# RERN REFERENCE

First Edition - January 2015

CHECK DRUG DOSES AND CLINICAL CRISIS ALGORITHMS

Responsibility for drug dosing and clinical actions remains with the treating clinician

# Rural Emergency Responder Network

The Rural Emergency Responder Network (RERN) comprises rural doctors who volunteer to respond to out-of-hospital emergencies. Rather than *ad hoc* responses by GPs, the members of RERN offer a standard level of care to patients in rural areas. RERN may support volunteer ambulance officers or value add when retrieval services are delayed. Members are provided with prehospital equipment and participate in ongoing skills maintenance with SA Ambulance & MedSTAR retrieval.

Remuneration is via Country Health SA utilising a specific RERN call out form. Participation is voluntary and members can decline a request to attend. Activation is via pager from SA Ambulance Emergency Operations Centre, although use of the GoodSAM app is encouraged to assist location of nearby RERN members.

This guide is designed as an aide memoire of common emergency conditions, drug doses and algorithms. Any suggestions for improvements are gratefully received and can be directed to :

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# CONTENTS

# EMERGENCY MEDICAL RETRIEVAL

## Activating MedSTAR - 13STAR (137 827) Option 1

**For all critical care transfers consider early involvement of the retrieval service**

**WHO?** – Patients who are critically ill or injured or are deteriorating and are likely to require critical/intensive care management.

**WHY?** – Early notification of MedSTAR will provide access to critical care advice to help manage patients locally and will allow timely activation of a retrieval response if required.

### Critical illness

- Intubated patients (requiring respiratory support)
- Circulatory failure (requiring inotropes)
- Severe sepsis
- Complex multi-system disorders with clinical instability
- Specialised critical care needed (eg balloon pump)
- Premature infants

***Referral may precede availability of results of tests or investigations***

### Major trauma

- Penetrating injuries (excluding isolated limb)
- Major head injury, blunt injuries or fractures
- Limb threatening injuries
- Uncontrolled significant haemorrhage
- Spinal injury with neurological signs
- Burns > 20%, special areas, paediatric burns
- Patients with high risk mechanism of injury whose vital signs deteriorate

***Refer also to the South Australian Statewide Trauma Team Activation Criteria***

**Early activation and timely critical care transfer may improve clinical outcomes**

**VITAL SIGNS (persistent abnormalities despite appropriate therapy – seek critical care advice)**

| | Adult | Child (1-4 years) | Neonate (0-3 months) |
|---|---|---|---|
| Consciousness AVPU or GCS (best response) | GCS <13 | V,P,U | Hypotonia, poor feeding, excessive sleepiness |
| Respiratory rate | <15 >30 | <20 >40 | <25 >60 |
| Respiratory distress | present | present | present |
| Heart rate | <40 >120 | < 90 >155 | <100 >180 |
| Systolic BP | <90 | <70 >110 | Cap refill >3 secs |
| $SpO_2$ (with $O_2$) | <90% | <95% | <90% |

# 13STAR (137 827) Option 1

## Statewide 24/7 (including telemedicine facilities)

**For inter-hospital transfers (not requiring a Retrieval Team) Fax Request: 1300 730 800**

Government of South Australia – SA Health

SA Ambulance Service

# PREPARATION FOR RETRIEVAL

**Contact: 13STAR (137827) Option 1**

med STAR Managing Medical Retrieval

Government of South Australia SA Health

SA Ambulance Service

*Careful preparation for retrieval transport improves patient care and reduces risk.*

## AIRWAY

### Ensure patient airway safety

1. Assess airway stability for all patients
2. Secure tracheal tube
3. Record tracheal tube (TT) size and length to lips
4. Oro/Naso-gastric tube (NGT/OGT) placed
5. CXR to confirm position of TT/NGT

## BREATHING

### Ensure ventilation optimised

1. Measure respiratory rate and record respiratory effort
2. Monitor $SpO_2$ and $EtCO_2$
3. Administer oxygen using appropriate device
4. Check blood gases if indicated and equipment available
5. Secure chest tubes if present

## CIRCULATION

### Control bleeding

1. Appropriate pressure/splintage
2. Consider reversing anti-coagulant treatment

### Ensure patient IV access

1. Insert two peripheral IV lines – appropriate size
2. Secure all lines – ensure injection ports are accessible
3. Prepare drug infusions in 50ml Luer lock syringes
4. Record all IV fluids and drugs
5. Consider arterial and central venous access

## DOCUMENTS

### Ensure patient documentation completed

1. Provide copies in envelope
   - all patient charts
   - investigation results – pathology and ECG
   - Imaging – x-rays / CT scans / ultrasound scans / MRI
2. Document and advise any 'limitation of treatment' orders

### OTHER

1. Maintain appropriate temperature
2. Consider indwelling urinary catheter
3. Maintain fluid balance chart
4. Empty drainage bags prior to transport
5. Administer antiemetic if indicated
6. Maintain spinal precautions if required

### ALERT

It is important you notify the MedSTAR coordinator of:

1. Significant deterioration in:
   - conscious state
   - blood pressure and/or heart rate
   - respiratory status and/or oxygenation
2. Major clinical developments such as significantly abnormal diagnostic tests, new clinical signs etc
3. The need for major interventions prior to the retrieval team arriving (e.g. intubation, surgery etc)

**Ensure patient and/or family are aware of plans and that there is no guarantee that relatives can accompany the patient.**

# TEAM RESILIENCE

Resuscitation of the critically unwell patient can be stressful, for both lead clinician and the team. In rural practice, pressures include :

- limited equipment
- relative infrequency of critical illness (risk deskilling)
- lack of team training
- no immediate back up

Nevertheless **critical illness does not respect geography** and it behoves rural clinicians to anticipate and plan for such events.

Rather than be afraid of critical illness, remember that initial management is concerned with DOING THE BASICS WELL

To build local team resilience, rural clinicians may :

- use mental rehearsal for anticipated crises
- encourage regular team training using sim
- reduce cognitive load via checklists & action cards
- ensure knowledge is up-to-date. Excellent online resources are available via FOAMed - free open access medical education

# CRISIS MANAGEMENT

- KNOW, MODIFY and OPTIMISE THE ENVIRONMENT
- ANTICIPATE and PLAN FOR A CRISIS
- ENSURE LEADERSHIP and ROLE CLARITY
- COMMUNICATE EFFECTIVELY
- CALL FOR HELP or SECOND OPINION EARLY
- ALLOCATE ATTENTION and USE AVAILABLE INFORMATION
- DISTRIBUTE WORKLOAD and USE AVAILABLE RESOURCES

# RESUS FENG SHUI

A well run resuscitation, whether at the roadside or in the ED, is characterised by **ESTABLISHING A CALM ENVIRONMENT & ENSURING OPTIMAL LAYOUT**.

Scene control at the roadside is under aegis of the **FIRE SERVICE**, with jurisdictional control under **POLICE.** Identify yourself to **FIRE COMMANDER** and then to the **MEDICAL INCIDENT COMMANDER** (usually ambulance). Follow their directions re: extrication and scene safety.

Unless in extremis, extrication can be left to prehospital providers and the RERN DOCTOR should focus on simultaneous assessment, treatment and packaging. **AN INITIAL SITREP** may be useful.

Ensure **360 DEGREE ACCESS** around stretcher, prepare for patient with **vac mat** and **pelvic binder**, splint to skin. Aim to **extricate in-line** where possible, using an extrication board to move patient from accident site straight onto ambulance stretcher at full of half-height.

Tether patient to safety with **MONITORING**, conduct **PRIMARY SURVEY** and **UPDATE SITREP**. procedures are best conducted on stretcher, either in ambulance (ltd access) or rear doors (**360 access**)

# TRAUMA PREPARATION

**BEFORE PATIENT ARRIVAL**

Call in available staff
(X-ray, Lab, Orderly, Medical, Nursing, Theatre)
Warm room & prepare warm fluids
**DONT FORGET BLOOD - CRYO - TXA 1g load**

Designate TEAM ROLES
Equipment according to anticipated injuries

**think "find the bleeding - stop the bleeding"**
**HEAD - CHEST - ABDO - PELVIS - LONG BONES**

**Notify SA Statewide Retrieval**
**MedSTAR**

## 13 - STAR

Use Telehealth if Available
or a "hands free" phone

Use a member of staff to relay messages
if you are busy performing procedures

**SET RESUS GOALS**
**USE A VISIBLE WHITEBOARD TO SCRIBE**

# TRAUMA - ARRIVAL

**PRIMARY SURVEY**

*ISBAR or AT-MIST handover*
*Airway - Breathing - Circulation - Disability - Exposure*
*(alternatively MARCH approach)*

*Spinal precautions - C collar, Vac Mat*
*Splint limbs and pelvis if appropriate*

*Wide bore IV access, warm fluid bolus aim MAP > 70*

**SECONDARY SURVEY**

Top-to-toe examination
Document abnormalities espec neurology
Bloods, Imaging inc VBG, Hb, urine bhCG, ADT, ABs

**TRANSFER CHECKLIST (A-O approach)**

Airway-Breathing-Circulation-Disability-Exposure
Fluids-Gut (orogastric, last ate)-Haematology (Hb etc)
Infusions-JVP (filled?)-Kelvin (temp)-Lines (x2)
Micro (ADT, IVABs) - Notes/Next of Kin - Other?

**DONT FORGET ANTI-EMETIC PRE-TRANSFER**

# TRAUMATIC ARREST

**Generally outcomes are POOR**
CPR may have no role to play - the problem is invariably one of either HYPOXIA, HYPOVOLAEMIA or OBSTRUCTION (eg bilateral tPTX, tamponade)
Efforts should therefore be addressed towards aggressive management of each

**SECURE AIRWAY (ETT or LMA)**

**IV or IO ACCESS - give VOLUME**
**(packed cells if available, otherwise crystalloid)**

**BILATERAL NEEDLE or PREFERABLY FINGER THORACOSTOMIES**

**CONSIDER CLAMSHELL THORACOSTOMY**
**(NB: only in penetrating injury)**

*Explain to the team what you are about to do. Join the dots between the two finger thoracostomies, using scalpel to incise skin then trauma shears to incise intercostals and then through sternum (use a Gigli saw if available). Allocate one person (gloved) to lever thoracic cage towards head, whilst operator identifies the heart and both removes clot in pericardium and/or controls bleeding from the ventricle.*

# IMPACT BRAIN APNOEA

This phenomenon is well described in animal models and may be a cause of EARLY TRAUMA DEATH. It refers to cessation of breathing after blunt trauma - which spontaneously reverts after several minutes unless death intervenes. There is therefore a narrow therapeutic window for intervention - basic measures such as maintaining airway patency (chin lift, jaw thrust) and assisted ventilation may be life-saving.

These are more likely to be delivered in early phase post trauma by bystanders than by EMS responders (who may take some time to arrive)

The GoodSAMapp (http://goodsamapp.org) was designed to facilitate BLS provision to trauma victims in London, but has been extended to crowdsource BLS-accredited responders throughout the world for other crises, in particular cardiac arrest.

The built-in GPS in a smartphone allows real time location of responders - which offers potential advantages for organisations such as RERN, and off-duty MedSTAR or Ambulance personnel, allowing nearby responders to be identified and tasked to deliver BLS prior to arrival of EMS services.

Register at http://GoodSAMapp.org (use RERN tab)

# HANDOVER

This is perhaps the most important part of care for the critical patient - also potentially the hardest.

Unless there is an IMMEDIATE need (under CPR, needs thoracotomy etc) maintain a HANDS OFF and give HANDOVER BEFORE MOVING the patient.

DO NOT ALLOW the team to commence switching monitor cables, measuring BP etc.

Better to stop and have a TEAM TIME OUT to listen to a STRUCTURED HANDOVER.

**ISBAR**

Identify (self/patient)
Situation
Background
Assessment
Response / Requirements / Readback

**AT MIST AMBO**

Age - Time
Mechanism - Injuries - Signs - Treatment / Trends
Allergies - Medications - Background Hx - Other info

# RETRIEVAL CHECKLIST

| | |
|---|---|
| A | Airway - patent & protected?<br>(if intubated, ETT size, length, CL grade) |
| B | Breathing - spont, non-invasive or IPPV<br>(vent settings - TV, freq, PEEP) |
| C | Circulation (cap refill, pulse, BP) |
| D | Disability (GCS in components ie E4V5M6) |
| E | Exposure |
| F | Fluids given |
| H | Haematology (Hb, VBG lactate, INR) |
| I | Infusions, Imaging & IDC |
| J | JVP (filled, over- or under-filled?) |
| K | Kelvin (temperature - active warming?) |
| L | Lines x2 (consider art line) |
| M | Micro (blood cultures? ADT? IVABs?) |
| N | Notes and Next of Kin |
| O | Other |

Attention to the basics will have significant downstream advantages. Tether patient to safety with O2, suction, ECG, SpO2, ETCO2, NIBP or IABP, two IV lines, urinary catheter, chest & orogastric drain if needed. Use minimum volume extension sets for infusions & consider pre-drawing standard strength infusions for transfer. Lines are best placed on R side for access. Ensure a recent VBG is available (iStat).

# AIRWAY MANAGEMENT

Remember the important principles of :

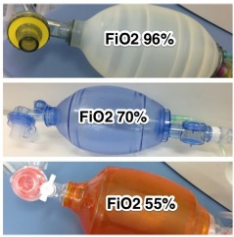
- **optimise patient position** (ramp the obese at 45º, position ear-to-sternum if possible)
- **maximise denitrogenation** - use a non-rebreather mask at 15l/min or BMV with PEEP valve; caution with BMV and spontaneously ventilating patients, as delivered FiO2 differs markedly between models
- **optimise PEEP** for those expected to desaturate preox with CPAP or BMV-PEEP valve+nasal specs
- prolong time to critical desaturation by using **apnoeic diffusion oxygenation** (NODESAT) during intubation attempts
- **maximise first pass success** - use a bougie or straight-to-cuff malleable stylet for all RSI
- **brief team** with agreed 30s drills for difficult airway
- **avoid hypotension** – have pressor available
- **discuss your post intubation plan** – ventilation and sedation/paralysis. **Confirm ETCO2**

# OPTIMISATION TECHNIQUES

*Ramp obese patients*

*Two handed BMV technique, gentle bagging with PEEP valve*

**On 15Lt/min SV:**




**All >95% FiO2 with PPV**

*Know the FiO2 of BMV for SV patients or use NRBM*

*Use nasal specs to deliver apnoeic diffusion oxygenation during ETI*

# AIRWAY - RSI

Not a procedure to undertake lightly - always consider alternatives inc. maintenance of spontaneous ventilation if adequate. That said, airway control allows control of ventilation, essential in head injury where we need normoxia, normocarbia as well as normotension.

Once decision is made to secure the airway then efforts should be focussed on this goal. Traditional use of sux has been advocated ("to allow patient to wake up if failed intubation"). This is nonsense in a critical patient. Instead, the team should be prepared to move swiftly (30s drills) from primary intubation plan, to secondary, then maintenance of oxygenation/ventilation and finally CICO.

Induction agents : Ketamine is proven safe in haemodynamically unstable and head-injured patients. Typical induction dose is 1-2 mg/kg - reduce to 10% of this if critically unwell. Alternatives are propofol or thiopentone - again, reduce dose to 10% of usual.

Paralysing agent : Rocuronium at 1.6mg/kg of ideal body weight gives same onset of intubating conditions as suxamethonium. Use of this non-depolarising NMB commits the operator to securing the airway - via ETT, iLMA or Emergency Surgical Airway (ESA)

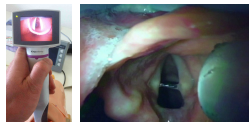
# DIFFICULT AIRWAY PLAN

**PLAN A**
Initial
Intubation
Strategy

**AIM FIRST PASS SUCCESS**
**ear-to-sternum, bougie**

**PLAN B**
Alternative
Intubation
Strategy

**eg: VIDEO LARYNGOSCOPY**



**PLAN C**
Maintenance of
Oxygenation &
Ventilation

**BAG-MASK or LMA**
Supreme LMA
or Intubating LMA (AirQ II)


**PLAN D**
Rescue techniques
"Can't Intubate
Can't Ventilate"

**SURGICAL AIRWAY**
**scalpel-finger-(bougie)-ETT**


*modified from www.das.co.uk*

# RSI CHECKLIST

**SET UP**

| | |
|---|---|
| Monitoring - BP, ECG, SpO2, ETCO2 | CHECK |
| Nasal Cannulae at 15l/min PLUS Mask O2 | CHECK |
| Pre-oxygenation for FOUR minutes | CHECK |
| Suction checked working & available | CHECK |
| Position optimised (inc RAMPING) | CHECK |

**IV & DRUGS**

| | |
|---|---|
| IV Cannula connected to fluid & running X2 | CHECK |
| NIBP on contralateral arm and BP seen | CHECK |
| INDUCTION AGENT drawn up, dose correct | CHECK |
| SUX or ROC drawn up, dose correct | CHECK |
| VASOPRESSORS drawn up, labelled | CHECK |
| POST INTUBATION drugs ready & labelled | CHECK |

**INTUBATION EQUIPMENT**

| | |
|---|---|
| BVM WITH PEEP connected to oxygen | CHECK |
| Guedel airways & two NPO airways ready | CHECK |
| Laryngoscope blade chosen, light working | CHECK |
| ET tube sizes chosen, cuff tested | CHECK |
| Bougie available | CHECK |
| Filter, inline ETCO2 (or EasyCap), tube tie | CHECK |
| Post RSI sedation & vent settings determined | CHECK |

**TEAM BRIEF**

| | |
|---|---|
| Roles assigned | CHECK |
| Difficult airway plans A/B/C/D discussed | CHECK |

# DELAYED SEQUENCE INTUBATION

**PRE-OXYGENATION**

- reverse Trendelenburg ro RAMP ear-to-sternum
- nasal cannulae sited under mask, separate O2 supply
- non-rebreather mask at 15l/min or
- if SpO2<90%, use CPAP via Oxylog/Boussignac
- if assisted ventilation reqd, use BMV with PEEP valve
- if agitated, judicious aliquot of ketamine
- titrate PEEP according to SpO2 & haemodynamics

**APNOEIC PERIOD**

- push induction & paralytic (ketamine + rocuronium)
- remove face mask, turn nasal cannulae to >15 lpm
- jaw thrust to maintain pharyngeal patency

NB for high risk patients requiring CPAP for pre-ox, consider leaving on the CPAP or GENTLE BMV with PEEP. Use a two handed technique to maintain PEEP

**INTUBATION PERIOD**

Leave nasal cannulae on throughout the intubation period to deliver apnoeic diffusion oxygenation (NODESAT)

FIRST PASS SUCCESS - USE BOUGIE, AIRWAY PLAN

# Delayed Sequence Intubation (DSI) Guidelines = Optimise the hypoxic agitated patient pre RSI

**AIM:** **To optimise the patient prior to intubation particularly in the face of hypoxia and / or agitation**

**Position**
- Semi-recumbent 20$^{O}$ head up (higher if more comfortable for pre oxygenation phase)
- Ramp patient's head, ear to sternal notch

**Nasal cannula & non-rebreather**
- Nasal cannula 10 liters per minute (off O2 cylinder)
- Well fitted NRBM maximal flow

**Consider Ketamine for agitation**
- First dose according to pt condition, try 0.3mg/kg titrate up to 1mg / kg slow IV push
- If indicated consider gastric decompression (NG tube)

**Consider CPAP for hypoxia**
- Use CPAP if sats <95%, aiming for >95%
- Titrate PEEP 5-15cm $H_2O$ depending on haemodynamics and oxygenation
- or BVM with PEEP valve 5-15cm $H_2O$ – need 2 hand mask seal

**Wait**
- Allow 3 minutes breathing at tidal volume or 8 maximal breaths
- Can you optimise patient further preintubation – consider other pretreatment drugs, need for fluids or blood, and need for inotropes and vasopressors

**Induction**
- Does the patient still need intubation?
- Give sedative-hypnotic and paralysis

**Apnoeic Oxygenation**
- Jaw thrust to maintain pharyngeal patency
- Nasal cannula flow to 15 l / min
- If needed CPAP or BVM with PEEP valve, consider leaving on until paralysed (≈45 secs)

**Intubate**
- Leave nasal cannula on throughout airway management period

## NOTES

- Always use your clinical judgment
- No single "recipe" fits everyone
- All patients should be optimally prepared pre-intubation
- Consider contraindications to the various elements of DSI including:
  - cardiac and respiratory arrest
  - spinal trauma
  - facial trauma
  - severe head injury
- Consider possible complications including:
  - CPAP - aspiration and gastric distension
  - Ketamine – may cause raised ICP, laryngospasm


**References**

1. Weingart SD. Preoxygenation, reoxygenation, and delayed sequence intubation in the emergency department. J. Emerg. Med. 2011 40;6;661-667
2. Kunzler, M. Protocol Name: Delayed Sequence Intubation Respiratory Therapy Urban Central Region Protocol. http://prehospitalandretrievalmedicine.files.wordpress.com/2012/06delayed20sequence20intubation.20/formal20 protocol05b15d-1.pdf Sourced 26/03/2013


This is not intended to be a comprehensive guide and is not to replace clinical judgment


James Rippey 2013; review 2016


DELAYED SEQUENCE INTUBATION

# EMERGENCY SURGICAL AIRWAY

Although the 'can't intubate, cannot oxygenate' (CICO) scenario is much feared, the need to perform an Emergency Surgical Airway should be considered in cases where airway management is required.

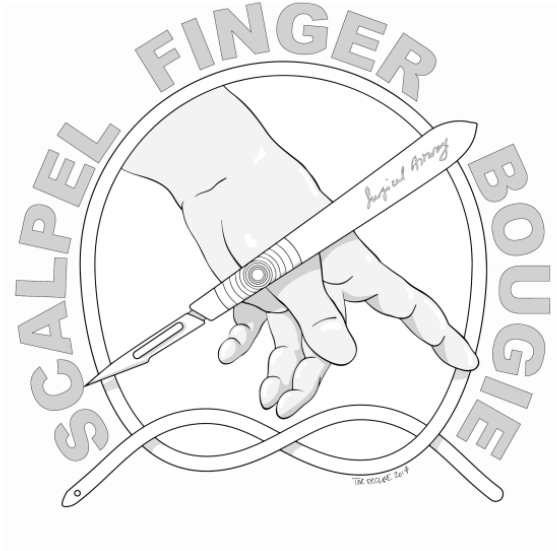
Identification of the cricothyroid membrane (CTM) and mental rehearsal of the indications (CICO) and required steps (scalpel-finger-bougie-tube) is easily practiced.

**The Laryngeal Handshake** (thanks to Rich Levitan)

- rest right (dominant) forearm on sternum
- rest left forearm on chin and identify broad prominence of the thyroid cartilage with thumb and middle finger…run index finger down to identify the CTM & keep finger there (or mark with indelible pen if performing prior to RSI)
- right hand now free to take size 20 scalpel and incise skin vertically over CTM
- once CTM localised, incise horizontally and place index finger of let hand (which has not moved) into the trachea
- the procedure is mostly tactile. Options now include either passage of a bougie into trachea over the highly left index fingertip OR passage of a size 6.0 cuffed ETT into trachea.

# SCALPEL-FINGER-BOUGIE-ETT

**Announce to team**
**“This is a CICO EMERGENCY”**
**Size 20 scalpel - Left Index Finger - Bougie**
**Size 6.0 cuffed ET tube**



# HYPOXIA

## Oxygen supply

**Check :**

- *Pressure gauges*
- *Flow meters*
- *FiO2*
- *Vaporizer housing*

## Anaesthetic machine

**Check Ventilator :**

- *VT*
- *Rate*
- *Airway Pressures*
- *Mode*

## Anaesthetic circuit

**Check Circuit :**

- *connections*
- *one-way valves*
- *filter*
- *soda lime*

## Patient Airway

**Check Airway :**

Exclude obstruction

- *in native airway*
- *in filter*
- *in airway devices*

Exclude secretions/plugging - pass suction catheter beyond end of ETT

## Ventilation of patient

**Ensure adequate ventilation:**

- *exclude bronchial intubation*
- *look/listen for bilateral AE*
- *assess adequacy of MV*
- *exclude bronchospasm*
- *recheck airway pressures*
- *exclude pneumothorax*

## Patient Lungs

**Consider Gas Exchange :**

- *aspiration*
- *pulmonary oedema*
- *consolidation*
- *atelectasis*

**Consider Embolism**

- *of thrombus, air or fat*

## Patient Circulation

**Circulation**

- *low cardiac output*

**Anaemia**

- *reduced O2 carriage*
- *high O2 extraction*
- *decreased mixed venous PO2*

## Patient Tissues

**Tissue Uptake of O2**

Increased metabolism

- *fever*
- *thyroid crisis*
- *etc*

# END-TIDAL CO2

## INCREASED ETCO2

**Inhaled / Exogeneous CO2**

Inhaled
*Check capnograph for return to baseline*

Exogeneous
*Laparoscopic CO2 insufflation*
*NaHCO3 administration*
*Inspired CO2 (soda lime exhausted)*
*Incompetent valves*
*Re-breathing*

**Hypoventilation**

*Respiratory depression*
*Increased mechanical load on lungs*
*(decreased compliance, increased resistance in system)*
*Inadequate IPPV - check TV/RR/PEEP*
*Increased dead space - anatomical/physiological*

**Increased Production of CO2**

*Fever*
*Parenteral nutrition*
*Malignant hyperthermia*

## DECREASED ETCO2

**Airway**

*Consider oesophageal intubation, accidental extubation*

**Circuit**

*Air entrainment (leak),*
*Dilution with circuit gases (sampling problem)*

**Ventilator**

*Ventilator settings,*
*Overenthusiastic bagging*

**Gas Exchange Problem**

*Pulmonary embolism,*
*Cardiac failure/arrest,*
*Severe hypotension*

**Decreased Production**

*Hypothermia*
*Hypothyroidism*
*Decreased metabolism*

# HIGH AIRWAY PRESSURES

## Gas supply

**Check Gas Supply:**

*- check O2 bypass*

*- ensure O2 flush not jammed*

*- eliminate other high pressure source*

## Anaesthetic circuit

**Check Circuit :**

*- bag / ventilator switch?*
*- obstruction to expiration in circuit/ventilator/scavenger system?*
*- PEEP valve & settings?*
*- exclude circuit & machine by ventilating with bag*

## Patient airway

**Exclude Obstruction :**

*- filter*

*- airway*

*- ETT*

*- secretions / foreign body*

## Patient lungs

**Bilateral chest expansion?**

*Endobronchial intubation, PTX*

**Breath sounds?**

*Bronchospasm, atelectasis, aspiration, pulmonary oedema, endobronchial intubation*

## Patient pleural space

**Consider and exclude :**

*- pneumothorax*
*- haemothorax*

*14G needle (2nd ICS MCL)*

*Finger or tube thoracostomy (ant axillary line 5th ICS)*

## Patient chest wall

**Exclude inadequate chest wall relaxation**

*- inadequate muscle relaxation*
*- opioid-induced rigidity*

*- malignant hyperthermia*

*- obesity*

## Surgical procedure

**Raised intrathoracic pressure**

*- surgical intervention*

*- insufflation*

*- patient position*

*- assistant leaning on chest !*

## HIGH AIRWAY PRESSURES

**Difficulty ventilating patient**
*decreased compliance in bag*
*poor chest expansion*
*reduced tidal volume*
*high airway pressure alarm*

**Hypoxia**
(due to hypoventilation)

**Circulatory collapse**
(high intrathoracic pressure)

**Tachycardia**

# VENTILATOR SET UP

The Oxylog 2000+ remains the workhorse in much of rural South Australia, allowing CPAP and IPPV with fixed FiO2 of 0.6 or 1.0 only. A few lucky centres have access to the Oxylog 3000 allowing true NIPPV with PEEp & pressure support plus variable FiO2 (thanks to George Douros for the Oxylog 3000 cheatsheets).

Expert advice is available from MedSTAR, but as with any equipment in the ED, all clinicians should be able to setup and operate the device initially.

Action cards can be useful to aid infrequent users, but early consultation and attention to the BASICS is recommended.

As a minimum, clinicians should be able to :

- switch the Oxylog on and select basic parameters
- be able to deliver CPAP
- be able to select appropriate IPPV settings for lung protective and obstructive ventilation strategies

*Ref : http://lifeinthefastlane.com/own-the-oxylog-3000/*

# OXYLOG 2000*plus*


**CPAP**
with air/O2 or
100% O2

**IPPV**

in either SIMV
or CMV modes

# OXYLOG - CPAP

Set up as per usual ie :TV/RR/Pmax/FiO2 - SELECT SpnCPAP mode. The following can additionally be set on the display for SpnCPAP / PS :

- Pressure support ΔPsupp above PEEP.
- Sensitivity Trigger for synchronization with patient's spontaneous breathing efforts. Successful patient triggering is briefly indicated by an asterisk (*) in the middle of status alarm messages
- Apnoea back-up (reverts to VC-CMV if apnoea)

Setting alarm for apnoea ventilation

1. Press the Settings key until page 2/3 appears.
2. Set Tapn with the rotary knob to a value between 15 and 60 sec.
3. Set RRapn and VTapn.
4. Set Pmax.This determines the maximum airway pressure allowed during !apnea ventilation.
5. Set Tapn to OFF (see setting apnea ventilation above) To end apnea ventilation
6. Press the Alarm Reset key.

The ventilation time ratio I:E = 1:1.5 and the plateau time Tplat % = 0 are preset during apnea ventilation.

Sit patient up & typically start CPAP with FiO2 1.0 (can titrate down) and a PEEP of 5 (**NB NOT IN ASTHMA**) Best to hold mask on facec (with reassurance from assistant) or five mins to ensure patient compliance, before securing mask with harness. Draw ABGs (or site arterial line) and reassess patient and ABG regularly. If tiring, consider **"do I need to intubate?".** If combative, experienced operators may consider sedation & delayed sequence intubation.

# OXYLOG - IPPV

## VC-CMV MODE FOR APNOEIC PATIENT
**(eg: paralysed or central apnoea)**

### TYPICAL ADULT SETTINGS

Set TIDAL VOLUME (typically 5-7 ml/kg)
Set RESPIRATORY RATE eg: 12
Set Pmax eg : 50 cmH2O
Set FiO2 (air/O2 mix ~ 40% or 100% O2)
Will start in VC-CMV mode (check is selected)

Select TRIGGER MODE - typically OFF for paralysed patient. If patient can make some resp effort, select a trigger value of 3-15 l/min to enable VC-AC mode

Select PEEP VALUE 5-10 cm H2O (default 5 cm H2O)
Select I:E ratio (range 1:4 to 3:1)
Select Tplat

Once ventilating, re-assess Pmax (Paw window) & reduce as appropriate, as well as TV & RR etc

Adjust ALARM parameters as appropriate

**IF PATIENT IS ABLE TO BREATH, ALBEIT IRREGULARLY, SWITCH TO VC-SIMV MODE**

# OXYLOG - IPPV

## VC-SIMV mode for patients with spontaneous respiration

Fixed minute volume MV is set with tidal volume VT & ventilation & respiratory rate. The patient can breathe spontaneously between the mandatory breaths and thus contribute to the total minute volume. Spontaneous breathing can be assisted with pressure support (PS)

**Set ventilation pattern with dials beneath display**

Tidal volume - VT
Respiratory Rate - RR.
Maximum airway pressure - Pmax.
O2 setting - FiO2.
Inspiration time - Ti.
Plateau time - Tplat % (in % of the inspiration time)
Positive end expiratory pressure - PEEP
Sensitivity Trigger.

**Pressure support (optional) VC-PS**

Setting on page 1: PS ΔPsupp above PEEP
Setting on page 2: Pressure rise time slope

# TROUBLESHOOTING

**Typical problems on CPAP**

- poor mask seal (adjust mask, tighten)
- poor compliance (may respond to reassurance, but beware patient hypercarbia and fatigue)
- insufficient PEEP. Start at 5 & titrate to max 20
- failure to reassess : patient response, ABG
- if difficulty, seek EXPERT HELP 13-STAR

**Typical problems on IPPV (intubated patient)**

- failure to switch from VC-CMV to VC-SIMV mode if patient makes own resp effort
- failure to adopt a lung protective strategy (TV 4-8 ml/kg IBW) with target plateau pressure <30cmH2O
- failure to troubleshoot hypoxia, rise or fall in ETCO2 or high airway pressures (**see action cards under AIRWAY**).
- Have low threshold to DISCONNECT VENT & troubleshoot from BMV-ETT-trachea-lung
- DOPE (inadvertent **d**isconnect, **o**bstruction in tube/trachea, **p**neumothorax, **e**quipment failure, **s**tacking). Beware the asthmatic!

# NIPPV & ASTHMA

These cases are challenging. Assume a standardised approach (salbutamol, ipratropium, steroids, Mg, adrenaline) & exclusion of pneumothorax etc

Non-invasive ventilation is best achieved with BiPAP which may be difficult using many ventilators in rural SA. The trick will be to avoid excessive PEEP, breath stacking and tolerate hypercarbia. NIPPV may offer :

- pre-oxygenation and ventilatory support whilst preparing for intubation
- avoidance of intubation (improved gas exchange and avoidance of fatigue)
- improved rate of recovery and limit drug side-effects (eg continuous nebs)
- use of ketamine as a delayed sequence intubation approach in experienced hands

**Typical initial BiPAP settings :**

- PEEP at 3-5 cmH20 (low)
- iPAP at 7-15 cmH20, adjust to target RR<25/min
- high inspiratory flow rate, low I:E ratio (e.g. 1:5) and prolonged expiratory time

# ASTHMA CRISIS

## STEP ONE

Continuous nebulised salbutamol
Neubulised ipratropium bromide
Hydrocortisone 200mg IV (4ml/kg kidsMgSO4 2g
(50mg/kg max 2g) IV slow push

## STEP TWO

Adrenaline 0.5mg IM (0.01mg/kg) = 0.5ml 1:1000
FLUID BOLUS 20ml/kg
CXR-ECG-VBG-iSTAT
Differentials? PTX, FB, ANAPHYLAXIS, PE etc

## COOPERATIVE

NIPPV iPAP 8 ePAP 0-3
continue nebuliser

if worsening
try ketamine 1.5mg/kg
IV over 30 secs
then
1mg/kg titrate to effect
if NO IV use 5mg/kg IM

## AGITATED

ketamine 1.5mg/kg IV
over 30 secs then
1mg/kg titrate to effect
if NO IV use 5mg/kg IM

if worsening
NIPPV
iPAP 8 ePAP 0-3
continue nebuliser

**AVOID INTUBATION IF POSSIBLE**

# GUIDE FOR INITIAL SETTINGS FOR **VOLUME CONTROLLED** VENTILATION FOR DRAEGER OXYLOG 3000 PLUS

Assumes patient is apnoeic from sedation & nursed at 30° to minimise aspiration

| | **LUNG PROTECTIVE STRATEGY** (all other patients >1yo if cuffed tube) | **OBSTRUCTIVE STRATEGY** (asthma/COPD if cuffed tube >1yo) |
|---|---|---|
| **Mode** | SIMV *(default)* | SIMV *(default)* |
| **VT** | 6ml/kg **ideal** body weight- **see chart** | 6ml/kg **ideal** body weight- **see chart** |
| **RR** | **16-18** breaths/min then titrate to normal $pCO_2$/pH | **6-8** breaths/min then examine **EXPIRATORY FLOW CURVES**. If breath stacking, ↓ RR (min: 4 breaths/min) **-permissive hypercapnoea** (pH> 7.1) |
| **Pmax***(alarm)* | ≥40 *(if alarms, follow instructions below)* | ≥40 *(if alarms, follow instructions below)* |
| **$FiO_2$** | titrate using $FiO_2$/PEEP scale→**$SpO_2$ of 88-95%** | minimal $FiO_2$ for **$SpO_2$ 88-95%** |
| **PEEP** | **$FiO_2$** 40 40 50 50 60 70 70 70 80 90 / **PEEP** 5 8 8 10 10 10 12 14 14 14 | **0** |
| **I:E** | 1:1.5 *(default)* | **≥1:4** |
| **AutoFlow: ON** | **Slope:** ⌐ *(default)* | **Slope:** ⌐ **(ie: fast inspiratory flow rate)** |
| **Other** | • if high PEEP results in ↓↓BP, give fluids & inotropes keeping MAP>65 (for paediatric values, check chart)<br>• if $P_{max}$ alarms, check for patient agitation/ tube obstruction. If not the cause, perform **INSPIRATORY HOLD MANOEUVRE** - if Pplat >30 ↓TV by 1ml/kg steps (min 4ml/kg) | • **sedate ++++**, avoid ongoing paralysis<br>• if ↓↓↓BP + difficult to ventilate, **disconnect** tube & allow to expire stacked breaths<br>• if $P_{max}$ alarms, check for patient agitation/ tube obstruction. If not the cause, perform **INSPIRATORY HOLD MANOEUVRE**- If Pplat >30 ↓TV by 1ml/kg steps (min 4ml/kg) |

Further modifications depends on **hourly ABGs and haemodynamics**

| | **5'0" 153cm** | **5'2" 156cm** | **5'4" 163cm** | **5'6" 168cm** | **5'8" 173cm** | **5'10" 178cm** | **6' 183cm** | **6'2" 188cm** | **6'4"/ 193cm** |
|---|---|---|---|---|---|---|---|---|---|
| **VT women (6ml/kg IBW)** | 276 | 295 | 330 | 360 | 385 | 415 | 440 | 470 | 490 |
| **VT men (6ml/kg IBW)** | 305 | 320 | 360 | 385 | 415 | 440 | 470 | 490 | 520 |

Other patients (i.e. modifications from **LUNG PROCTECTIVE STRATEGY**)

- **HEAD INJURY:** too much PEEP can ↓BP and thus ↓ cerebral perfusion pressure. PEEP=5*(default)* is OK. 30° head up. Aim for low-normal $CO_2$
- **METABOLIC ACIDOSIS:** RR ≥ patient achieved, $ETCO_2$ ≤ patient achieved. Lighten sedation to allow patient to add additional breaths as required -add pressure support (**Δsupp=10, Trigger=2**) to these breaths as patient tired.
- **HYPERTENSIVE APO:** start PEEP=10 and rapidly titrate up while rapidly titrating IV GTN for SBP≤140.
- **CARDIOGENIC SHOCK:** avoid high-level PEEP as can ↓BP .
- **PREGNANCY:** left lateral position. **TV: 8ml/kg** ideal body weight, **RR 18-20bpm** aim for low/normal $pCO_2$&normal pH.

If patient is crashing….

- **Take the ventilator out of the equation-bag the patient to feel how they are to ventilate**
- Check the **tube**- displaced/ dislodged/ obstructed
- Check the **patient**- pneumothorax -bedside US/CXR and needle/finger thoracostomy
- Check the **ventilator**

# GUIDE FOR INITIAL SETTINGS FOR **PRESSURE CONTROLLED** VENTILATION FOR DRAEGER OXYLOG 3000 PLUS

Assumes patient is apnoeic from sedation & nursed at 30° to minimise aspiration.

**Recommended for all UNCUFFED tubes**

| | **LUNG PROTECTIVE STRATEGY (all other patients)** | **OBSTRUCTIVE STRATEGY (bronchiolitis/asthma)** |
|---|---|---|
| **Mode** | **PC SIMV+** | **PC SIMV+** |
| **VT** | *can't be set in PC mode- see Pinsp* | *can't be set in PC mode- see Pinsp* |
| **RR** | **see chart**- then titrate to normal $pCO_2$/pH | **(1/3 normal RR)- see chart** then examine **EXPIRATORY FLOW CURVES**- if breath stacking, ↓ ↓ RR by further 20% **-permissive hypercapnoea** (pH> 7.1) |
| **Pmax***(alarm)* | ≥40 *(if alarms, follow instructions below)* | ≥40 *(if alarms, follow instructions below)* |
| **$FiO_2$** | titrate using $FiO_2$/PEEP scale→**$SpO_2$ of 88-95%**<br>$FiO_2$ 40 40 50 50 60 70 70 70 80 90<br>PEEP 5 8 8 10 10 10 12 14 14 14 | minimal $FiO_2$ for **$SpO_2$ 88-95%** |
| **PEEP** | **5** *(default)* | **5** *(default)* |
| **Pinsp** | **start at 20 then titrate to VT (6ml/kg IBW)- see chart** | **start at 20 then titrate to VT (6ml/kg IBW)- see chart** |
| **I:E** | 1:1.5 *(default)* | **≥1:4** |
| **Slope** | ⟋ *(default)* | ⌐ **(ie: fast inspiratory flow rate)** |
| **Other** | • if high PEEP results in ↓BP, give fluids & inotropes keeping SBP as per chart<br>• if $P_{max}$ alarms, check for patient agitation/ tube obstruction. if not the cause, perform **INSPIRATORY HOLD MANOEUVRE**- if Pplat >30 ↓TV by 1ml/kg steps (min 4ml/kg) | • **sedate** ++++, avoid ongoing paralysis<br>• if ↓↓BP + difficult to ventilate, **disconnect** tube & allow to expire stacked breaths<br>• if $P_{max}$ alarms, check for patient agitation/ tube obstruction. if not the cause, perform **INSPIRATORY HOLD MANOEUVRE**- if Pplat >30 ↓TV by 1ml/kg steps (min 4ml/kg) |

Further modifications depends on **hourly ABGs and haemodynamics**

| **Age/ IBW** | **RR (obstructive RR)** | **VT (6ml/kg)** | **Systolic BP** |
|---|---|---|---|
| **Term/ 3.5kg** | 40-60 (13-20) | 20ml | ≥ 50 |
| **3 months/ 6kg** | 30-50 (10-16) | 36ml | ≥ 50 |
| **6 months/ 8kg** | 30-50 (10-16) | 48ml | ≥ 60 |
| **1 year/ 10kg** | 30-40 (10-13) | 60ml | ≥ 65 |
| **2 years/ 13kg** | 20-30 (7-9) | 78ml | ≥ 65 |
| **4 years/ 15kg** | 20 (7) | 90ml | ≥ 70 |
| **6 years/ 20kg** | 16 (6) | 120ml | ≥ 75 |
| **8 years/ 25kg** | 16 (6) | 150ml | ≥ 80 |
| **10 years/ 30kg** | 16 (6) | 180ml | ≥ 85 |
| **12 years/ 40kg** | 16 (6) | 240ml | ≥ 90 |
| **14 years/ 50kg** | 16 (6) | 300ml | ≥ 90 |
| **17 years +/ 70kg** | 16 (6) | 420ml | ≥ 90 |

Other patients (i.e. modifications from **LUNG PROCTECTIVE STRATEGY**)

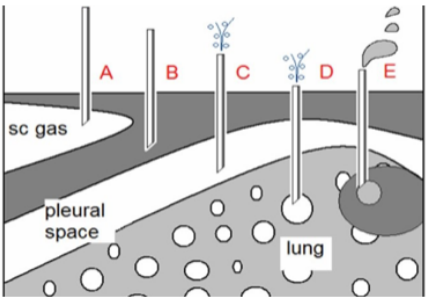
- **HEAD INJURY:** too much PEEP can ↓BP and thus ↓ cerebral perfusion pressure. PEEP=5*(default)* is OK. 30° head up. Aim for low-normal $CO_2$
- **METABOLIC ACIDOSIS:** RR > patient achieved, $ETCO_2$ ≤ patient achieved. Lighten sedation to allow patient to add additional breaths as required -add pressure support (**dsupp=10**, **Trigger=2**) to these breaths as patient tired.

If patient is crashing….

- **Take the ventilator out of the equation-bag the patient to feel how they are to ventilate**
- Check the **tube**- displaced/ dislodged/ obstructed
- Check the **patient**- pneumothorax -bedside US/CXR and needle/finger thoracostomy
- Check the **ventilator**

# TENSION PNEUMOTHORAX

Suspect clinically (eg: mechanism of injury, sudden desaturation in IPPV) and confirm clinically. Auscultation can be difficult at roadside or in busy resus. Percussion note may be asymmetrical, raising possibility of wither HTX (dull) or PTX (resonant). Tracheal deviation is a late sign. Hypotension may be only clue. Standard ATLS-EMST teaches needle decompression in the fifth intercostal space, mid-clavicular line. Be aware that many cannulas will not reach the pleura. An alternative is 5th ICS, anterior axillary line or to proceed direct to FINGER thoracostomy in ventilated patients. This has advantage of confirming entry to pleural space & chest can be 're-fingered' if PTX recurs.




**1.11A** Needle tip positions in chest decompression. Used with permission from A/ Prof Mark Fitzgerald

**Problems of needle decompression in 5th ICS MCL**

# CHEST DRAIN

For confirmed or suspected HAEMO-PNEUMOTHORAX

USS > CXR for PTX, particularly in supine patient

- Identify site - typically 5th ICS, anterior mid axillary line
- Prep & Drape (aseptic - gown, gloves, hat, mask)
- Infiltrate with local anaesthetic to pleura
- Incise skin ABOVE rib (avoid neurovascular bundle) and blunt dissect perpendicular to skin using Spencer Wells until enter pleural space. Finger sweep to ensure no adhesions
- Place drain - typically 28Fr. Look for swinging and bubbling in drain (portex drain with Heimlich valve)
- Suture in place with 2/0 silk
- Ensure tube secure with sleek and connections firm (but not obscured by tape)
- Confirm placement with CXR

# RESUSCITATION

| | |
|---|---|
| **Adrenaline 1:1000**<br>**1mg / ml** | Take 1 amp (1ml)<br>Dilute to vol 10ml N/S<br>= 100mcg/ml |
| **Adrenaline 1:10,000**<br>**1mg / 10ml** | 10 mcg/kg IV stat in resus |
| **Atropine 600 mcg** | Dilute 600 mcg / 6mls N/S<br>= 100 mcg/ml<br>Typically 20 mcg/kg IV stat |
| **Sodium Bicarbonate** | 8.4% ( 1 mmol / ml)<br>1 - 2 mmol / kg<br>= 1 - 2 ml / kg slow IV |
| **Glucose 50%** | 1 ml / kg IV stat |
| **Naloxone** | 400 mcg per ampoule<br>0.1 mg/kg |
| **Defibrillation** | 2 J/kg initially, then<br>4 J/kg thereafter<br>(round to nearest 10) |
| **Cardioversion** | 1 J/kg initially, then<br>2 J/kg thereafter<br>(round to nearest 10 |

# PAEDIATRIC RESUSCITATION

## WET FLAG

| | | |
|---|---|---|
| **WEIGHT (kg)** | < 1 yrs | 0.5 x age (mos) + 4 |
| | 1 - 5 yrs | (2 x age yrs) + 8 |
| | > 5 yrs | (3 x age yrs) + 7 |
| **ENERGY** | 2 J/kg initial shock then 4 J/kg | |
| **TUBE** | Diameter | (age yrs/4) + 4 |
| | Length | (age yrs/2) + 12 |
| **FLUIDS** | 20 mls / kg for medical emergency<br>10 mls / kg for trauma | |
| **LORAZEPAM** | 0.1 ml / kg | |
| **ADRENALINE** | IV dose | 0.1 ml/kg 1:10,000<br>0.01 ml/kg 1:1000 |
| **GLUCOSE** | 10% | 2 ml/kg |

# MAJOR HAEMORRHAGE

**GET ACCESS to the CIRCULATION**
Two wide bore IVs
IO or Cutdown or Rapid Infuser Catheter

**TREAMENT PARAMETERS**
Permissive hypotension MAP 65-70 may be acceptable (unless TBI/spinal/exsanguination)
t > 35, pH . 7.2, Lactate < 4, BE < -6
**Measure VBG (lactate), COAGS, Urine Output**

**FIND THE BLEEDING, STOP THE BLEEDING**
**Minimise time to surgery**
**Call RETRIEVAL EARLY**
**Tourniquet/Aortocaval compression** (fist/knee)
**Control bleed** (pressure, Foley, RapidRhino)
**Splint to skin - long bones & pelvis**
**TXA 1g** load if < 3hr post injury
**WARM FLUIDS, WARM ROOM**
**Early use of BLOOD, PROTHROMBINEX**

**if PPH - uterine massage, oxytocin infusion, ergometrine, misoprostol, TXA, Bakri, B-lynch**

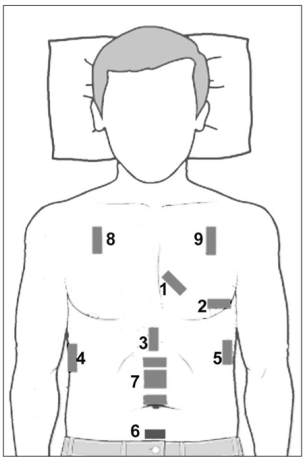
**Arterial Line. Consider Ca++ (citrate toxicity)**
**ALWAYS CATHETERISE THE BLADDER**

# RUSH PROTOCOL

The **R**apid **U**ltrasound for **S**hock & **H**ypotension exam can be useful. It is looking specifically at :

- the PUMP (cardiac evaluation)
- the TANK (volume status)
- the PIPES (vascular system)

*Further reading* : "Intro to Bedside Ultrasound" *on iBooks*




1. Parasternal long cardiac
2. Apical 4-chamber view
3. IVC
4. Morrisons + HTX view
5. Splenorenal + HTX view
6. Bladder view (PoD)
7. Aorta slide views
8. Lung views

Curvilinear array 1-7
High frequency array 8,9

**PNEUMOTHORAX Ax**
*Look for lung sliding, "waves on beach", comet tails (no PTX) vs "barcode" or lung point (PTX)*

**OVERFILLING (APO) Ax**
*Look for B lines/lung rockets*

# INTEROSSEOUS ACCESS

EZ-IO drill preferred to Bone Injection Gun

Use either 1st line (resus, paeds burns, extrication with limited access) or after 2 failed attempts at IV

Access sites include :

HEAD OF HUMERUS
PROXIMAL TIBIA
DISTAL TIBIA
ILIAC CREST

Push into skin (do not activate drill) at 90 to surface
The tip of needle should rest on bone with ~ 5mm of needle visible outside skin
DRILL WITH PRESSURE- a slight 'POP' is felt

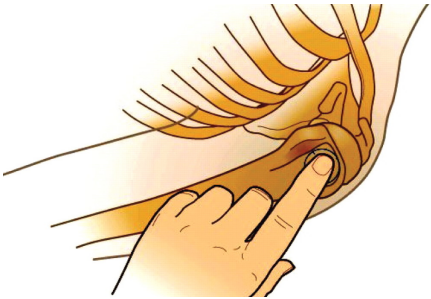
Aspirate blood (can use in iStat)
Most pain is from FLUID BOLUS not insertion

The IO is useful for administration of drugs eg: ketamine or fentanyl to facilitate extrication, RSI etc

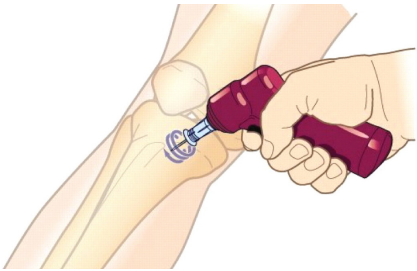
Inotropes can be run through an IO (central access)

Pressure (eg three-way tap) is required for fluid bolus

# INTEROSSEOUS SITES



Proximal humerus (identify humeral head)



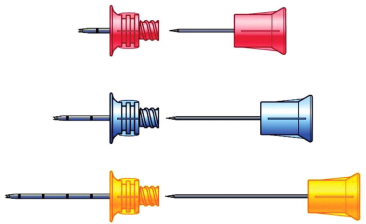
Proximal tibia (identify tibial plateau)

# EZ-IO NEEDLE

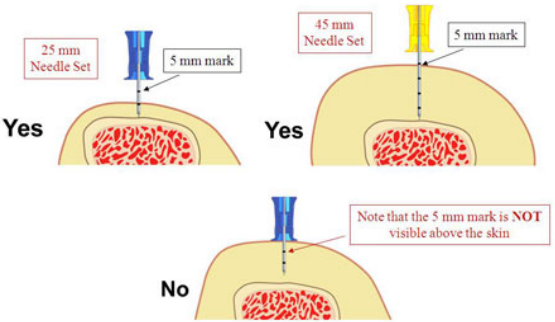
*paediatric tibia*

*adult tibia*

*adult humerus*



**OBSERVE DEPTH MARK before enter BONE**



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| **ADRENALINE** | IV dose | 0.1 ml/kg 1:10,000<br>0.01 ml/kg 1:1000 |
| **GLUCOSE** | 10% | 2 ml/kg |

# PAEDIATRIC ANAESTHESIA

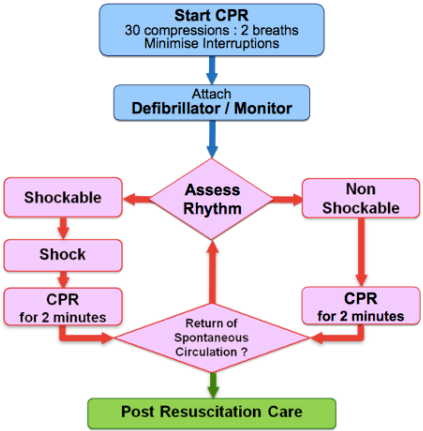
**1 ml = dose per 10 kg (ie: 30kg child, give 3 ml of)**

| DRUG | PREP | CONCN | 1 ml/10kg equivalent | DOSE RANGE |
|---|---|---|---|---|
| Thiopentone | 500mg | 500mg into 20ml **25 mg/ml** | 2.5 mg/kg | 1-5 mg/kg |
| Sux | 100mg in 2ml | 100mg in 10ml **10 mg/ml** | 1 mg/kg | 1-2 mg/kg |
| Rocuronium | 50mg/5ml | Neat **10mg/ml** | 1 mg/kg | 0.75 to 1.5 mg/kg |
| Midazolam | 15mg/3ml | 15mg in 10ml **1.5 mg/ml** | 150 mcg/kg | 50-150 mcg/kg |
| Fentanyl | 100 mcg in 2ml | 100 mcg / 10ml **10 mcg/ml** | 1 mcg/kg | 1 mcg/kg at induction |
| Atropine | 600 mcg in 1 ml | 600 mcg into 3ml **200 mcg/ml** | 20 mcg/kg | 20 mcg/kg |
| Adrenaline | 1 mg/ml | 1 mg into 10ml **100 mcg/ml** | 10 mcg/kg | 10 mcg/kg bolus |
| Morphine | 10mg/ml | 10 mg into 10ml **1 mg/ml** | 100 mcg/kg | 50-100 mcg/kg |
| Ketamine | 200mg in 2ml | 200mg in 20ml **10 mg/ml** | 10 mg/ml | 1-2 mg/kg |
| Vecuronium | 10mg | 10mg into 10ml `mg/kg | 100 mcg/kg | 100 mcg/ kg |

New Zealand Resuscitation Council

# Advanced Life Support for Adults

Australian Resuscitation Council




**During CPR**
Airway adjuncts (LMA / ETT)
Oxygen
Waveform capnography
IV / IO access
Plan actions before interrupting compressions
(e.g. charge manual defibrillator)
Drugs
Shockable
* Adrenaline 1 mg after 2nd shock
(then every 2nd loop)
* Amiodarone 300 mg after 3rd shock
Non Shockable
* Adrenaline 1 mg immediately
(then every 2nd loop)

**Consider and Correct**
Hypoxia
Hypovolaemia
Hyper / hypokalaemia / metabolic disorders
Hypothermia / hyperthermia
Tension pneumothorax
Tamponade
Toxins
Thrombosis (pulmonary / coronary)

**Post Resuscitation Care**
Re-evaluate ABCDE
12 lead ECG
Treat precipitating causes
Re-evaluate oxygenation and ventilation
Temperature control (cool)

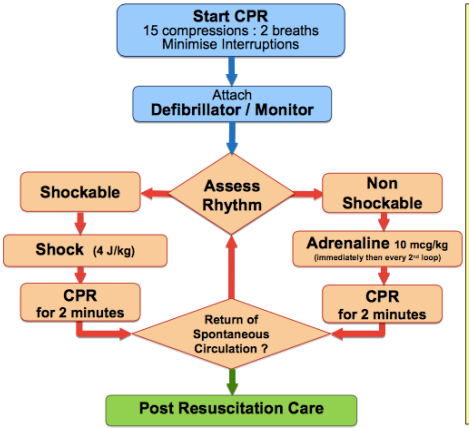
December 2010

ADULT ARREST

New Zealand Resuscitation Council

# Advanced Life Support for Infants and Children

Australian Resuscitation Council




**During CPR**
Airway adjuncts (LMA / ETT)
Oxygen
Waveform capnography
IV / IO access
Plan actions before interrupting compressions
(e.g. charge manual defibrillator to 4 J/kg)
Drugs
Shockable
* Adrenaline 10 mcg/kg after 2nd shock
(then every 2nd loop)
* Amiodarone 5mg/kg after 3rd shock
Non Shockable
* Adrenaline 10 mcg/kg immediately
(then every 2nd loop)

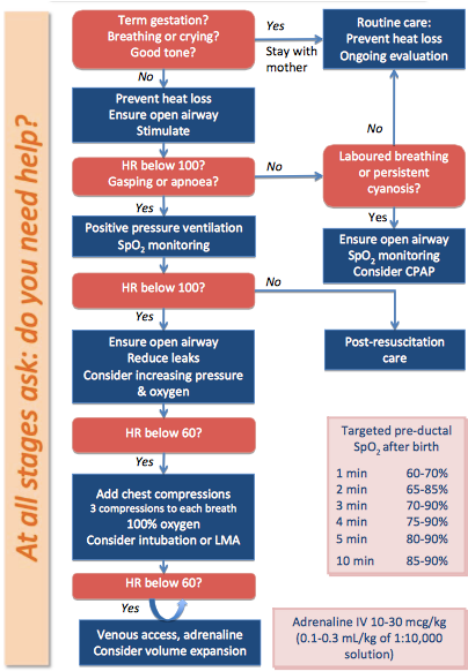
**Consider and Correct**
Hypoxia
Hypovolaemia
Hyper / hypokalaemia / metabolic disorders
Hypothermia / hyperthermia
Tension pneumothorax
Tamponade
Toxins
Thrombosis (pulmonary / coronary)

**Post Resuscitation Care**
Re-evaluate ABCDE
12 lead ECG
Treat precipitating causes
Re-evaluate oxygenation and ventilation
Temperature control (cool)

December 2010

PAEDIATRIC ARREST

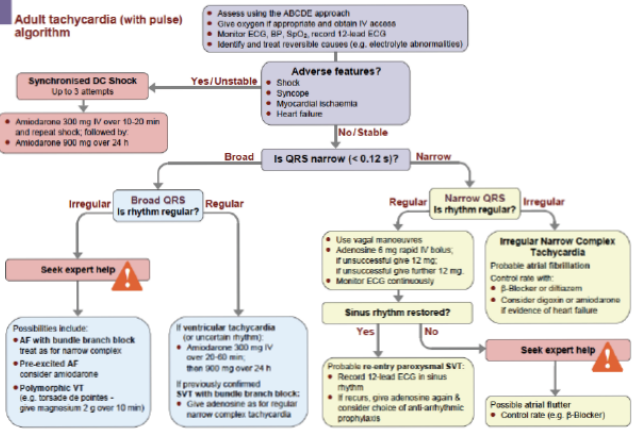
# NEONATAL RESUS



2010 Resuscitation Guidelines

Resuscitation Council (UK)

## Adult tachycardia (with pulse) algorithm



# TACHYCARDIA

**MEDICATIONS - seek expert help if uncertain**

**AMIODARONE - 300 mg IV over 10-20 mins then infusion of 900 mg over 24 hrs (see below)**

| Syringe Driver - Amiodarone 600mg / 50ml (12 mg/ml) | | | |
|---|---|---|---|
| Use AMIODARONE 300 mg in 3 ml ampules. Dilute 600 mg (4 x 3 ml = 12 ml) up to 50 ml with 5% Dextrose NOT NORMAL SALINE. In an emergency can give 150-300 mg over 1-2 minutes, otherwise commence with a loading dose of 5 mg/kg over 20 minutes, then follow with infusion of 0.4-0.7 mg/kg/hr over 24 hrs | | | |
| 50 ml syringe | 70kg ADULT | DOSE RANGE | RATE OF INFUSION (Syringe Driver) |
| | Loading Dose | 350 mg (29 ml) | 87 ml/hr for 20 mins only |
| | Maintenance | 28 - 50 mg/hr | 2.3 - 4.2 ml/hr |

**ADENOSINE :** 6 mg - 12 mg - 18 mg via fast IV & flush

**METOPROLOL :** 5mg aliquots IV

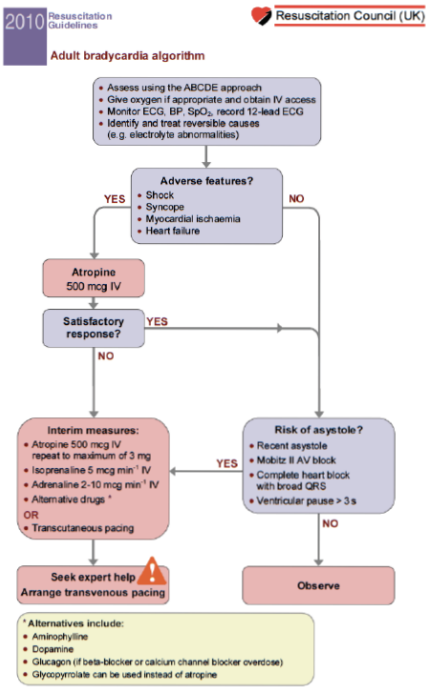
**ESMOLOL** : at a dose of 0.5mg/kg
100mg/ml dilute in 10ml = 10mg/ml
100kg = 50mg = 5ml

**DIGOXIN :** load 125mcg - 500mcg as appropriate

**DILTIAZEM :** 0.25 mg/kg IV for SVT

**MAGNESIUM :** 2g over 20 mins

# BRADYCARDIA



# PACING

Ensure valid indication (symptomatic bradycardia)

Consider ISOPRENALINE INFUSION
Ensure adequate SEDATION IF CONSCIOUS
(typically ketamine 30mg IV or small aliquots of fentanyl & midazolam)
ENSURE ACCESS TO AIRWAY TROLLEY

TO PACE

- Switch on defibrillator
- Place external pads
- Place either usu position or AP (L sternum, L spine)

- Select PACING MODE

- Rate of 80 bpm
- Start at 60 mAs, increase in 10mAs until capture
- Set final mAs at >10% above capture mAs

**Consider alternatives and adjuncts**

ie isoprenaline infusion
use of GLUCAGON if beta-blocker OD

**Seek EXPERT HELP 13-STAR (MedSTAR)**

# ISOPRENALINE INFUSION

| Syringe Driver<br>Isoprenaline 1 mg / 50 ml (20 mcg/ml) | | |
|---|---|---|
| Use Isoprenaline hydrochloride 1mg/5ml ampoules<br>Dilute 1 mg (5 ml) up to 50 ml with 5% Dextrose<br>Give 20 µg (1 ml), repeated to clinical response, followed by infusion at 1-4 µg/min (3 - 12 ml/hr) | | |
| 50 ml syringe | **DOSE RANGE** | **RATE OF INFUSION (Syringe Driver)** |
| | 1 mcg / min | 3 ml / hr |
| | 2 mcg / min | 6 ml / hr |
| | 4 mcg / min | 12 ml / hr |

1. Side effects include palpitations, headache, flushing, angina, nausea, vomiting, tremor, dizziness, weakness & sweating.

2. If HR exceeds 80 or patient develops chest pain or other arrhythmias decrease dose or temporarily discontinue infusion.

3. Administer with caution in the elderly, diabetic, hyperthyroid, patients with ischaemic heart disease or concurrently with other inotropes

**Required response usually achieved at doses of < 3 µg/min, though may increase up to 20 µg/min if necessary to obtain required response**

# ANAPHYLAXIS

**Use IM adrenaline in advance of IV dosing**

IM Adrenaline 1:1000 (1 mg / ml)
0.01 mg / kg to a maximum of 0.3 - 0.5 mg IM
[i.e. 0.01 ml / kg of 1:1000 adrenaline]

Can repeat 5 minutely if not better or worse

| AGE | DOSE ADRENALINE 1:1000 vial | VOLUME 1:1000/ml |
|---|---|---|
| Adult | 500 micrograms IM | 0.5 ml |
| >12 yrs | 500 micrograms IM | 0.5 ml |
| 6 -12 yrs | 300 micrograms IM | 0.3 ml |
| < 6 yrs | 150 micrograms IM | 0.15 ml |

Give normal saline 10-20ml/kg boluses for hypotension

Salbutamol nebs may help with ongoing bronchospasm.

Patients on beta-blockers who do not respond to adrenaline may benefit from glucagon IV (20 to 30 mcg/kg up to a maximum of 1 mg).

IV adrenaline may be given if there is no resolution despite multiple doses of IM adrenaline — experts vary in their recommendations of how to give this.

APLS guidelines suggest 0.1-5.0 micrograms/kg/min.

# ASTHMA IN ED

## STEP ONE

Continuous nebulised salbutamol
Neubulised ipratropium bromide
Hydrocortisone 200mg IV (4ml/kg kidsMgSO4 2g
(50mg/kg max 2g) IV slow push

## STEP TWO

Adrenaline 0.5mg IM (0.01mg/kg) = 0.5ml 1:1000
FLUID BOLUS 20ml/kg
CXR-ECG-VBG-iSTAT
Differentials? PTX, FB, ANAPHYLAXIS, PE etc

## COOPERATIVE

NIPPV iPAP 8 ePAP 0-3
continue nebuliser

if worsening
try ketamine 1.5mg/kg
IV over 30 secs
then
1mg/kg titrate to effect
if NO IV use 5mg/kg IM

## AGITATED

ketamine 1.5mg/kg IV
over 30 secs then
1mg/kg titrate to effect
if NO IV use 5mg/kg IM

if worsening
NIPPV
iPAP 8 ePAP 0-3
continue nebuliser

**AVOID INTUBATION IF POSSIBLE**

# PSYCHIATRIC SEDATION

Immediate de-escalation; calm, quiet commands
Call CODE BLACK if concerns
Ensure safety - yourself, team, patient
Baseline obs inc HR-BP-Temp-RR-BP-BGL-RASS
Dress in hospital gown; bag & secure clothes.
Check bag/clothes for potential weapons, drugs, notes
Collateral history from friends/family/police
Assess suicidality / homicidality
CONSIDER A NICOTINE PATCH
Psych sedation is procedural sedation - risk/benefit

| NO IV ACCESS | IV ACCESS |
|---|---|
| Olanzapine 10-20mg PO | Midazolam 2-5 mg IV titrate |
| Midazolam 10mg IM | Haloperidol 5 - 10 mg IV |
| Ketamine 4mg/kg IM | Ketamine 1 - 1.5 mg/kg IV |

*Repeat doses as necessary, target RASS score 0 to -3*

The risk of apnoea should be anticipated

**MANDATORY 1:1 NURSING**
**SUPPLEMENTAL OXYGEN AT ALL TIMES**
**ECG / NIBP / SpO2 MONITORING**
**ETCO2 if RECEIVED SEDATIVE**
**DISCUSS WITH DR re FREQUENCY OF OBS**

**EQUIPMENT TO MANAGE AIRWAY SHOULD BE IMMEDIATELY AVAILABLE**

| RICHMOND AGITATION SEDATION SCALE | | |
|---|---|---|
| **Term** | **Description** | **Score** |
| COMBATIVE | overtly combative, violent, immediate danger to self/others | +4 |
| VERY AGITATED | pulls or removes tube(s), catheter(s), aggressive | +3 |
| AGITATED | frequent non-purposeful movement, fights ventilator | +2 |
| RESTLESS | anxious but movements not aggressive or vigorous | +1 |
| ALERT & CALM | Doctor or Nurse | 0 |
| DROWSY | Not fully alert, but sustained awakening to voice (**eyes open > 10s**) | -1 |
| LIGHT SEDATION | briefly awakens with **eye contact to voice < 10s** | -2 |
| MODERATE SEDATION | movement or eye opening to voice **but no eye contact** | -3 |
| DEEP SEDATION | no response to voice, but **movement or eye opening to physical stimulation** | -4 |
| UNROUSABLE | **no response to voice or physical stimulation** | -5 |

**Procedure**

(i) observe patient - patient is alert, restless, agitated or combative (0 to +4)

(ii) If not alert, state patient's name and say to open eyes and look at speaker
*-1 if awakens with sustained eye contact to voice > 10s to voice*
*-2 if awakens with eye contact to voice < 10s*
*-3 if moves or opens eyes to voice but no eye contact*

(iii) If no response to voice, use physical stimulus (shoulder shake, trapezius squeeze, jaw thrust)
*-4 if any movement to physical stimulation*
*-5 if no response to physical stimulation*

**TARGET RASS is 0 to -3**

**AIRWAY EQUIPMENT and MONITORING must be available**

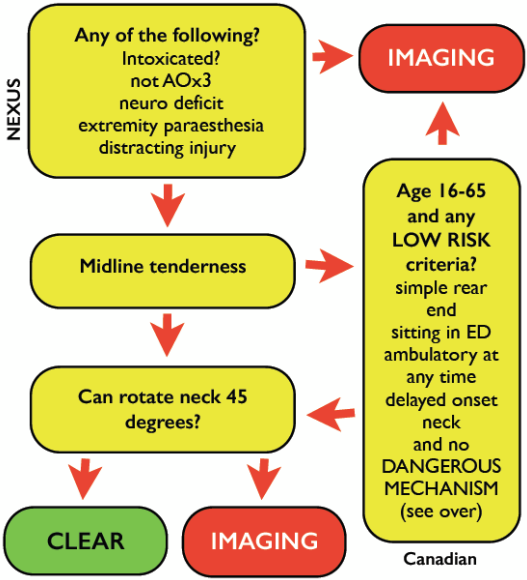
**1:1 NURSING, 10 minutely obs**

**LIAISE WITH RETRIEVAL SERVICE**

# RICHMOND AGITATION SEDATION SCALE

RASS

# C SPINE DECISIONS




Low threshold to immobilise (vac mat) & transfer
CAUTION with HARD COLLAR - risk pressure necrosis

# Canadian & Nexus Combi

Dangerous Mechanism: fall from >3 ft or 5 stairs, an axial load to head, high speed (>60 mph) MVC, Rollover or Ejection MVC, Recreational Vehicle Collision, or Bicycle Collision.

Painful Distracting Injury: Including, but not limited to long bone fracture, visceral injury requiring surgical consultation, large laceration, de-gloving injury, crush injury, large burns, or any injury causing acute functional impairment.

Midline Tenderness: in a 2cm band anywhere from the occiput to level of T1

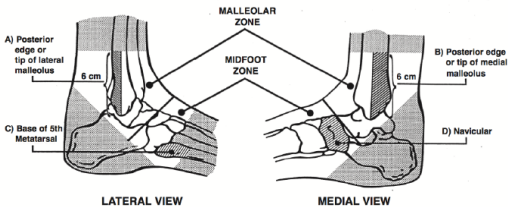
Simple rear-end collision does not include: being pushed into oncoming traffic, being hit by a bus or large truck, rollover, being hit by a high-speed vehicle

Neck rotation: able to rotate neck 45° regardless of pain

CCR vs. Nexus: NEJM 349:26, Dec 25, 2003. Nexus : Annals EM 1992;21:1454-60. CCR : JAMA 2001;286:1841

**Think one spinal injury? Think ANOTHER!**

# OTTOWA ANKLE & KNEE RULES




**a) An ankle x-ray series is only required if there is any pain in malleolar zone and any of these findings:**

1. bone tenderness at A OR
2. bone tenderness at B OR
3. inability to bear weight both immediately and in ED

**b) A foot x-ray series is only required if**
there is any pain in mid-foot zone and any of these findings:

1. bone tenderness at C OR
2. bone tenderness at D OR
3. inability to bear weight both immediately and in ED

## Knee X-ray indications after acute injury if :

- age 55 or over
- isolated tenderness of patella or head of fibula
- inability to flex 90 degrees
- inability to weight bear (two steps each leg) either immediately after injury or on presentation

http://www.racgp.org.au/afp/2012/april/the-ottawa-knee-rules/

# INFUSIONS

| | |
|---|---|
| **Adrenaline**<br>**1mg / 1 ml** | 3mg to volume 50 ml N/Saline<br>= *60 mcg per ml*<br>Infuse at 2 - 20 ml/hr (max 100) |
| **Amiodarone**<br>**150 mg / 3 ml** | 300mg to volume 50 ml N/Saline<br>= *6 mg per ml*<br>Bolus 50ml/hr over one hour |
| **GTN**<br>**50 mg / 10ml** | 25mg to volume 50ml 5% Dex<br>= *500 mcg per ml*<br>Infuse at 2ml/hr,<br>titrate up 1ml/hr every 5-10’ |
| **Heparin**<br>**5000 U/ml** | 25000 U to volume 50 ml N/Saline<br>= *500 U per ml*<br>Bolus 5000 U (10ml)<br>Infusion at 1000 U/hr (2ml/hr) |
| **Insulin**<br>**100 U amp** | 50 U to volume 50ml N/Saline<br>= *1 U per ml*<br>Titrate to BSL (0.05-0.3 U/kg/hr) |
| **Isoprenaline**<br>**1 mg / 5ml** | 1mg to volume 50 ml 5% Dex<br>= *20 mcg per ml*<br>Infuse 3 - 6 - 12 ml/hr as needed |

# INFUSIONS

| | |
|---|---|
| **Ketamine**<br>**200 mg / 2ml** | 200mg to volume 50 ml N/Saline<br>= *4 mg per ml*<br>1-2 mg/kg/hr (0.25-0.5 ml/kg/hr) |
| **MgSO4** | 1g MgSO4 = 4 mmol Mg++<br><br>PET - load 4g over 20 mins<br>PET - infuse at 1-3 g/hr<br><br>Arrhythmia - 5-10 mmol slow bolus<br>Arrhythmia - infuse at ½ -1g / hr |
| **Morph/Midaz**<br>**1 mg / ml** | 50mg each to volume 50 ml N/S<br>Load 2 - 10 ml : run 2 - 15 ml/hr |
| **Noradrenaline**<br>**4 mg / 4ml** | 3ml (3mg) to volume 50ml N/Saline<br>60 mcg per ml<br>Infusion at 2-20 ml/hr |
| **Propofol**<br>**Salbutamol**<br>**5 mg / 5ml** | Run at max 1mg/kg/h<br>3 mg to volume 50 ml N/Saline<br>= *60 mcg / ml*<br>1 - 20 ml / hr |
| **Syntocinon**<br>**10 U / ml** | Third stage - 10 IU IV or IM<br>Infuse 40 U in 40ml N/S at 10 ml /hr |

# ADRENALINE INFUSION

**1:1000 ADRENALINE**
**vial (1 mg / ml)**

**Add 3 mg (3 vials 1:1000)**
**to 50 mls N Saline (60 mcg/ml)**

**Run at 2 - 20 ml / hr**
**aim MAP > 70**

**If in a hurry, I prefer this simple approach:**

- grab 1 mg of adrenaline 1:1000 from resus trolley
- inject into 1000 ml bag of normal saline
- start infusion at 1 ml/min, which is 1 microgram/min (this would be 0.1 micrograms/kg/min for 10 kg child)
- increase rate until resolution of severe anaphylaxis
- **DON"T FORGET TO TURN OFF**

# ADRENALINE IV DOSING

## PAEDIATRIC ARREST

IV: 0.01 mg/kg (10 mcg/kg)
1/10,000 - 0.1 ml/kg IV ie. 10 kg - 1ml
ETT - 1/1000 - 0.1ml/kg

## ADULT ARREST

Non-shockable- 1mg immediately
Shockable - 1mg after 2nd shock
then after every second loop

**BOLUS DOSE IV**

**1:10,000 ADRENALINE**
**MiniJet (1 mg / 10 ml)**

**Add 1 ml to 9 ml Normal Saline**
**= 100 mcg adrenaline in 10 ml**

**Use 5 - 10 mcg (0.5 - 1 ml) boluses**
**titrate to effect**

# GTN INFUSION

## Syringe Driver - Niki T34L
## GTN 50 mg / 50 ml (1000 mcg/ml)

- Use GTN 50 mg in 10 ml ampoule
- Dilute 50 mg (10 ml) up to 50 ml with 5% Dextrose
- Commence at 25 - 50 mcg/min (1.5 - 3.0 ml/hr)
- Increase by 1 ml/hr every 5-10 mins according to clinical response, watch BP

| | DOSE RANGE | RATE OF INFUSION (Syringe Driver) |
|---|---|---|
| 50 ml syringe | 50 mcg/min | 3 ml/hr |
| | 100 mcg/min | 6 ml/hr |
| | 150 mcg/min | 9 ml/hr |
| | 200 mcg/min | 12 ml/hr |

This infusion is for NIKI T34L syringe driver

# ISOPRENALINE INFUSION

| Syringe Driver<br>Isoprenaline 1 mg / 50 ml (20 mcg/ml) | | |
|---|---|---|
| Use Isoprenaline hydrochloride 1mg/5ml ampoules<br>Dilute 1 mg (5 ml) up to 50 ml with 5% Dextrose<br>Give 20 µg (1 ml), repeated to clinical response, followed by infusion at 1-4 µg/min (3 - 12 ml/hr) | | |
| 50 ml syringe | **DOSE RANGE** | **RATE OF INFUSION (Syringe Driver)** |
| | 1 mcg / min | 3 ml / hr |
| | 2 mcg / min | 6 ml / hr |
| | 4 mcg / min | 12 ml / hr |

1. Side effects include palpitations, headache, flushing, angina, nausea, vomiting, tremor, dizziness, weakness & sweating.

2. If HR exceeds 80 or patient develops chest pain or other arrhythmias decrease dose or temporarily discontinue infusion.

3. Administer with caution in the elderly, diabetic, hyperthyroid, patients with ischaemic heart disease or concurrently with other inotropes

**Required response usually achieved at doses of < 3 µg/min, though may increase up to 20 µg/min if necessary to obtain required response**

# MORPHINE & MIDAZOLAM

## Syringe Driver
## Morphine 30 mg
## & Midazolam 30mg (30ml)

Dilute 30 mg Morphine plus 30 mg Midazolam made up to 30 ml with Normal Saline

1 mg/ml dose

Administer a loading dose of 2 - 10 ml

Commence infusion at 2.5 - 5 ml/hr

| | DOSE RANGE | RATE OF INFUSION |
|---|---|---|
| 30 ml Syringe | 2.5+2.5mg/hr | 2.5 ml/hr |
| | 5.0+5.0mg/hr | 5 ml/hr |
| | 10+10mg/hr | 10 ml/hr |
| | 15+15mg/hr | 15 ml/hr |

NB : can use 50mg morphine/50mg MDZ in 50ml

# KETAMINE

| | |
|---|---|
| INDUCTION | 1-2 mg/kg IV<br>(use 10% dose if unstable)<br>5 - 10 mg/kg IM |
| ANALGESIA | 0.1 - 0.3 mg/kg IV |
| SEDATION | 0.25 - 0.5mg/kg IV<br>2 - 4 mg/kg IM |
| INFUSION IV | 200mg in 20ml N/saline<br>LOAD then 1-2 mg/kg/hr |
| INTRANASAL<br>(use MAD) | 0.5 - 1 mg/kg N analgesia<br>up to 10mg/kg sedation |

# INTRANASAL DOSING

Use concentrated preparations where possible in order to minimise volume. Always use a Mucosal Atomisation Device (MAD) and divide dose between each nostril. Be aware of dead space in nozzle. May need repeat dosing after 10-15 minutes. **Monitor HR, BP, SpO2, ETCO2, RASS**

| | | |
|---|---|---|
| **SEDATION** | Fentanyl | 1 - 3 mcg / kg |
| | Ketamine | 10 mg / kg |
| | Midazolam | 0.5 mg / kg |
| **ANALGESIA** | Fentanyl | 2 mcg / kg |
| | Ketamine | 0.5 - 1 mg / kg |
| | Lignocaine | 2 % topical 5 ml |
| **SEIZURES** | Midazolam | 0.2 - 0.5 mg / kg<br>use 10 mg in adults<br>use 5 mg/ml concn |
| **OPIATE OD** | Naloxone | 2 mg (2 ml) |

**HOW TO TOPICALISE THE OROPHARYNX**

*3 - 5 mg / kg lignocaine*
*(2% = 20 mg/ml)*

Three-way tap - Cannula - Syringe
O2 at > 8 l/min to drive