine with normal saline to maintain normovolaemia and aim for Na >140mmol/l with hypertonic boluses.

    - Inappropriate mannitol use- chase urine output with normal saline to maintain normovolaemia and MAP as per protocol above.

When should the patient with severe brain injury be woken?

If ICP monitoring is in situ then the decision to wake is based on this. The patient is kept asleep until ICP has decreased below 20 mmHg (as sedation is part of therapy to reduce intracranial pressure).

In the absence of ICP monitoring, management is based on an educated guess of ICP based on GCS, pupils and CT scan findings. A plan should be made on daily rounds with surgeons and intensive care staff. For example:

- If initial scan the brain is very swollen (either on CT scan or at the end of craniotomy) it is often prudent to keep the patient asleep (sedation score 2-3) for a few days whilst instituting methods outlined above to minimise ICP. The patient should then be rescanned either immediately if new clinical signs arise (eg pupils stop reacting/dilate) or on day 3 if otherwise stable. Depending on whether edema persists, has worsened or is reduced decisions can be made to either wake at this stage or continue to sedate up to 7days total.

- If there is minimal swelling on CT scan despite admission GCS 3-8, or if patient has had successful surgery to drain hematoma then it would be reasonable to consider waking earlier and using clinical assessment of patients condition. Often sedated and ventilated for a short period to ensure stability before the sedation is withdrawn (often the following morning).

- Similarly, if prognosis is deemed dreadful (collating GCS, pupils, age and CT scan and other findings eg diabetes insipidus) and injury is thought not survivable then early waking to assess for brain death is prudent.

Intracranial pressure management- some key points:

Intracranial pressure monitoring is not currently available at CWM but may be in the foreseeable future. When this becomes the case then:

Indications for ICP monitoring.

- GCS 3-8 and an abnormal CT scan
- GCS 3-8 and a normal CT if **two or more** of the following features are noted at admission
    1. Age over 40 years
    2. Unilateral or bilateral motor posturing
    3. Systolic BP <90 mmHg
    4. GCS 3-8 and the patient requires prolonged surgery

Targets (based on current BTF guidelines):

- **Intracranial pressure (ICP)** <25mmHg in adults and 20mmHg in children
- **Cerebral perfusion pressure (CPP)**
    - adults 60-70 mmHg
    - children range is age dependant(40-65mmHg)
- **Mean arterial pressure (MAP)** titrated according to ICP to achieve target CPP knowing CPP= MAP-ICP

If ICP monitoring is inserted then invasive arterial monitoring is also required to allow accurate achievement of CPP goals. The arterial transducer should be zeroed to the level of the tragus for patients with intracranial pressure monitoring (ICP monitor or EVD).

It is useful to also insert CVP line to monitor fluid increments for MAP and allow administration of vasopressors. Note: internal jugular lines should be avoided as this will potentially increase ICP by impairing venous drainage from head).

ICP < 25 mmHg

- Use points 1-12 above to optimise ICP and CPP.
- If ICP <20mmHg aim for serum sodium >140mmol/l. If ICP 20-25 aim for Na 145mmol/l.

ICP > 25 mmHg

- **An ICP above 25mmHg for more than 5 minutes should be actively treated**
- Ensure measures for ICP < 25 are being followed as above
- If the intracranial pressure is > 25 mm/Hg the **serum Na+ should be increased with hypertonic saline** to between 150-155
- **Ensure adequate sedation**. Increase sedation if required. Propofol may be added to Morphine & Midazolam if required.
- **Ensure senior medical staff a**ware of escalation in ICP and therapy.
- Maintain cerebral perfusion pressure whilst controlling ICP
    Ensure the preload is adequate. Consider a fluid load to increase BP
    Use increase in vasopressor if required, Noradrenaline is the first choice.
    Note: CPP > 70 may be harmful. Once ICP has come down agin to desired range if the patient has had his inotropes increased then reduce then as required to keep CPP 60-70mmHg
    Document length of time ICPs were raised above 25 mmHg

If above measures fail to control the rise in ICP then:

- **neuromuscular blockade** may be used targeting 1-2 on TOF (see notes on NMBlocade)
- **If external Ventricular Drainage insitu, drain CSF.** Note: If the patient has external ventricular drainage check the of drainage is at 15cmH2O (or as directed by the neurosurgeon or consultant) prior to drainage of CSF.
- **Repeat CT scan**
  New or unexplained rises in ICP warrant acute hyperventilation for short term control, a repeat CT head and discussion with the neurosurgeon.

Other methods to reduce ICP (in patients with refractory intracranial hypertension):

- **Hypothermia**
  This may be instituted for ICP persistently greater than 25mmHg refractory to other therapy. Using cooling mattress the patient is cooled to between 33.5 to 34.5 degrees Celsius (using bladder temperature monitor). These patients should all be drug paralysed. Cooling is removed as intracranial hypertension begins to resolve.
- **Decompressive craniectomy** may be indicated but must be done urgently

Asthma policy

Signs of severe asthma and impending arrest

- Accessory muscle use
- recession
- A limited number of words per breath or monosyllabic utterances
- HR>130/min
- RR>30/min
- Paradox>15mmHg
- Inability to lie down
- Silent chest
- Lethargy, somnolence, advancing fatigue
- Normal or elevated Pco2

Intubation in acute asthma patient

- assume full stomach
- Preoxygenate well, RSI
- Use drugs you are familiar and happy with (this is not the time to try new things!):
    - ketamine if available is a very good bronchodilator
    - fentanyl better than morphine
    - suxamethonium may cause histamine release but can still use

Principles of ventilation

- Oxygenate and ventilate
- Rest respiratory muscles
- Buy time while medications work
- Allow trapped air to escape (avoid barotrauma)
- LONG EXPIRATORY TIME I:E ratio 1:3-4 or longer
- Safe ventilation will probably mean elevated pCO2

How to set up the ventilator:

If possible use one of the new blue (vela) ventilators as these have functional insp and exp pause buttons, synchonised nebulisation and allow larger settings for i:e ratios.

- TV 8ml/kg
- aiming for as long an I:E ratio as possible to allow lung deflation- At least 1:3 or 1:4 but may require 1:8 or longer
- Therefore- RR not>12, start at 6-8
- high insp flow rates 80-100L/min (1.3- 1.7L/sec on servo)
- Peak insp press likely to be high but does not appear to cause barotrauma (check insp pause to confirm)
- FiO2 1.0 initially, weaning once stabilized titrating to saturation.
- PEEP
    - initially use 0cmH20 (patient already has DHI)
    - once patient recovering (starts breathing spont) use 5-8cmH20
    - note: if patient has concomitant problems with oxygenation (eg congestive cardiac failure or pneumonia then use PEEP 5-8cmH2o to allow weaning oxygen to Fio2 <0.6)

Drugs used for asthma in ICU:
All patients must have:

- salbutamol nebs initially continuously, then increase interval as improves
- Hydrocortisone 2-4mg/kg every 6hours
- Rehydration and supportive care

If intubated and ventilated must also have:

- Beta agonist infusion, either:
- Salbutamol :
    - Bolus dose (can trial this to avoid impending intubation)
        - draw up 500mcg in 10mls and use 50-250mcg boluses (1-5mls)
    - For infusion use 2000mcg in 100mls (1ml/hour = 0.33 mcg/min)
        - Infuse at 5-20mcg/min (ie 15-60mls/hour)

- Adrenalin infusion
    - Adrenaline is made up as 6 mg in 100 mL (1ml/hour=1 mcg/min).
        - Infuse at 1-20mcg/ min (ie 1-20mls/hour)

Other options to consider in severe asthma

- Anticholinergics (benefit as adjuct)- nebulised atrovent qid
- Ketamine infusion
- Inhalational agents (care with halothane and adrenalin)
- Magnesium
- ?role of leukotriene antagonists

Please note: Aminophylline infusion- has conflicting evidence is severe asthma in studies and has a narrow therapeutic index with toxicity. It can also interact with IV adrenalin and/or ventolin so cause arrhythmias and therefore in our patient group already on these drugs it is best to avoid concomitant aminophylline.

Should I use paralysis?
Aim to paralyse and sedate only if necessary and cease as soon as practical.

Evidence: **Myopathy** after NMBAs for severe asthma occurs in 30% of those receiving paralytics; resultsin longer duration of mechanical ventilation (27 vs 7 days) and ICU stay. Behbehani, CHEST 1999 + others
However it is often necessary to sedate and paralyse initially to get control of gas trapping in patients who fight the ventilator).

What things tell you about gas trapping and effectiveness of ventilation when ventilated for asthma?

- Chest expansion and relaxation
- Wheeze to end of expiration
- Plateau pressure- aim <25cmh20
- Intrinsic peep- exp pause- aim <12cmh20
- VEI- end insp lung volume– total exp volume in 30-60sec apnoea to FRC- aim <20ml/kg- requires paralysis

n Plateau pressure (Pplat)

approximates alveolar pressure
single inspiratory pause manoeuvre
<25-30cmH2O

n Intrinsic PEEP (iPEEP)

more a measure of proximal airway pressure
single expiratory pause manoeuvre
less reliable than Pplat because of air trapping
<12-15cmH2O

n End-expiratory volume (Vei) - Tuxen

Collection of all expired gas from TLC to FRC
Requires 40-60seconds of apnoea
Requires sedation and paralysis
>20ml/kg correlated with barotrauma(1.4l in 70kg adult)
Can be measured or derived
Vei = $\frac{vT \times Pplat}{Pplat-iPEEP}$

What is the differential Dx of high airway pressures/inability to ventilate?

After intubation and ventilation the patient may be very difficult to ventilate with very high airway pressures. This is likely due to high airway resistance and reduced lung compliance doe to hyperinflation. HOWEVER, this is a diagnosis of exclusion. It is important to check insp pause (alveolar pressure) to check barotraumas risk is minimized and exclude other problems causing high airway pressures.

Differential diagnosis includes:

- Circuit problems
- ETT- in too far (RMB intubation), out, kinked, blocked, cuff herniation
- Airway- FB, asthma**, aspiration, anaphyllaxis
- Alveoli- pulmonary edema, blood etc
- Pleura- tension pneumothorax
- Chest wall- relaxation, burns etc
- Abdomen- distension etc

- Examine the patient - particularly
  - CVS look at BP, PR, CVP/JVP, perfusion
  - Resp look at TML, PN, Breath sounds
- Look at the ventilator
  - Peak Airway Pressure
  - Plateau pressure
  - AutoPEEP
- If having Trouble Hand Ventilate !!

If in addition the pulse is very difficult to feel or becomes progressively bradycardic or arrests this is likely very severe gas trapping causing severe impairment venous return. Emergency management includes:

- disconnect from the ventilator and do not reconnect until good cardiac output resumes. When pulse is palpable again, start very slow hand ventilation first (1-2 breathes/min)
- CPR, adrenalin, treat Hs and Ts (this is likely EMD)fluid load,
- consider treating pneumothorax with needle thoracosentesis then chest tube.

Patient controlled intravenous opioid analgesia (PCA)

For this to be successful, the patient must be lucid and cooperative.

Use boluses of morphine or fentanyl to achieve good analgesia prior to commencing the PCA.

Patient controlled analgesia using microprocessor controlled pump.

Morphine

- Add morphine 100 mg to normal saline to make a volume of 100 ml (1 mg/ml solution);
- set a 1 ml bolus (1 mg),(in the elderly use a 0.5 ml bolus (0.5 mg) instead).
- with a lockout interval of 5 minutes, and
- no background infusion;

Fentanyl

Occasionally, after consultation with the senior registrar or consultant, fentanyl may be used instead of morphine (in patients with renal failure);

- add fentanyl 1000 mcg to normal saline to make a volume of 100 ml (10 mcg/ml solution),
- set a 2 ml bolus (20 mcg), in the elderly use a 1 ml bolus (10 mcg) instead.
- with lockout time of 5 minutes, and
- no background infusion

Epidural Analgesia

DUTY of ANAESTHETIST inserting EPIDURALS

If you have inserted an epidural, it is your duty to:

1. Hand over to the on call registrar
2. Receive hand over of any issues from the night registrar.
3. Review the patient daily.

Write epidural orders: clearly

Date /	POST – ANAESTHESIA ORDERS [name]
Time	
	This patient has an EPIDURAL in situ.
	Please do not change the settings on the infusion pump.
	If any problems arise, please:
	• call the anaesthetist on call (after hours) or
	• [name] on [phone number] during business hours
	Please also call the anaesthetist to:
	• Change the syringe
	• If the pump malfunctions
	Q4H observations. Please notify anaesthetist if:
	• Systolic BP < [#] or > [#]
	• HR < [#] or > [#]
	• RR < [#] or > [#]
	• Temp > 38 C
	• Pain
	Please perform the additional observations Q4H and report if:
	• Urine output < [#] mls in 4 hours
	• Leg weakness
	Signature
	Name
	Phone number

DAILY REVIEW
Should consist of:

- History of pain or motor block.
- Review vital signs especially:
    - BP
    - HR
    - Temperature
- Examine
    - Motor block
    - Insertion site for erythema or tenderness
    - Level of block
    - Syringe pump
    - Medication chart (additional opioid use, heparin)

- Plan:
    - For the next 24 hours
    - Removal is to be performed by the anaesthetist (not nursing staff) after reviewing
        - Heparin administration
        - Coagulation studies (if indicated eg if abnormal LFT's or massive blood transfusion)
- Clear documentation

The exception to this is when a patient is transferred to ICU, where the ICU registrar will manage the epidural. (It is still good practice to review your patients while they have an epidural in situ). If the patient leaves ICU with the epidural, the responsibility returns to the anaesthetist who inserted the epidural.

TROUBLE SHOOTING.

As the on call or night registrar, you may be asked to review a patient with an epidural.

Some tips:

- Pain
    - Take a history, review opioid use
    - Check block
    - If LOW block, bolus (with solution in the infusion pump) and increase rate by 2ml/h
    - If NO block, consider bolus with 2% lignocaine
    - ** ask nursing staff to take BP Q10min after a bolus for 30 mins. Review patient within 30 mins and reassess.
- Hypotension
    - Take history, check block.
    - Consider phone order for oxygen, fluid bolus (NaCl rather than DSal)
    - Consider IV ephedrine bolus or 30 mg IM ephedrine if persistent.
    - Consider other differential dx eg AMI
    - Consider transferring to ICU (or PARU if ICU is full)
- Motor Block
    - History, examination.
    - Consider ceasing epidural to assess return of motor function but remember to restart the epidural.
- Temperature
    - Examine for back tenderness.
    - Remove epidural if T>39C

Still to be written:

Tracheostomy care

Measurement of intraabdominal pressure

Apache scoring

Oxygen therapy with masks

INFECTION CONTROL POLICY FOR THEINTENSIVE CARE UNIT (ICU)

Intensive Care is a high risk area for nosocomial infections because of the patient diagnostic mix, the frequent use of devices that breach patient defences against infection (e.g. urinary catheters, endotracheal tubes and intravascular cannulation devices), and the widespread use of multiple broad-spectrum antibiotics. Further, the frequent close patient contact and contact with body fluids required in the provision of nursing and medical care to this patient group allows for the increased transmission of infective organisms between patients, including multi-resistant organisms (MROs).

Current Recommendations for infection control for all patients in ICU:

A minimum of Standard Precautions must be strictly adhered to in ALL intensive care patients. Please refer to section 4.2 Fiji Ministry of Health Infection Control Manual (Fiji MOH ICM) for details.

Note: Many Intensive care units use Contact Precautions (see section 4.3 Fiji MOH ICM) for all patient care activities in ICU. This practice is based on the presumption that this may reduce nosocomial infection rates and the transmission of MROs, however there is not sufficient evidence in the literature to support this theory and it is not currently recommended in international guidelines.

HAND HYGIENE:

Strict hand hygiene is the mainstay of ICU infection prevention.

Recent evidence demonstrates that alcohol-based hand rubs are superior to hand washing with soap and water for the prevention of nosocomial infection, due to enhanced efficacy in reducing microorganisms on the skin and ease of use. Alcohol-based hand rubs are therefore now recommended for standard hand hygiene practice in ICU.

When to practice hand hygiene with alcohol-based hand rub:

- **On entering and leaving** the intensive care unit
- **Before** and **after ANY** direct contact with patients
- When moving **between** a contaminated body site (e.g. a wound) and a clean body site
- **After** glove use
- **After** contact with inanimate objects in the immediate vicinity of the patient, including medical equipment and charts
- **Before** and **after** inserting in-dwelling urinary catheters, peripheral vascular catheters or other invasive devices that do not require a surgical hand wash.

Hand-washing with soap and water is indicated only:

- Before eating
- After using a bathroom
- After removing powdered gloves
- When hands are visibly dirty
- If exposed to Clostridium difficile.

When using an alcohol-based hand rub:

- Apply the hand rub to dry skin only
- Squirt once onto the palm of the hand
- Rub hands together, ensuring whole hands are covered including between fingers and around nails
- Roll over all surfaces until dry (~ 15 seconds)
- Do not wash hands immediately after application.

When hand washing with soap and water:

- Do not apply soap to dry skin, always moisten skin first to prevent skin irritation
- Do not combine soaps.

Nails:

Nails must be kept short and clean. Artificial nails are not permitted.

Jewellery:

Jewellery (rings and bracelets etc) should not be worn, with the exception of a simple wedding band.

GOWNS:

The routine wearing of gowns by all personnel in the ICU has not been shown to reduce the risk of nosocomial infection and is therefore not required. However, gowns must be worn:

1. For the care of patients for whom Contact Precautions are required.

2. To protect the skin and clothing of health care workers (HCWs) for any procedure where there is a potential exposure to blood or body fluids. This includes (but is not limited to):

- Suctioning of endotracheal tubes
- Nasogastric tube insertion
- Emptying bags containing body fluids e.g. urinary catheter bags
- Wound dressings
- Changing of diapers or soiled bed linen
- Sponging and cleaning of patients as part of care.

Gowns may also be worn if HCWs clothing will have substantial contact with the patient, environmental surfaces or items in the patient's room if the HCW believes this to be important (e.g. unproven MRO infection in a high risk patient).

Gowns are for staff to use in caring for a single patient and are dedicated to the care of that patient only. If moving to another patient or bed space the gown must be removed and hands washed before proceeding. Gowns may be kept at the patient's bedside for use again when returning to that bed, but must be hung on dedicated stands avoiding contact with other objects in the room/bed space.

Gowns must be sent for laundering:

- Daily, at the commencement of the morning nursing shift, or
- Immediately any soiling is present.

GLOVES:

Non-sterile gloves should be available to be worn by HCWs for any procedure where there is a potential exposure to blood or body fluids, as outlined in detail in section 4.2 Fiji MOH ICM Standard Precautions. Gloves MUST also be worn for the care of patients for whom Contact Precautions are required.

Gloves are to be used for the care of one patient only and removed and discarded prior to moving to the next patient.

Gloves should not be washed or reused.

Hands must be washed after removal of gloves. Use of gloves does not eliminate the need to wash hands.

ENVIRONMENTAL CLEANING POLICY

Bed Spaces: are to be thoroughly cleaned after each patient leaves the ICU and before the next patient occupies the space. This includes: Bed (top and bottom), mattress, bed tables, shelves and wall beside bed.

Equipment: should be single use, or cleaned and disinfected between each patient.

Airconditioning - should be maintained in good working condition at all times. Schedule for full cleaning monthly or whenever deemed appropriate by infection control team.

Curtains - are to be laundered every 2 weeks, or immediately if they become soiled.

Ward - Sweep and mop every morning and afternoon. The ward is damp dusted every morning using Milton solution.

ADDITIONAL PRECAUTIONS:

Contact Precautions

Full Contact Precautions MUST be used in the following patient groups:

- Known or suspected MRO infection or colonization (MRSA, Multi-resistant Gram negative bacteria, VRE and others named by the Infection Control Committee)
- Diarrhoeal illnesses e.g. Clostridium difficile infection
- Highly contagious skin infections e.g. impetigo, scabies, mucocutaneous Herpes simplex virus infection.

During Contact Precautions, in addition to Standard Precautions the following is recommended:

- Use of gowns and gloves if HCWs clothing and hands will have substantial contact with the patient, environmental surfaces or items in the patient's room
- Single use or dedicated equipment for each patient; (if equipment must be shared, thorough disinfection is essential before use on the next patient)
- Isolation of patient in single room if practicable.
- Visitors must wear gowns and adhere to strict hand hygiene.

Airborne and Droplet precautions:

See section 4.3 and table 4.1 in Fiji MOH ICM

ASEPTIC TECHNIQUE:

Must be used for the following procedures:

- Insertion of Central venous lines
- Insertion of peripheral long lines
- Insertion of arterial lines
- Insertion of urinary catheters.

This involves:

- Use of sterile gown, gloves and equipment trays.
- Appropriate hand scrubbing (see section 7.3 Fiji MOH ICM Hand scrub before surgical procedure)
- Appropriate skin preparation (see section 7.1 and 7.4 Fiji MOH ICM Skin preparation before surgical procedure)
- Careful no touch technique.

CARE OF INTRAVENOUS (IV) CANNULAE and OTHER INVASIVE DEVICES

IV cannula sites must be frequently inspected (every 4 hours) for signs of phlebitis.

Peripheral IV cannulae should be routinely resited every 48-72 hours, or earlier if concerns. This should coincide with changing of administration sets. IV fluid bags should be changed every 24 hours.

Central and arterial lines inserted under aseptic conditions do not require routine change as above. However they should be removed immediately if there is:

- Local signs of infection (erythema, purulent exudate).
- Signs of systemic infection including: rising WCC, fever, rigors, SIRS response particularly if more than 5 days since insertion.

For details of care of urinary catheters see chapter 16.3 Management of urinary catheters.

FOR FURTHER INFORMATION IN RELATION TO INFECTION PREVENTION AND CONTROL, REFER TO THE CURRENT GUIDELINES FOR INFECTION PREVENTION AND CONTROL USED BY THE MINISTRY OF HEALTH

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Scope and Application	This CPG is intended for use by all health care workers in their daily care of patients in ICU
Effective Date	2010
Supercedes Policy Number	Not applicable
Review Responsibilities	In consultation with the lead Intensivist, The Chairperson of the Anaesthetic/ICU Network will initiate the review of this guidelines every 3 years from the date of issue or as required.
Further Information	Anaesthetic/ICU CSN Chairperson

RESPONSIBILITY:

CPG Owner: Anaesthetic/ICU CSN

CPG Writer: Ministry of Health **Date: November 2010**

Endorsed:

National Medicines & Therapeutic Committee, MOH

Date: 23 November 2010

Endorsed:

National Health Executive Committee, MOH

Date: 25 November 2010