

NEURO ICU



RAISED ICP

- **Tier 1 interventions** (within 15 mins of ICP rise):
 1. Check ABG to ensure PaCO₂ has not gone up. Increase minute ventilation to target PaCO₂ 35-40 mmHg
 2. Assess sedation and analgesia. Give a generous bolus of sedation to see if it reduces ICP
 3. Consider concentrated salt bolus if Na <155
 4. Check EVD functioning properly (if in-situ) or needed (if not)

If ICP is not controlled with tier 1 intervention, consult the ICU Fellow or SMO & notify neurosurgeon

- Institute **Tier 2 interventions** for elevated ICP if not controlled by tier 1 within 15 minutes
 1. Administer a bolus of [atracurium](#) and consider if an infusion is needed
 2. External cooling to 37.0-37.5°C
- Institute **Tier 3 interventions** for elevated ICP if not controlled by tier 2 within 1 hour of the initial ICP rise. Notify the ICU Fellow or SMO
 1. [Thiopentone](#) (give 75mg boluses until ICP is controlled or a total of 500mg is administered)
 2. External cooling to 35.0-35.5°C
 3. Consider surgical decompression
 4. Consider aiming for PaCO₂ 32-35 mmHg (only if effective) for a brief period while arranging surgical intervention or imaging

CERVICAL SPINE CLEARANCE

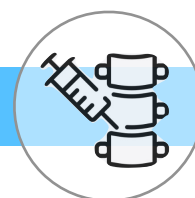
- Trauma patients who are intubated & ventilated require a CT of their cervical spine as they are unable to be assessed clinically
- The cervical spine can only be radiologically cleared by a senior radiologist (SMO or post part-II RMO)
- If a final report is not immediately available, cervical spine precautions must remain in place. However, if the preliminary radiology report has not identified any injury, it is reasonable to use lateral support (rolled towels preventing neck rotation) rather than a full collar. This is particularly important in patients with elevated ICPs where a poorly placed collar may reduce venous return
- If desedation for neurological assessment is required **before** radiological cervical spine clearance, a well-fitted collar must be applied before sedation is turned off

OTHER NEUROLOGICAL CONDITIONS

- For patients admitted following thrombolysis or clot retrieval for an ischaemic stroke, the blood pressure target should be charted as '**SBP strictly < 180 mmHg**'. The lowest acceptable blood pressure should not be different to any other ICU patient (MAP > 65 mmHg). If the interventional radiologist has inserted a stent they may request a different lower limit.
- For patients with a haemorrhagic stroke, aim SBP < 150mmHg

- For patients with aneurysmal SAH, [nimodipine](#) should be charted even if the patient is receiving noradrenaline. The dose or frequency should be adjusted as per the Drug Manual entry. It should be withheld if noradrenaline rate is > 15 mL/hr.
- For management of acute agitation that presents an immediate threat to the safety of patients and/or staff:
 - 1st line Rx: **0.5 - 2 mg [haloperidol](#) IV** (for people who are elderly or frail) or **2 - 10 mg [haloperidol](#) IV** (for people who are young and fit)
 - 2nd line Rx: **1 - 2 mg [midazolam](#) IV** (for people who are elderly or frail) or **5 - 10 mg [midazolam](#) IV** (for people who are young and fit)
- For ongoing management of agitated delirium:
 - 1st line Rx: **1 - 2.5 mg [haloperidol](#) PO/NG/IV TDS** (for people who are elderly or frail) or **2 - 10 mg [haloperidol](#) PO/NG/IV TDS** (for people who are young and fit)
 - 2nd line Rx: **[dexmedetomidine](#) 0 - 1.5 mcg/kg/hr**. Commence at 1 mcg/kg/hr for 30 minutes and then, if possible, reduce by 0.2 mcg/kg/hr every 30 minutes to the lowest effective dose
 - 3rd line Rx: **[quetiapine](#) 12.5 mg OD to BD** (for people who are elderly or frail) or **50 mg [quetiapine](#) OD to BD** (for people who are young and fit).

EPIDURALS & LUMBAR DRAINS



In a patient with an epidural or lumbar drain:

- De-sedate the patient and assess lower limb motor function as soon as possible
- **Do not wait for neuromuscular blockade to wear off**
- If necessary, administer sugammadex to reverse the neuromuscular blockade
- If required, and no motor block has been demonstrated, the patient can then be resedated

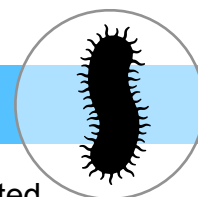
If a motor block is noted in a patient with an epidural:

1. **Stop the epidural immediately**
2. If motor block has not resolved within 2 hours of stopping the epidural, notify the ICU SMO & arrange an **urgent MRI to exclude epidural haematoma**
3. If motor block resolves, restart epidural at a lower rate

If a patient with an epidural is in pain:

- Assess block height
- If the block is inadequate, administer **5 mL** as a clinician bolus through the epidural pump. *The pump can be unlocked using '588' (Level 2 code)*
- Reassess pain control & block height after 15 minutes. If pain has reduced, increase the rate by 2 mL/hr (but not higher than the prescribed maximum rate)
- If this does not work, contact the Duty Anaesthetist or Pain Team for advice

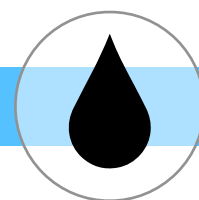
MICROBIOLOGY/INFECTIOUS DISEASES



- Patients with suspected infection after 3 or more days in hospital should be treated empirically with [meropenem](#)
- Patients who acquire infection in the community or within 3 days of hospitalisation should be treated empirically with [ceftriaxone](#)

- Current evidence suggests that minimising time below MIC reduces mortality for patients on beta lactams.
 - Meropenem and [piperacillin-tazobactam](#) should be administered by continuous infusion. Start with a bolus dose then commence continuous infusion at half of the dosing interval. For example, if the desired dose is 1 gm Q8 hrly of [meropenem](#), given 1 gm of [meropenem](#) stat and then commence a continuous infusion that gives 1 gm every 8 hours on an ongoing basis starting 4 hours later
 - [Ceftriaxone](#) should be dosed twice daily to minimise the time below MIC
 - [Augmentin](#) is routinely given as 'boosted'. This means it should be charted as 1.2 gm of augmentin given every 8 hours, interspersed with 1 gm of amoxicillin given every 8 hours but commenced 4 hours after the augmentin dose. Practically, this could be charted as 1.2gm augmentin 0800, 1gm amoxicillin 1200, 1.2gm augmentin 1600, 1gm amoxicillin 2000 etc.

IV FLUIDS & TRANSFUSION IN ADULTS



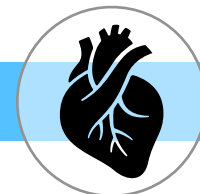
MAINTENANCE FLUIDS

- [Crystalloids](#) are the preferred choice for fluid administration in adults
 - In brain injury, **0.9% saline** should be used
 - **Plasma-Lyte** should be used in all other conditions
- Unless there is clinical evidence of volume overload, elective major abdominal surgery (including vascular surgery and gynaecological surgery) patients should receive **1.5 mL/kg per hour** of maintenance fluid for the first 24 hours in ICU
- Cardiac surgery and non-elective ICU patients do not require maintenance fluids

TRANSFUSION THRESHOLDS

- The following transfusion thresholds in critically unwell adults are supported by evidence from randomised clinical trials and are therefore reflected in our usual approach:
 - For general ICU patients, only transfuse if Hb < 70 g/L
 - For cardiac surgery patients, only transfuse if Hb < 75 g/L
 - For acute brain pathologies (TBI, SAH, and ICH), transfuse if Hb < 90-100 g/L
 - In patients with acute myocardial infarction transfuse if Hb < 100 g/L

CARDIAC SURGERY



The cardiac surgeon looking after the patient is the most important person to contact if a cardiac surgical patient has arrested. If there are any concerns around peri-operative cerebral perfusion or an embolic event, on arrival in ICU after surgery the patient should be desedated **as soon as possible** (with active reversal of paralysis) to check for bilateral limb movement. Once observed, they can be re-sedated to be woken later normally.

Bleeding after cardiac surgery:

- **> 100 ml/hr is troublesome.** Manage actively: warm, correct hypocalcaemia, reverse any residual heparin effect, correct other coagulopathy
- **> 200 ml/hr is worrying.** Notify Intensivist and Cardiothoracic registrar
- **> 400 ml/hr is a surgical emergency.** Call Intensivist and Cardiac Surgeon



Shock after cardiac surgery:

- Do not start a second vasoactive agent without first talking to the Intensivist
- Inform the Intensivist if the patient requires noradrenaline > 10 mLs/hr to maintain MAP or any vasoactive agent is rapidly escalated

Prescribing after cardiac surgery:

We use a pre-printed cardiac surgery drug chart but there are some nuances. [Aspirin](#) is given to CABG patients 6 hours after admission (unless bleeding). If the patient is unlikely to be extubated the next day, they will require a nasogastric tube for this to be administered. Every patient receives 3 doses of antibiotic prophylaxis (th. [Beta blockers](#) should be withheld if a patient is on noradrenaline or pacing-dependent. [Statins](#) are required for CABG patients and others who were already on a statin pre-op. [Enoxaparin](#) prophylaxis should be charted for day 1 (unless bleeding). [Omeprazole](#) should be charted for all patients.

STRESS ULCERS

- As above, all patients after cardiac surgery should receive [omeprazole](#). Do not prescribe stress ulcer prophylaxis for other patients routinely, but continue PPIs if the patient takes them regularly
- For patients who are mechanically ventilated, expected to remain ventilated beyond the day after tomorrow, and where upper GI bleeding would be problematic (need anticoagulation or dual antiplatelet therapy), prescribe [omeprazole 40 mg IV/PO/NG](#) once daily

ENTERAL FEED

- Most patients with enteral access (nasogastric, nasojejunal or percutaneous endoscopic gastrostomy) should be fed. The exceptions to this are a non-functioning GI tract (perforation, ileus, fistula, recent surgery), haemodynamic instability, or surgery or anaesthesia planned in the next 6 hours
- The default feed in ICU is **Nutrison Protein Plus Multifibre** which should be charted unless the patient has known allergies to any components (milk, soy, fish oil)
- The starting rate is weight based. Follow the protocol available at every bed space in the red folder, or [online here](#)
- All non-radiologically/endoscopically placed enteral tubes **must** have their position radiologically confirmed by an ICU doctor before use. This requires a post-placement chest X-ray showing the feeding tube traversing the mediastinum in the midline (beyond the carina), passing below the diaphragm, with the tip seen in the stomach. No other means of confirming placement such as aspiration of contents, litmus test, auscultation during air injection, or ultrasound are acceptable
- Most patients should have a fine-bore nasogastric feeding tube placed after tracheostomy insertion. The stiffening wire should be left in-situ to aid radiological identification until placement has been confirmed

DVT PROPHYLAXIS

[Enoxaparin](#) is the preferred agent and should be dosed at night (to reduce bleeding risk during daytime procedures). The prophylactic dose should be adjusted for weight & renal function thus:

All patients (Medical, Surgical and Trauma):

Weight	Dose if GFR $\geq$ 30 mL/min	Dose if GFR < 30 mL/min OR whilst on CVVHDF
< 50 kg	20 mg nocte	20 mg nocte
50 - 99 kg	40 mg nocte	20 mg nocte
100 - 149 kg	60 mg nocte	40 mg nocte
150 - 199 kg	80 mg nocte	40 mg nocte
$\geq$ 200 kg	100 mg nocte	60 mg nocte

Detailed guidance on when to start enoxaparin prophylaxis in specific patient groups, or administration timing around device removal/insertion is provided in the [ICU Drug Manual](#).

There is no need to routinely perform anti-Xa monitoring for patients receiving enoxaparin as DVT prophylaxis.

WARFARIN

For patients who require [warfarin](#) and in whom the INR is normal (<1.3), warfarin should be commenced at 3 mg each day for 3 days unless directed otherwise

LAXATIVES

Constipation is frequent in ICU patients. There is an algorithm for laxatives that differs between patients with or without brain injury. It is available at every bed space in the red folder. Please follow this when asked to chart laxatives

MAGNESIUM & PHOSPHATE REPLACEMENT

We do not encourage routine replacement of magnesium or phosphate. However, in clinical situations where this is required, the enteral route should be used if the patient can swallow or has a nasogastric tube. Recent evidence has shown:

- Enteral replacement is just as effective at increasing serum electrolyte levels as IV
- Enteral replacement is well tolerated
- Enteral replacement is better for the environment (14.2 gm of CO₂ emissions are required to produce 2 gm of enteral phosphate 843 gm to produce 20mL of KH₂PO₄)
- IV phosphate replacement is 10x more expensive than enteral (\$3.70 vs \$37.70)

When prescribing magnesium and phosphate, please prescribe as follows:

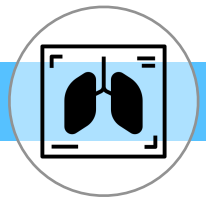
Magnesium:

Magnesium hydroxide 8%, 10 mL NG BD. Can increase to max 10 mL QID NG

Phosphate:

Phosphate effervescent tablets, 500 mg NG BD. Can increase to max 500 mg QID

INVESTIGATIONS



MORNING CHEST X-RAYS

Daily CXRs should be ordered by the team on the night shift for the following patients:

1. All patients after cardiothoracic surgery with chest drains
2. All ventilated patients except those who are completely stable
3. All non-ventilated patients who have had a deterioration in respiratory parameters or an increase in respiratory support

If in doubt, order the CXR. The amount of radiation exposure with a portable CXR is similar to the exposure that occurs on a flight from Wellington to Auckland (i.e. it is trivial).

ORDERING INVESTIGATIONS & REFERRALS

- If you think a post-cardiac surgery patient requires a transoesophageal echo (TOE), call the Intensivist. Some can do the TOE themselves, others will ask you to call the cardiac anaesthetist. If an ICU patient requires a TOE for another reason (infectious endocarditis etc.), call the cardiology imaging registrar
- To order a transthoracic echo (TTE), complete a cardiology investigation referral on the Medical Access Portal (MAP). The echo technicians will usually come and complete ICU echocardiograms first thing in the morning so if the TTE can wait until the next morning, you do not need to ring anyone
- To order neurophysiology testing (EEG, SSEP) fax a request to 80072 and ring the neurophysiology technician on 80079
- To refer a patient to palliative care, complete a Palliative Care Referral: Inpatient Team & Hospice on MAP and ring palliative care referrals on #6567 (from 0800-1700 Monday to Friday)