



Royal Flying Doctor Service

WESTERN OPERATIONS

*The furthest corner. The finest care.*

# Clinical Manual

## Part 1 Clinical Guidelines

Version 5.0  
1 June 2008

# INTRODUCTION

## ***Purpose of the Manual***

This manual is an aid to the clinical management and aeromedical transport of patients by RFDS Western Operations (RFDSWO). It has been developed as a multi-disciplinary project with input from RFDSWO Medical Officers and Flight Nurses from all bases. Additional information and feedback has been received from nurses, general practitioners and medical specialists.

## ***Structure***

The manual is divided into five parts, each of which contains reference material which may be of use before, or during flight. It is not intended as a comprehensive coverage of all topics but as a ready reference for doctors and nurses when access to more detailed references may not be available. The parts are as follows:

- Part 1 Clinical Guidelines
- Part 2 Drug Infusion Guidelines
- Part 3 Procedures
- Part 4 Standard Drug List
- Part 5 Standard Aircraft Minimum Equipment List

## ***Part 1 - Clinical Guidelines***

These are guides to the pre-flight and in-flight management of various cases. They are intended to cover conditions not commonly encountered for which specific treatment is required (for example various types of overdose), as well as common problems for which we have developed standard guidelines for management. Definitive management of patients always remains the responsibility of the appropriate RFDSWO Medical Officer.

On occasions Flight Nurses may encounter unexpected medical problems. Advice should always be sought from an RFDSWO Medical Officer by telephone or radio. However, in the event that communication is not possible, these clinical guidelines should be used. Flight Nurses must always practise within the scope of RFDSWO flight nursing practice and in accordance with RFDSWO Flight Nurse Competency Standards and RFDSWO Nursing Practice Standards. Emergency actions in accordance with these clinical guidelines that are within the scope of the individual's medical or nursing practice will be endorsed by the Medical Director and the Director of Nursing and Primary Health Care.

## ***Part 2 - Drug Infusion Guidelines***

This section provides information on commonly used drug infusions. The particulars of preparation are appropriate to the range and volumes of drugs and intravenous fluids carried on our aircraft. Simple tables minimise the calculations required in flight. Further information related to Drug Infusion Guidelines can be found in the Introduction to that section.

## ***Part 3 - Procedures***

This part contains brief notes and guidelines for procedures that may need to be carried out by RFDS Medical Officers or Flight Nurses. These guidelines are aimed to provide brief, practical advice on procedures and do not preclude variations based on the individual practitioner's experience and assessment of the case. Flight Nurses are authorised to carry out procedures that are identified in the RFDSWO Flight Nurse Competency Standards.

## ***Part 4 – Standard Drug List***

This part outlines the minimum standard drugs which should be available for any patient transport flight conducted by RFDS Western Operations. The list covers the most common emergency and routine drugs and the minimum quantities required for flights from any region of the State. The list is a balance between coverage of a diverse range of potential clinical needs and the provision of an excessive choice of agents. Additional drugs or extra quantities of drugs may be carried for specific cases.

## INTRODUCTION (CONT.)

### **Part 5 – Standard Aircraft Equipment List**

This section lists the minimum equipment on each aircraft, irrespective of the different storage options and configuration of different aircraft types.

### **Updates**

The manual is distributed to all RFDS Flight Nurses and Medical Officers with a reference copy kept at each base. Updates and new guidelines will be provided at regular intervals. With each set of update pages, a list will be provided indicating which pages are new additions and which are replacements for existing pages.

The manual is a dynamic document with continuing additions and revisions.

### **Validity**

Pages in this document will remain valid indefinitely unless otherwise updated or deleted.

### **Errors and Modifications**

Despite our best efforts, typographical and other errors can occur. Clinical staff are requested to notify the Medical Director of any errors noted so that they may be rectified.

The manual is by nature a dynamic document and needs to be constantly reviewed in light of changing clinical practice. Staff are encouraged to submit suggested additions, deletions, or modifications to the Medical Director. The manual and its contents will be reviewed by the Medical Director and the Director of Nursing and Primary Health Care in conjunction with Senior Medical Officers and Senior Flight Nurses.

### **Disclaimer**

These notes are issued as a guide only. Whilst all care is taken to ensure they are accurate and complete, reference should be made to standard textbooks of treatment or to the manufacturer's written drug or equipment information, where any discrepancy exists.

This manual has been prepared solely for the use of RFDSWO personnel and RFDSWO takes no responsibility for the consequences of any use (authorised or unauthorised) by other persons. This manual remains the property of RFDSWO and no part of it may be copied or distributed without the consent of the Medical Director.

### **Reference**

This manual has been compiled using the principles outlined in the publication 'Guidelines for the Development and Implementation of Clinical Practice Guidelines' published by the Quality of Care and Health Outcomes Committee, NHMRC, AGPS 1995.

.....  
Medical Director

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Date

.....  
Director of Nursing & Primary Health Care

.....  
Date

**Abbreviations used in this document**

Use of abbreviations has been minimized wherever possible. However the following standard abbreviations will be found.

mL	= millilitres
L	= Litres
mg	= milligrams
µg	= micrograms (or mcg)
g	= grams
kg	= kilograms
mEq	= milliEquivalents
IU	= International Units
mmol	= millimoles
min	= minute
hr	= hour
J	= Joules
Mm	= millimetres
cm	= centimetres
km	= kilometres

## Other common abbreviations

IV	= intravenous
IM	= intramuscular
IA	= intra-arterial
SC	= subcutaneous
HR	= heart rate
BP	= blood pressure
T	= temperature
R	= respiratory rate
SaO <sub>2</sub>	= saturation
ETCO <sub>2</sub>	= end-tidal CO <sub>2</sub>
FHR	= fetal heart rate
ETT	= endotracheal tube
NGT	= nasogastric tube
CVC	= central venous catheter
CVP	= central venous pressure
NIBP	= non-invasive blood pressure
IBP	= invasive blood pressure
MAP	= mean arterial pressure
ICP	= intracranial pressure
PaO <sub>2</sub>	= partial pressure arterial oxygen
PaCO <sub>2</sub>	= partial pressure arterial carbon dioxide
P <sub>B</sub>	= barometric pressure
LBBB	= left bundle branch block
RBBB	= right bundle branch block
VF	= ventricular fibrillation
VT	= ventricular tachycardia
SVT	= supraventricular tachycardia
AF	= atrial fibrillation
bpm	= beats per minute

1% = 1 g per 100mL

## PART 1

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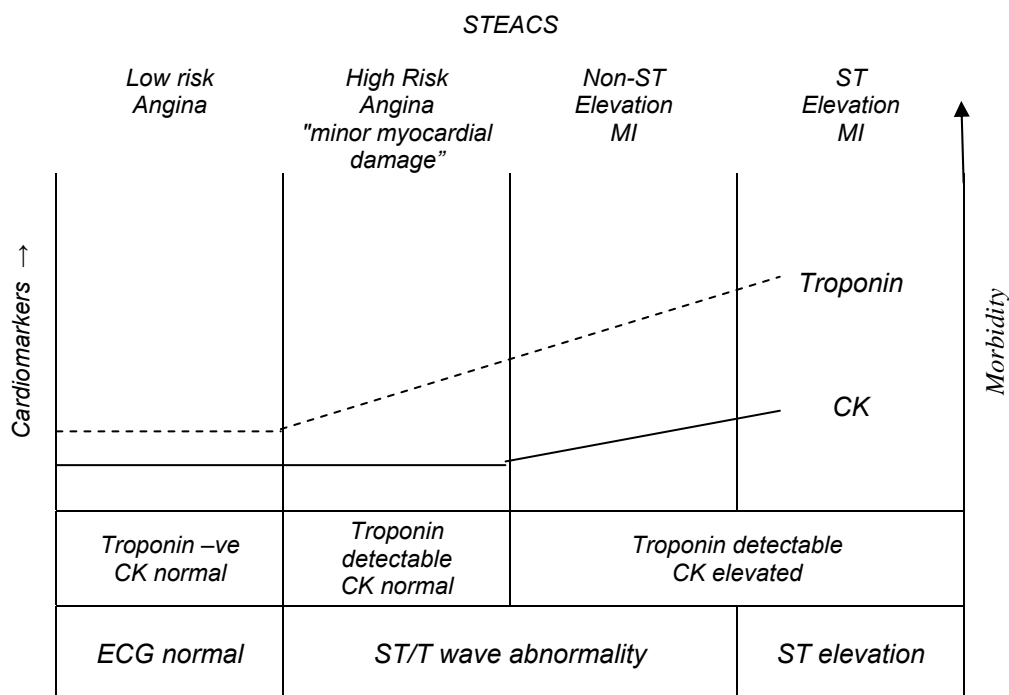
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## SECTION ONE – CARDIOVASCULAR

### 1.1 ACUTE CORONARY SYNDROMES

#### Theory

- "Acute Coronary Syndromes" (ACS) covers a broad spectrum of symptomatic ischaemic heart disease. ACS can be divided into TWO broad groups: STEMI (ST elevation myocardial infarction) and NSTEMI (non-ST-elevation acute coronary syndromes). NSTEMI range from stable (low risk) angina, through unstable (high risk) angina, to non-ST-segment-elevation myocardial infarction (NSTEMI).
- ACS represent a large proportion of RFDS workload and is Australia's leading cause of death. Early recognition and management of ACS is vital to reduction in both morbidity and mortality. Whilst acute STEMI is regarded as high risk, particularly in remote settings and are transported urgently, NSTEMI can be stratified according to selected criteria as high, intermediate or low risk for transport.
- Establishing an initial working diagnosis with ECG and clinical picture will guide decision-making for treatment and transport.
- During air transport, altitude hypoxia will further compromise myocardial oxygen delivery. Supplemental oxygen by facemask during air transport is essential.
- Anxiety during air transport increases heart rate and myocardial oxygen demand, also exacerbating ischaemia.



#### Pre-flight Management

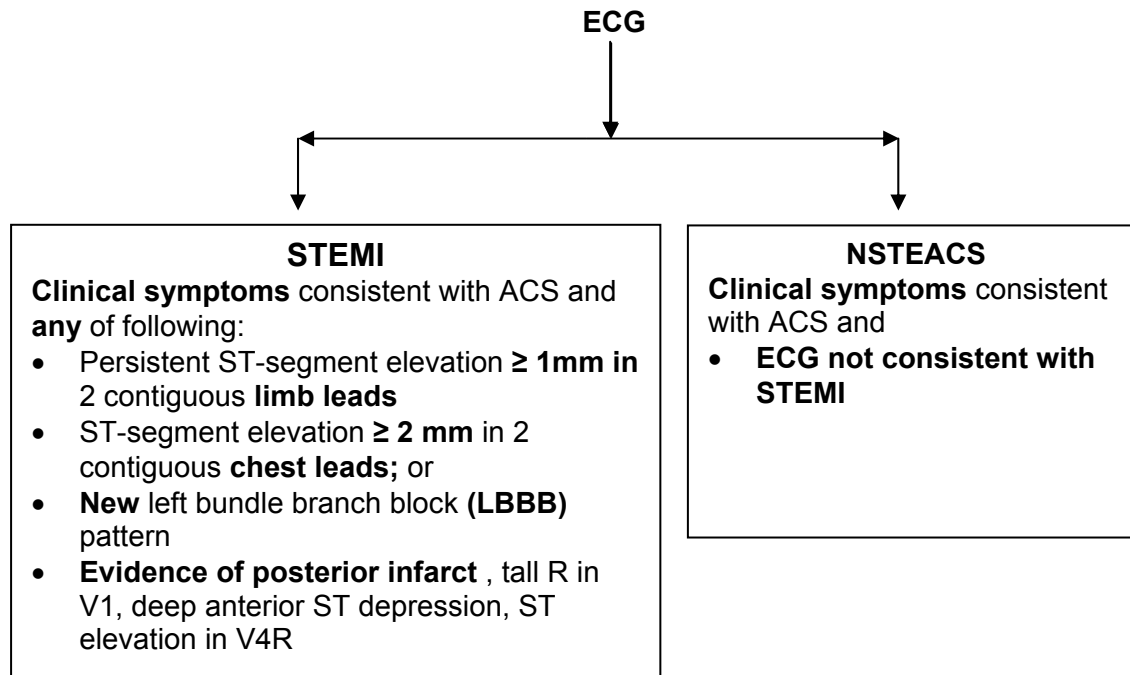
The patient may be in a remote primary setting, or referred from a health service. Generic first line management is similar.

#### 1st Line Management

Confirm or initiate:

- Oxygen therapy - 6-8 L/min by face mask.
- Nitrates - GTN spray or sublingual tablets, Isordil sublingual (Medical Chest Item 147)
- Aspirin - 150-300mg orally (Medical Chest Item 62)

4. Morphine - establish intravenous access in health care setting and give Morphine 2.5mg-5mg IV as required. In a remote setting, advise Morphine 5-10mg IM according to pain and body weight. (Medical Chest Item 96).
5. 12-lead ECG to establish a working diagnosis if available. Follow with continuous ECG monitoring.



6. The ECG is the sole test required to select patients for emergency reperfusion (fibrinolytic therapy or direct PCI).
7. Based on the working diagnosis, manage the patient and transport them according to the following guidelines for:
  - ST elevation Myocardial Infarction (STEMI)
  - Non-ST elevation Acute Coronary Syndromes (NSTEACS)

## 1.2 ST-ELEVATION MYOCARDIAL INFARCTION

### Theory

1. STEMI implies infarction of full thickness of myocardium. Death due to ventricular fibrillation is most common in the first 24 hours.
2. The major aim of treatment is to effect reperfusion of the affected myocardium, followed by prevention of extension of infarction and prevention of complications (heart failure, rhythm disturbances).
3. Aggressive fibrinolysis within 12 hours reduces morbidity and mortality by reducing the amount of cardiac damage. Aspirin inhibits platelet aggregation and should be administered to all patients.

### Pre-flight Management

1. Confirm the working diagnosis is ST segment elevation myocardial infarction based on history, 12 lead ECG and additional biochemical markers if available. Have the ECG faxed to you if there is any doubt.

### Primary Evacuation

1. Confirm first line management has been initiated (oxygen, nitrates, morphine, aspirin).
2. Determine if an AED (defibrillator) is available and advise on having it set up. Mobilize road ambulance or other resources which can provide monitoring or early defibrillation prior to RFDS arrival.
3. Flight should be Priority 1 and doctor-accompanied due to the risk of sudden death and need for urgent fibrinolysis within the "window of opportunity".

### Secondary Interhospital Transfer

1. Confirm first line management and recommend fibrinolysis if appropriate. See considerations below.
2. Confirm adjuvant therapy to be commenced (Clopidogrel, Beta blocker, Heparin, Tirofiban). See also below.
3. Assign a priority to the flight. Uncomplicated STEMI in a location where fibrinolysis is available will usually be Priority 2 or 3 depending on successful reperfusion, monitoring facilities, presence of complications.
4. Doctor may not be necessary on transport if >24 hours since infarct, successful reperfusion, pain-free and no complications or infusions (other than Heparin).

### Management Considerations

#### Reperfusion therapy (Percutaneous Coronary Intervention PCI vs. Fibrinolysis)

Choice of reperfusion therapy is dependant on the following factors;

- Travelling time from a cardiac catheter facility.
- Time of presentation after onset of symptoms.
- Contraindications to fibrinolysis.

In practice most RFDS patients cannot reach a facility in time for percutaneous coronary intervention (PCI). An exception is Rottneest Island and some inner rural locations reached by helicopter.

Symptom onset < 1hr before presentation.		Symptom onset 1-3 hrs before presentation.		Symptom onset 3-12 hrs before presentation.	
PCI available with in 1 hour?		PCI available within 90 min?		PCI available within 90min OR 2hrs if offsite.	
<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>No</b>	<b>Yes**</b>	<b>No</b>
PCI	Fibrinolysis*	PCI	Fibrinolysis*	PCI	Fibrinolysis*

### Fibrinolysis

Second generation agents which can be given by bolus (eg Reteplase or Tenecteplase) are the fibrinolytics of choice. RFDS carries Tenecteplase. Streptokinase is inappropriate for ATSI patients, or those with previous exposure to the drug (due to Streptococcal antibodies.)

Patients should give verbal consent after a discussion of risks and benefits with the doctor.

#### *Tenecteplase Dosage.*

Patient weight (kg)	Tenecteplase (IU)	Tenecteplase (mg)	Volume of reconstituted solution (ml)
<60	6,000	30	6
60 to <70	7,000	35	7
70 to <80	8,000	40	8
80 to <90	9,000	45	9
>90	10,000	50	10

*Reteplase* is given as 10 units intravenously, followed by 10 units after 30 minutes

*Streptokinase* (if all that is available) is given as 1.5 million units given over 60 minutes.

#### Contraindications to fibrinolysis

Absolute Contraindications	Relative Contraindications
Risk of Bleeding <ul style="list-style-type: none"> <li>Active bleeding or bleeding diathesis (excluding menses)</li> <li>Significant closed head of facial trauma within 3 months</li> <li>Suspected aortic dissection (including new neurological symptoms)</li> </ul>	Risk of Bleeding <ul style="list-style-type: none"> <li>Current use of anticoagulants: the higher the INR, the higher the risk of bleeding</li> <li>Non-compressible vascular punctures</li> <li>Recent major surgery (&lt;3weeks)</li> <li>Traumatic or prolonged (&gt;10min) CPR</li> <li>Recent (within 4 weeks) internal bleeding (eg. GI or urinary)</li> <li>Active peptic ulcer</li> <li>Pregnancy</li> </ul>
Risk of intracranial haemorrhage <ul style="list-style-type: none"> <li>Any prior intracranial haemorrhage</li> <li>Ischaemic stroke within 3 months</li> <li>Known structural cerebral vascular lesion</li> <li>Known malignant intracranial neoplasm (primary or metastatic)</li> </ul>	Risk of intracranial haemorrhage <ul style="list-style-type: none"> <li>History of chronic, severe, poorly controlled hypertension</li> <li>Severe uncontrolled hypertension on presentation (&gt;180mmHg SBP or &gt;110mmHg DBP)</li> <li>Ischaemic stroke more than 3 months ago, dementia, or known intracranial abnormality not covered in contraindications</li> </ul>

#### Adjuvant therapy

- Antiplatelet therapy.
  - Aspirin 300mg for all patients. AND
  - Clopidogrel loading dose 300mg (unless likely CABG required).
- Antithrombin therapy.
  - Heparin bolus 60units/kg (max 4000 units) followed by infusion of 12 units / kg / hr (max 1000 units/hr). Adjust dose if on Glycoprotein IIb/IIIa inhibitor.  
OR
  - Enoxaparin (Heparin) (bolus 30mg IV, then 1mg/kg SC 12 hourly). Adjust dose if renal failure. Avoid if >75y.o.
- If the patient is likely to proceed to PCI, Heparin infusion preferred (easier to reverse).

4. Glycoprotein IIb/IIIa inhibitor. These agents (eg. Tirofiban) are only available in some large regional centres. May be recommended for patients having PCI. Avoid with fibrinolysis.
5. Beta blocker. If no contraindication, oral Atenolol 25-100mg or Metoprolol 25-100mg OR intravenous Atenolol 5-10mg (1mg /min) titrated to SBP (not below 95mmHg) and HR (not below 55/min).
6. Tight glycaemic control. Insulin infusion if necessary.
7. Normalise electrolytes (in particular K+)
8. Consider ACE inhibitor and a statin.
9. Adequate pain relief with GTN and morphine. Aim for no pain.

### Failure to reperfuse

Successful reperfusion is suggested by:

- Relief of symptoms
- Restoration of haemodynamic / electrical stability
- Reduction by 50% of initial ST segment elevation within 60-90 mins.

Failure to reperfuse may be an indication for urgent transport for "Rescue PCI", or if very geographically isolated, repeat thrombolysis. Seek consultant cardiologist advice in this situation.

### Pre-flight assessment and prioritisation

The following recommendations are a guide only. It is expected that RFDS doctors exercise their clinical judgment in individual cases.

Potential STEMI or unknown ACS (no ECG available), or no capacity to thrombolyse.	Priority 1	Doctor accompanied
STEMI with reperfusion, haemodynamically stable. No monitoring or HDU.	Priority 2	Doctor accompanied
Well staffed HDU, or experienced staff and capacity to monitor.	Priority 3	Doctor accompanied (if within 24 hours)
STEMI with failed reperfusion and cardiologist opinion that suitable for rescue PCI	Priority 1	Doctor accompanied
STEMI with ongoing pain, large size, poor LV function, renal impairment	Priority 2	Doctor accompanied

### In-flight Management

- Administer oxygen during all phases of transport.
- Continuous ECG monitoring during all phases of transport.
- Ready access to defibrillator. (Apply defibrillation pads if previous arrest.)
- Continue post-thrombolysis care, such as Heparin infusion.
- Ensure diagnosis on Obs chart clearly identifies case as STEMI.

**Medical Chest Items**

For patients in remote settings, the following agents may be useful.

- Aspirin 300mg tabs (Item 62)
- Isordil sublingual tabs 5mg (Item 147)
- Morphine injection 15mg/ml (Item 96)
- Frusemide tabs 40mg (Item 85)
- Frusemide injection 20mg/2ml (Item 120)

**References**

*Heart Foundation of Australia. Guidelines for the management of acute coronary syndromes 2006. Med J Aust Vol 184 No.8 Suppl.*

### 1.3 NON ST-ELEVATION ACUTE CORONARY SYNDROMES

#### Theory

1. These are patients with clinical features of ACS who do not meet the criteria for STEMI.
2. These patients need to have other diagnoses ruled out and undergo RISK STRATIFICATION to determine priority, escort requirements and treatment...

#### Risk Stratification

<p><b>High Risk</b></p> <ul style="list-style-type: none"> <li>• <b>Repetitive or prolonged (&gt;10min) ongoing pain / discomfort</b></li> <li>• Elevation of <b>cardiac marker</b></li> <li>• Persistent or <b>dynamic ECG changes</b> (ST depression <math>\geq 0.5</math> mm or t – wave inversion <math>\geq 2</math>mm)</li> <li>• Transient <b>ST elevation</b> <math>\geq 0.5</math>mm in 2 contiguous leads</li> <li>• <b>Haemodynamic compromise</b> (SBP&lt;90mm Hg, cool peripheries, CCF, new Mitral regurgitation, sweating).</li> <li>• <b>Sustained VT</b></li> <li>• LV systolic dysfunction</li> <li>• PCI or CABG within 6 months</li> <li>• Diabetes (with typical symptoms of ACS)</li> <li>• Chronic renal impairment (with typical symptoms of ACS)</li> </ul>	<p><b>Treatment</b></p> <ul style="list-style-type: none"> <li>• Aspirin</li> <li>• Clopidogrel</li> <li>• Heparin or Clexane</li> <li>• B blocker</li> <li>• Glycoprotein IIb/IIIa inhibitor (if cardiologist advises)</li> </ul>	<p><b>Other</b></p> <p>Early angiography / revascularisation</p>	<p><b>Flight tasking</b></p> <ul style="list-style-type: none"> <li>• P1 and doctor if primary location.</li> <li>• P1 or P2 for IHT depending on location and doctor accompanied.</li> </ul>
<p><b>Intermediate risk (does not meet high risk and)</b></p> <ul style="list-style-type: none"> <li>• <b>Chest pain in last 48 hours at rest or repetitive or prolonged but now resolved</b></li> <li>• <b>&gt;65 yrs</b></li> <li>• Known MI with LVEF <math>\geq 0.4</math> or known coronary lesion &gt;50% stenosis</li> <li>• No high risk changes on ECG</li> <li>• 2 or more of : known hypertension, family history, smoking, hyperlipidaemia</li> <li>• Diabetes (with atypical symptoms of ACS)</li> <li>• Chronic renal failure (with atypical symptoms of ACS)</li> <li>• Event while taking aspirin</li> </ul>	<p><b>Treatment</b></p> <ul style="list-style-type: none"> <li>• Aspirin</li> </ul>	<p><b>Other</b></p> <p>Serial ECG and Troponin and observation to enable reclassification to high or low risk.</p> <p>Upgrade medical therapy</p>	<p><b>Flight tasking</b></p> <ul style="list-style-type: none"> <li>• P1 and doctor if primary location</li> <li>• P2 or P3 depending on location, capacity to monitor and further risk.</li> </ul> <p>Most regional centres should be able to perform required serial ECG and Troponin. If develops high risk features doctor accompanied, therefore reassess if delay in transport.</p>
<p><b>Low Risk</b></p> <ul style="list-style-type: none"> <li>• Clinical features consistent with ACS without feature of high or intermediate risk</li> <li>• Onset of symptoms in last month</li> <li>• Worsening severity or frequency of angina</li> <li>• Lowering of angina threshold</li> </ul>	<p><b>Treatment</b></p> <ul style="list-style-type: none"> <li>• Aspirin</li> </ul>	<p><b>Other</b></p> <p>Upgrade medical therapy.</p> <p>Outpatient cardiology follow-up.</p>	<p><b>Flight tasking</b></p> <ul style="list-style-type: none"> <li>• Suitable for commercial flight if available. Otherwise P3 no doctor when operationally convenient.</li> </ul>

#### Pre-flight assessment

1. Undertake a structured pre-flight assessment and obtain a copy of a 12 lead ECG to determine patient's risk category according to the table above.
2. Confirm with Operations and record on the pre-flight assessment documentation the risk category eg "High Risk ACS".

3. Ensure basic medical therapy is appropriate (anti-platelet,  $\beta$  blocker, pain relief with nitrates or morphine, anti-thrombin agents if indicated).

***In-flight***

1. Administer oxygen during all phases of transport
2. Continuous ECG monitoring during all phases of transport.
3. Ensure access to defibrillator at all times.
4. Continue medical therapy, aiming for no pain.
5. If pain escalates, repeat a 12-lead ECG on the Zoll defibrillator and manage according to findings.
6. Ensure diagnosis on Obs chart clearly identifies case as NSTEMI or NSTEMACS.

***Medical Chest Items***

For patients in remote settings, the following agents may be useful.

- Aspirin 300mg tabs (Item 62)
- Isordil sublingual tabs 5mg (Item 147)
- Morphine injection 15mg/ml (Item 96)

***References***

*National Heart Foundation of Australia. Guidelines for the management of acute coronary syndromes 2006. Med J Aust Vol 184, No 8, Suppl.*

## 1.4 ACUTE PULMONARY OEDEMA

### **Theory**

Respiratory failure will be exacerbated by altitude hypoxia so supplemental oxygen is mandatory.

### **Pre-flight & In-flight Management**

1. Flights are usually Priority 1, doctor accompanied, depending on the facilities at the referring location.
2. Diagnose and treat precipitating causes, including myocardial infarction, cardiac arrhythmias, pericardial effusion, hypertrophic cardiomyopathy and valvular heart disease. Consider non-cardiogenic pulmonary oedema.
3. Administer high flow oxygen with the patient sitting upright.
4. Give Nitrates, either sublingually, or by infusion (commence at 25 µg/min). Topical application may not be reliable if sweaty or clammy.
5. Give IV Frusemide 20 mg - 80 mg IV, repeating at 20 minutely intervals as necessary.
  - Note: a urinary catheter is essential to monitor output hourly.
6. If hypotensive, consider Dopamine or Dobutamine infusion
7. Consider the need for Digoxin, especially if in atrial fibrillation.
8. If condition worsening consider CPAP or ventilation with +5 mmHg of PEEP and high dose oxygen.
9. Other treatment modalities include venesection of 500 mL of blood (beware risk of hypovolaemia) or rotating tourniquets.
10. In dialysis patients who are overloaded, consider inducing diarrhoea with Sorbitol/Lactulose (difficult in in-flight environment).

### **Special Notes**

1. Intubation should be considered for all patients in APO who require high flow O<sub>2</sub> at rest at the referring location.
2. CPAP may avoid the need for intubation but this is currently not available as a transport option.
3. Avoid nitrates in patients who have received Sildenafil (Viagra) in the previous 24 hours.
4. Morphine has been shown to adversely affect outcome in some studies and should be only be used judiciously.

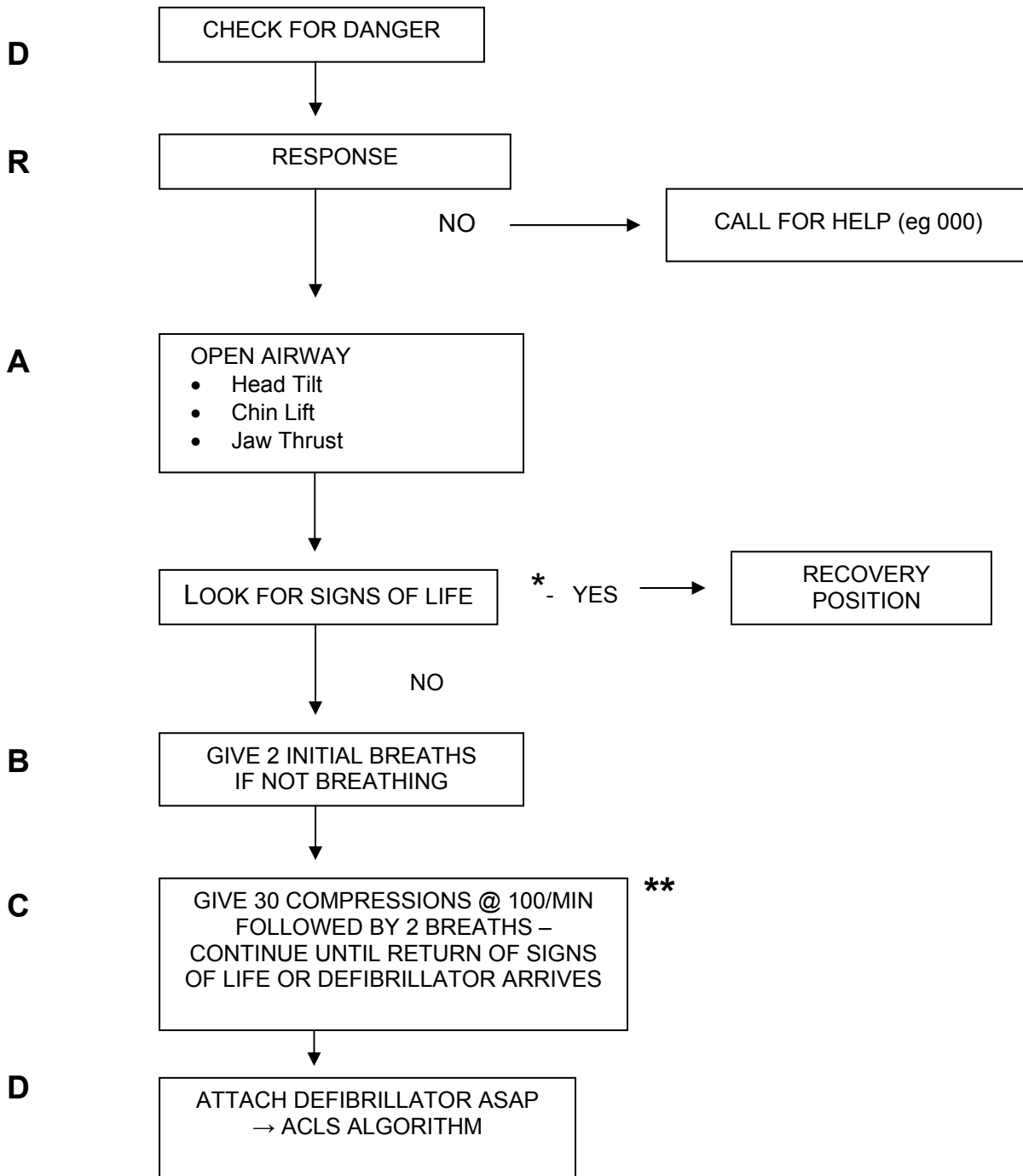
### **Medical Chest Items**

Frusemide tabs 40 mg (Item 85), Frusemide ampoules 20 mg/2mL (Item 120), intramuscularly if necessary, sublingual Isordil 5 mg (Item 147), Aspirin 300 mg tabs (Item 62).

### **References**

Oh TE. (Ed) *Intensive Care Manual*. 4<sup>th</sup> Ed, Butterworth Heinemann, 1997.  
Therapeutic Guidelines Limited. *Therapeutic Guidelines: Cardiovascular* 4<sup>th</sup> 2004  
Dr Mark Thomas. *Orientation Manual for Renal Unit Medical Officers*, Current 1999.  
Royal Perth Hospital. *CAPD Manual for Remote Nurses*, Current 1999.  
Emergency Medicine Journal vol 16 Feb 2004 pg 47.

**1.5 BASIC LIFE SUPPORT FLOW CHART (ADULT)**

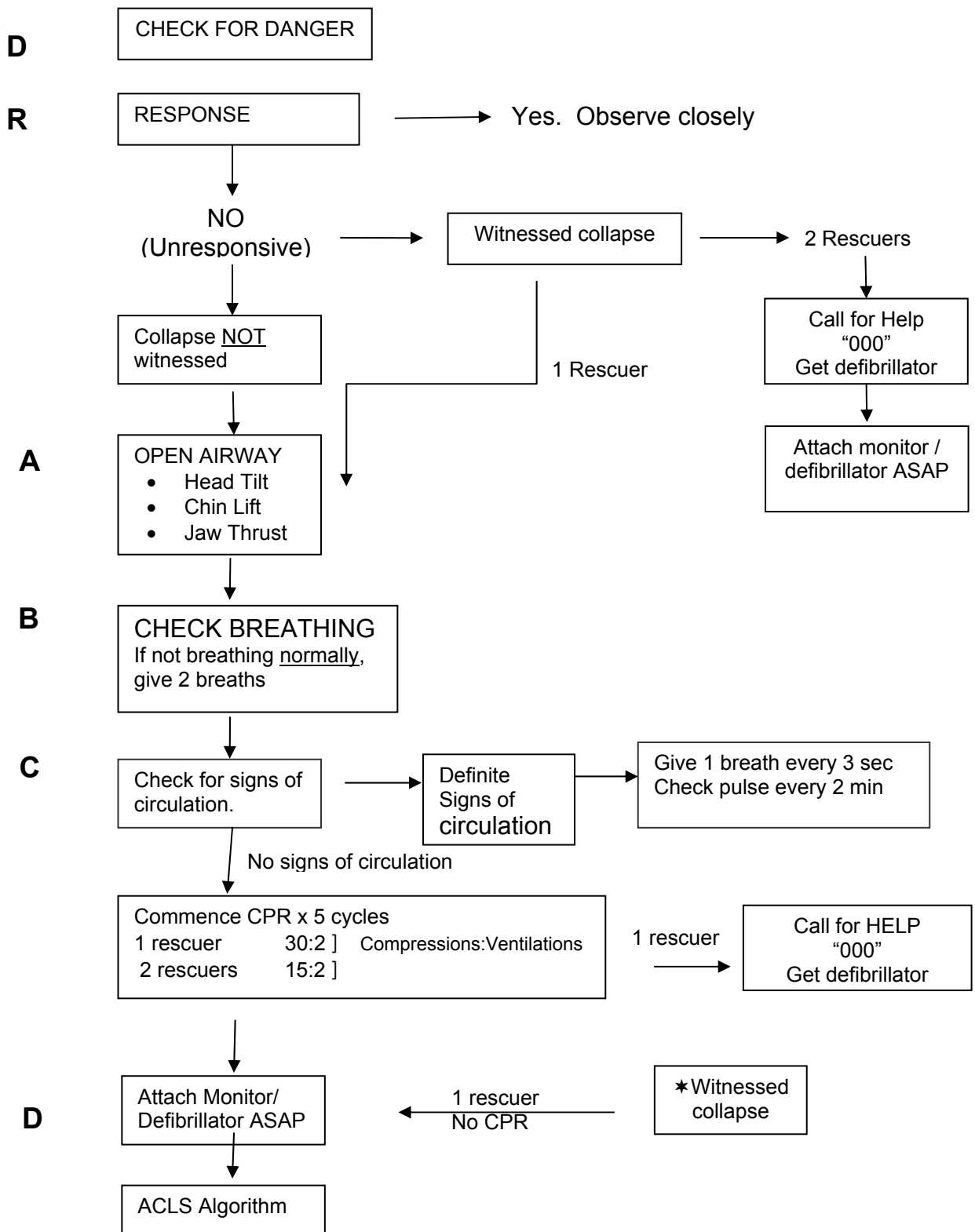


\*\* Until defibrillator available.  
 \* No signs of life – unconscious, unresponsive, not breathing normally, not moving.

**Reference:**

ARC Basic Life Support Flow Chart – March 2006

**1.6 BASIC LIFE SUPPORT FLOW CHART (PAEDIATRIC)**

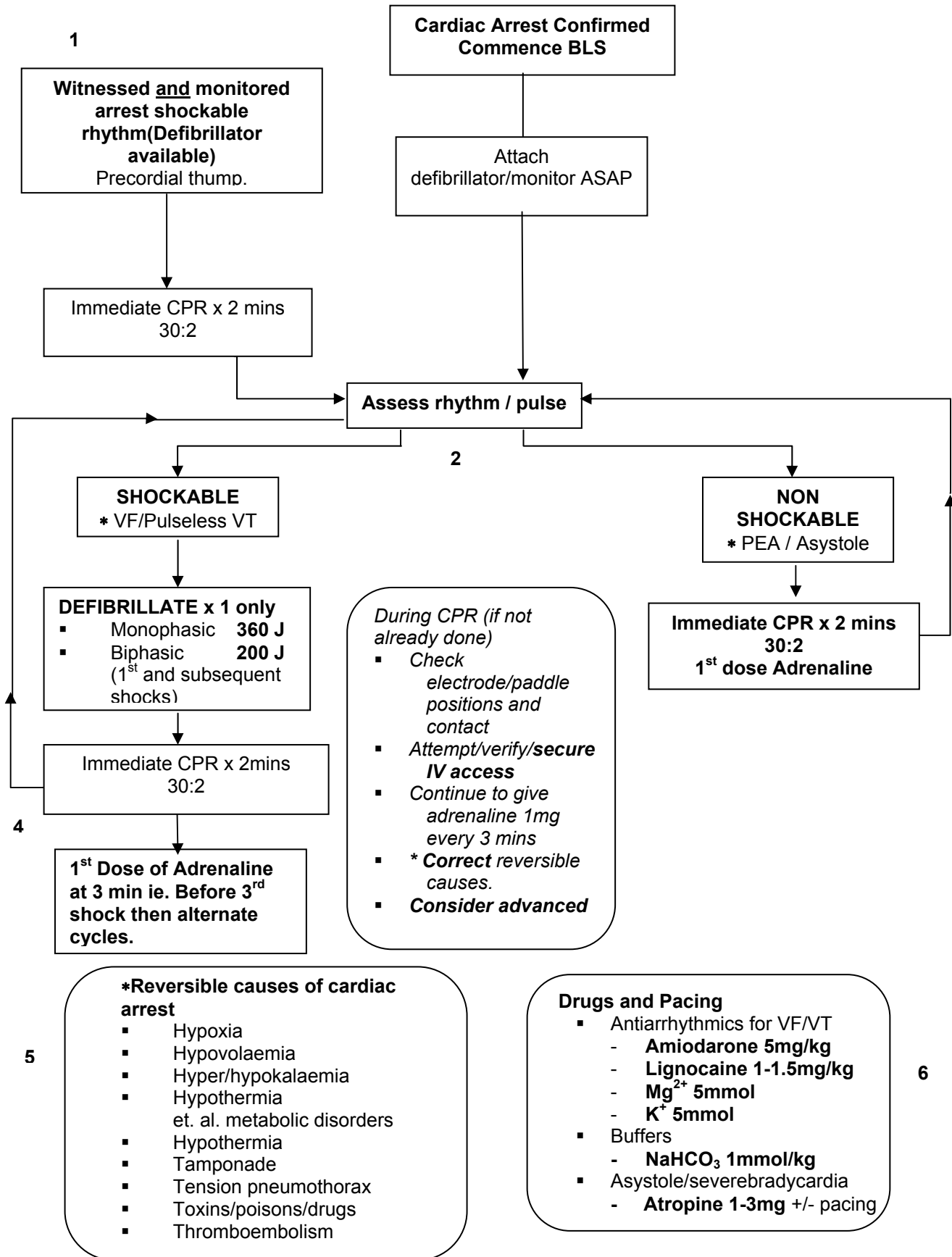


**Reference**

ARC Basic Life Support Flow Chart – March 2006

American Heart Association Guidelines. Part 11. Paediatric Basic Life Support Nov 2005

**1.7 ADVANCED LIFE SUPPORT (ADULT)**



## 1.6 ADVANCED LIFE SUPPORT (ADULT) - CONT.

### Notes

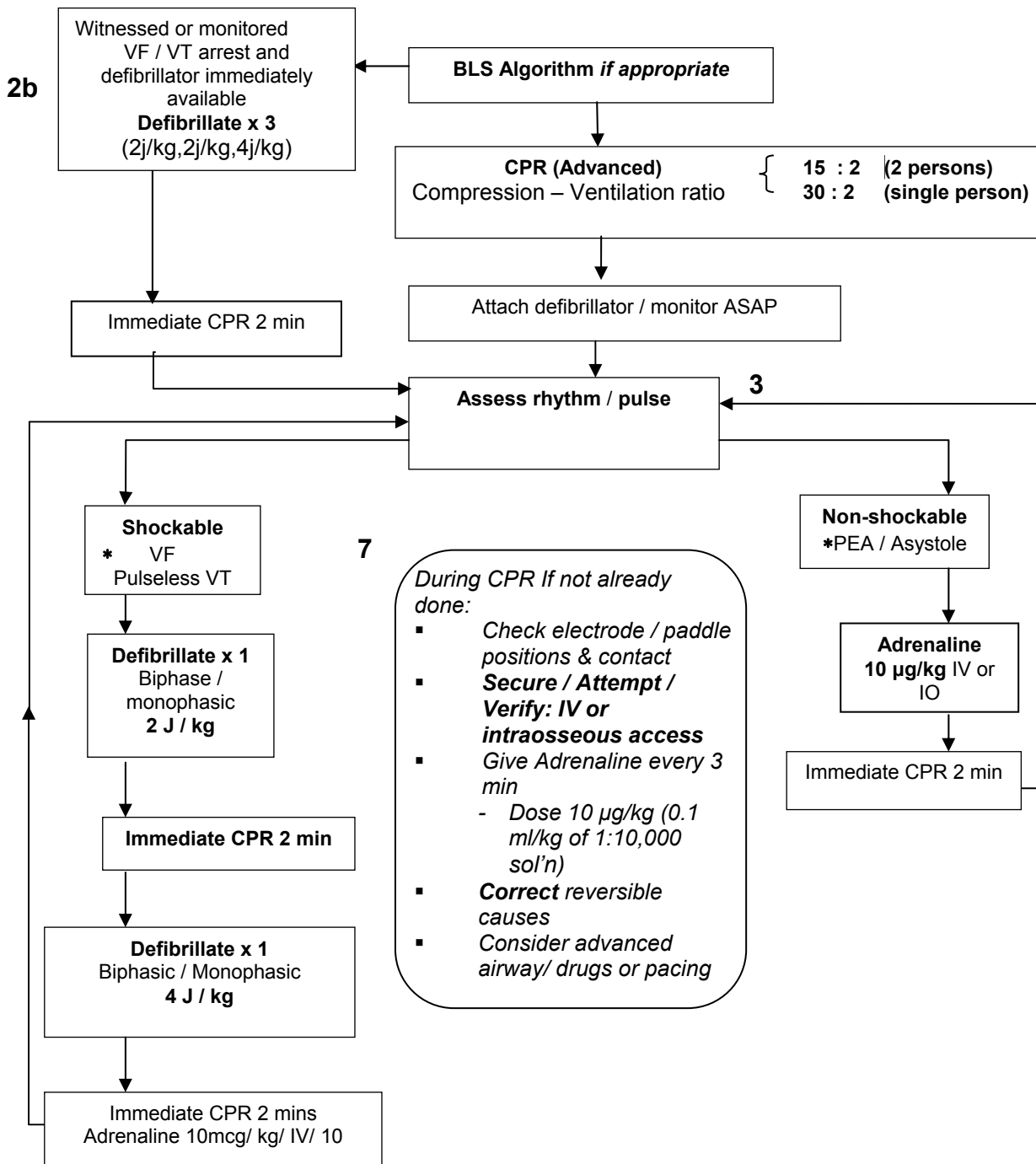
1. Return of spontaneous circulation at any stage ie a perfusing rhythm → post-resuscitation support.
2. Feel for carotid pulse for 10 sec. only – if not definitely felt, continue algorithm
3. Majority of patients revert with 1st shock. One shock means less interruption of compressions (thought to be most important part of CPR). Biphasic defibrillators compensate automatically for patient's impedance. There is minimal benefit from stacked shocks.
4. CPR – emphasis is on compressions with minimal interruptions for procedures, defibrillation or to check pulse or rhythm. Rate now 30 compressions to 2 ventilations; compressions 100/min. ie as hard and fast as possible.
  - Continual interruptions to CPR lead to poor coronary perfusion pressure (CPP). Increasing CPP increases the likelihood of successful defibrillation.
  - Correct reversible causes.
5. Consideration of advanced airway (ETT, LMA, combitube) is now much later. (Should NOT be considered by single operator) Correct BVM technique just as successful in ventilating patient and less interruption to CPR. Once advanced airway in situ – compressions should be continuous and not interrupted for ventilations. Patient should be ventilated at a rate 8-10/min. and just sufficient to make chest rise. Hyperventilation reduces cerebral and coronary perfusion.
6. Drugs.
  - Amiodarone now 1st line for VF/VT although no proven benefit over Lignocaine.
  - Mg<sup>2+</sup> given ahead of K<sup>+</sup> now.
  - Adrenaline acts purely via alpha receptors causing marked vasoconstriction, increased venous return and increased coronary and cerebral perfusion pressures.
  - Mg<sup>2+</sup> is first line for Torsade de Pointes.

### References

Australian Resuscitation Council, Guidelines 1.2. March 2006

American Heart Association Guidelines, Part 7.2 Management of Cardiac Arrest

### 1.8 ADVANCED LIFE SUPPORT (PAEDIATRIC)



**Reversible causes of cardiac arrest. \***

- Hypoxaemia
- Hypothermia
- Hypovolaemia
- Hyper/Hypokalaemia & metabolic disorders
- Tamponade
- Toxins / poisons / drugs
- Tension pneumothorax
- Thromboembolism

**Drugs & Pacing**

- Antiarrhythmics for VF / VT:
  - Amiodarone 5 mg/kg**
  - Lignocaine 1 – 1.5 mg/kg**
  - Mg<sup>++</sup> 0.1 – 0.2 mmol/kg for Torsade de Pointes**
- Buffers:
  - NaHCO<sub>3</sub> 1 mmol/kg**
  - Atropine 20 µg/kg + pacing for asystole / severe bradycardia**

## 1.8 ADVANCED LIFE SUPPORT (PAEDIATRIC) - CONT.

### Notes

#### 1. Definition

- a) Infant < 1 yr
- b) Child 1 – 8 yrs
- c) Older child > 8 yrs – use adult protocols.

#### 2. Initial Actions

- a) Unwitnessed collapse. Start CPR x 2 mins immediately then obtain help
- b) Witnessed collapse. Obtain help and defibrillator first then start CPR.

#### 3. Assessing signs of circulation – NB No praecordial thump in children.

Feel for brachial pulse in infants, carotid in older children. Even experienced clinicians may find it difficult to ascertain the presence of a pulse. Feel for NO LONGER than 10 secs. Pulse less than 60 is inadequate commence CPR.

If no signs of circulation (ie No movement, breathing (NOT agonal gasps), or coughing) commence CPR.

If not definitely felt – continue arrest algorithm.

#### 4. Cardiorespiratory arrest in children

- Only 10-15% go into VF (due to underlying congenital heart disease).
- Usually due to prolonged hypoxia, sepsis and acidosis. By the time a child arrests it's usually an asystolic arrest and chances of successful revival are very small. Exceptions are near drownings in toddlers in icy water (associated with profound hypothermia) or drug ingestions.

#### 5. Compression : ventilation ratios

- Basic life support 30 : 2. Compressions thought to be initially most important and this ratio easy to teach to laymen as same as all other forms of basic life support.
- Advanced life support:

1 person	30 : 2 compressions : ventilation
2 persons	15 : 2 compressions : ventilations
- Allows better oxygenation of child (hypoxia often first cause of arrest).

#### 6. As with adults compressions should be hard (compressing $\frac{1}{3}$ - $\frac{1}{2}$ depth of thorax) and fast (~ 100 / min) with minimal interruptions.

**Infant:** Two finger compressions / thumb encircling technique

**Child:** Heel of hand or two handed technique

**Older child:** Two handed technique

#### 7. Ventilation via advanced airway. Avoid hyperventilation causing vasoconstriction of cerebral blood vessels resulting in reduced cerebral blood flow. 10 breaths per min.

## 1.9 CARDIAC ARRHYTHMIAS

### *Theory*

1. Cardiac arrhythmias are common and do not always require treatment in flight.
2. Diagnosis should be based on a 12 – lead ECG where possible.
3. Priorities in management are always AIRWAY, BREATHING and CIRCULATION with establishment of intravenous access. Patients should be fully monitored. If the patient has sustained a cardiac arrest, manage immediately according to ACLS protocol.
4. If not arrested, patients may be assessed as either stable or unstable. Unstable patients are those that are hypotensive, have significant chest pain or are in acute left ventricular failure. If these features are absent then the patient is stable and there is no requirement to treat their arrhythmia in flight (the only exception is VT which may suddenly deteriorate into VF).
5. All antiarrhythmic agents (other than Digoxin) will exacerbate hypotension and have the potential to cause further arrhythmias. Therefore very unstable patients should be treated with synchronized cardioversion as 1<sup>st</sup> line. This will require the presence of a medical officer.

### *Pre-flight and In-flight Management*

1. Pre-flight assessment should establish the type of arrhythmia, its likely cause and whether the patient is stable or unstable. RFDS doctors should provide advice on resuscitation, antiarrhythmic drugs and doses, and synchronized cardioversion if required.
2. Priority of the flight will depend on the arrhythmia, its cause, the patient's condition and local facilities including the GPs skills.
3. Unstable patients, those with acute myocardial infarction and those at risk of deterioration in flight should be doctor-accompanied.
4. All patients should receive oxygen and be fully monitored.

Recognition and treatment of specific arrhythmias:

#### ***Sinus Arrhythmia***

ECG – irregular spacing of sinus rhythm commonly associated with respiration in young people.

Rx – nil

#### ***Sinus Tachycardia***

ECG – sinus rhythm at a rate > 100 bpm

Rx – is of the underlying condition (eg. hypovolaemia, pain, fever, heart failure, anxiety)

#### ***Sinus Bradycardia***

ECG – sinus rhythm at a rate < 60 bpm

Rx – only indicated if patient is symptomatic (eg. syncope, hypotensive, cardiac failure) or rate < 30 bpm.

Atropine 0.3 - 0.6 mg IV repeated prn

Consider transcutaneous pacing and/or Isoprenaline or Adrenaline in resistant cases

#### ***Atrial Ectopics***

ECG - premature P waves of sometimes unusual shape. The PR interval may be short.

Rx - multifocal atrial ectopics are clinically indistinguishable from AF, so patients must have ECG to confirm diagnosis.

- nil

**Atrial Flutter**

ECG - P waves are replaced by flutter waves (sawtooth appearance best seen in II, III and a VF)

- atrial rate is always exactly 300 bpm. Commonly there is a 2:1 block resulting in a ventricular rate of exactly 150 bpm. QRS complexes are narrow and regular.

Rx - often fails to respond to drug treatment but can try Digoxin 10 mcg/kg oral or IV over 30' OR Verapamil (if not hypotensive or in failure) 1 mg/min to max. 10mg OR Amiodarone 300mg IV infusion over 2 hrs followed by 900mg IV infusion over 22 hrs

- Rx of choice is synchronized cardioversion, especially if patient is unstable.

**Atrial fibrillation**

ECG - irregularly irregular narrow complex rhythm at a rate usually > 100 bpm without P waves

Rx - ONLY FOR NEW AF (<48 hrs old) OR IF PATIENT UNSTABLE

2 options: Rate control – Digoxin oral or IV 0.5mg q6-8h

OR Atenolol 1mg/min (max. 10mg) IV

OR Metoprolol 50mg oral

OR Verapamil 0.5-1.0 mg/min (don't mix with  $\beta$  blocker)

Cardioversion-amiodarone (? No better than Digoxin)

-Flecainide (not carried by RFDS)

-electrical (synchronized) cardioversion

NB Rx of choice if patient is unstable

**Supraventricular Tachycardia**

ECG - rapid, regular narrow complex tachycardia 140 – 250/min.

P waves usually obscured

Rx - vagal manoeuvres (eg. carotid sinus massage, Valsalva, ice on face)

Adenosine 6mg IV stat, if not reverted give 12mg, then 18mg IV.

NB: Adenosine must be administered via large bore cannula sited as close to the heart as possible (i.e. cubital fossa not back of hand) into a fast running line and given as a very rapid bolus. Warn patient of sensation of impending doom that is commonly associated.

- Verapamil 1mg/min to max. 10mg

(Verapamil contraindicated if patient taking  $\beta$ -blocker)

**Nodal Rhythm**

ECG - no impulses from sinoatrial node, AV node takes over as pacemaker.

- no P waves, usually narrow complexes, 50-60/min.

Rx - depends on cause (Digoxin toxicity, myocardial infarction)

- Atropine 0.6-1.2mg IV if rate <30/min or symptomatic (i.e. loss of consciousness, pulmonary oedema, hypotension)

- withhold Digoxin if Digoxin toxicity suspected

**Ventricular Ectopic Beats**

ECG - wide, bizarre, premature QRS with no preceding P wave. May occur in normal subjects or be precipitated by myocardial ischaemia, hypoxia, Digoxin, sympathomimetics.

Rx - except for 'R on T' ectopics (VEB's occurring on top of the T wave, which commonly precipitate a VF arrest), VEB's now thought to be benign and do not predict risk of VF. Therefore do not require Rx, except of cause.

**Ventricular Tachycardia**

ECG - broad complex regular tachycardia. Differential diagnosis is SVT with bundle branch block (aberrant conduction). Consider clinical setting to determine which (eg. elderly patient with IHD = VT). If in doubt treat for VT.

Rx - if patient unconscious and pulseless, treat as for VF arrest.

- if patient unstable, trial of one drug only while setting up for synchronized cardioversion. If drug Rx fails, cardiovert immediately.
- if patient stable, give Lignocaine 1–1.5mg/kg IV.
- 2<sup>nd</sup> line drugs include Amiodarone 3mg/kg IV, or Procainamide 1mg/kg

**1° Heart Block**

ECG - PR interval prolonged > 0.2 sec (1 large square)

- normal QRS complexes

Rx - may be normal in patients with bradycardia (eg fit athletes)

- other causes include myocardial infarction, Digoxin toxicity
- no Rx required. Avoid  $\beta$ -blockers.

**2° Heart Block – 2 types:****a) Mobitz I (Wenckebach)**

ECG - progressive lengthening of PR interval until dropped beat, then cycle begins again.

Rx - usually benign condition not requiring Rx, except in setting of AMI when may progress to complete heart block, so requires observation.

**b) Mobitz II**

ECG - PR interval remains constant (prolonged), with intermittent failure of conduction resulting in dropped QRS complexes

Rx - high risk of deterioration into complete heart block Atropine 0.6–1.2mg IV or transcutaneous pacing if patient symptomatic.

**3° (Complete) Heart Block**

ECG - complete dissociation of P waves and QRS complexes. Ventricular escape pacemaker results in broad, bizarre QRS with rate 20-30/min

Rx - Atropine 0.6–1.2mg IV

- isoprenaline or adrenaline infusion (adrenaline preferred in setting of acute ischaemia as coronary perfusion better maintained) as temporizing measure.

Transcutaneous pacing or temporary pacing wire prior to insertion of permanent pacemaker is Rx of choice.

## SECTION TWO - ENDOCRINE

### 2.1 DIABETIC KETOACIDOSIS

#### **Theory**

1. Diabetic Ketoacidosis is a state of relative or absolute deficiency of insulin, resulting in hyperglycaemia, ketoacidosis and dehydration. The hyperglycaemia causes glycosuria, osmotic diuresis and progressive loss of fluid and electrolytes.
2. In a fully evolved hyperglycaemic coma, the most important clinical features are deep rapid breathing (Kussmaul respirations, secondary to acidosis), severe dehydration, circulatory insufficiency (hypotension, tachycardia) muscular weakness and a depressed level of consciousness.
3. Average deficits in diabetic ketoacidosis are 5-7 litres of water, 300-450 mmol of sodium and 3-5 mmol/kg of potassium. Correction of hyperglycaemia (4-8 hours) is more rapid than correction of acidosis (10-20 hours).

#### **Pre-flight and In-flight Management**

1. Pre-flight and in-flight management will be aimed at replacing fluid and electrolyte losses, correcting the hyperglycaemia and commencing treatment for any underlying cause.
2. Flights are usually Priority 1 or 2, doctor accompanied, depending on the facilities at the referring location.
3. Secure the airway, administer oxygen therapy and establish IV access.
4. Monitor GCS and vital signs frequently, BSL and urine output hourly and consider NG tube insertion.
5. Intravenous fluids: Haemaccel 10 mL/kg if shocked, with dose repeated until perfusion is established. Subsequently / otherwise use Normal Saline 1000 - 2000 mL in the first hour, further litres dependent on vital signs, clinical hydration state and CVP. Switch to 5% Dextrose when BSL < 15 mmol/l. (Children: requirements dependent on degree of dehydration. Aim to give deficit [% dehydration x body weight] + maintenance over 48 hours).
6. Insulin infusion:
  - In adults give Actrapid 10 International Units bolus IV then infuse at 0.1 IU/kg/hr, halve rate to 0.05 IU/kg/hr when BSL < 15 mmol/l.
  - In children give Actrapid 0.2 IU/kg SC then follow with 0.1 IU/kg SC every 2 hours, reduce to 0.1 IU/kg SC every 4-6/24 when BSL < 8 mmol/l.
7. If laboratory facilities available check electrolytes, glucose and blood culture; also request urea, creatinine, osmolarity, blood gases, 12-lead ECG, to look for signs of hyper- or hypokalaemia and acute myocardial ischaemia.
8. Potassium level may be high initially despite depleted stores. Requirements for replacement are approx 20 mmol in the first 6/24: care with administration if the serum level is not known and do not commence potassium replacement in the presence of oliguria.
9. Sodium Bicarbonate use is controversial, consider only if severe acidosis.

#### **References**

Oh TE. (ed) *Intensive Care Manual*. 4<sup>th</sup> Ed, Butterworth Heinemann, 1997.

Efron D. (ed) *Paediatric Handbook*. 5<sup>th</sup> Ed, Royal Children's Hospital Melbourne, Blackwell Science, 1995.

Princess Margaret Hospital for Children. *Emergency Department Clinical Guidelines*. 1997.

## 2.2 HYPOGLYCAEMIA

### Theory

1. Hypoglycaemia needs to be considered as a differential diagnosis in all unconscious patients (especially but not exclusively diabetic patients), in all patients with abnormal behaviour and in all patients with unexplained neurological signs.
2. Moderate hypoglycaemia is characterised by tachycardia, sweating, clamminess, paraesthesia (face and hands), irritability, hunger and agitation.
3. Severe hypoglycaemia is characterised by mental confusion, bizarre behaviour, seizures, hypothermia and coma (hydrated, quiet and flaccid).
4. All symptoms may be blunted by alcohol, sedatives, patients on  $\beta$ -blockers and in the elderly.
5. The most common cause of hypoglycaemia is overdose of insulin or oral hypoglycaemics, particularly long acting sulphonylureas. Other causes include inadequate food intake, reactive (post-prandial), drugs (salicylates, iron, alcohol), status epilepticus and counter-regulatory (Addison's disease, hypopituitarism, myxoedema, severe cachexia, hepatic failure or severe renal failure).

Age	Normal Reference Range
0 - 6 months	2.2 – 5.0 mmol/l
7 - 12months	1.9 – 8.0 mmol/l
2 years	2.8 – 7.2 mmol/l
3 years	3.3 – 6.7 mmol/l
adults(fasting)	3.6 – 5.8 mmol/l

Note: Hypoglycaemic attacks may occur at almost normal levels if a patient is accustomed to high blood sugar levels.

### Pre-Flight and In-Flight Management

1. If Conscious;
  - Oral barley sugar, sweetened orange juice or sandwiches.
  - If cause was a long-acting Insulin (NPH or Lente) or Oral sulphonylurea, an IV infusion of 5% Dextrose 100 – 125 mL/hr will need to be run for 24 hours and the patient will need to be admitted for observation.
2. If Unconscious;
  - Resuscitation as for all unconscious patients, with attention to airway, breathing and circulation.
  - Establish IV access and give 50 mL of 50% Dextrose in water at 10 mL/min.
    - May cause hypokalaemia if given too quickly.
  - Most patients recover in 5-10 mins unless hypoglycaemia was prolonged.
  - If chronic alcohol consumption is suspected, give 100mg Thiamine IM or IV before Dextrose to prevent Wernicke's encephalopathy.
  - Treat fitting with Diazepam 0.2 mg/kg, repeated as needed or PR Diazepam 0.5 mg/kg

## 2.2 HYPOGLYCAEMIA (CONT.)

### **Special Notes**

1. Neonates;
  - Give 20 mL of 5% Dextrose orally or N-G tube or 1 mL/kg of 50% Dextrose IV or 2 mL/kg of 25% Dextrose.
2. Glucagon;
  - Can be given 1 mg IM or SC or IV, 0.03 mg/kg IM for children to a maximum dose of 1mg.
  - Side effects include nausea and vomiting, initially hyperkalaemia, then hypokalaemia.
  - Not currently stocked in RFDS drug box but is carried in St John's Ambulances.

### **References**

Dunn R. (ed) *The Emergency Medicine Manual*. Dr Robert Dunn, Deakin ACT 1997.

Oh TE. (ed). *Intensive Care Manual*. 4th Ed, Butterworth Heinemann, 1997.

Fulde, G. *Emergency Medicine. The Principles of Practice*. 3<sup>rd</sup> Ed.

Saunders and Ho, Editors. *Current Emergency Diagnosis & Treatment*. 4<sup>th</sup> Ed, Lange, 1992

## 2.3 HYPOCALCAEMIA

### **Theory**

1. This is a relatively common condition and though rarely life-threatening it needs to be recognised and treated appropriately if potentially serious problems are to be prevented.
2. Serum calcium is composed of 2 major fractions, 45% of the total serum calcium is bound to plasma proteins, chiefly albumin and the other 55% exists as ionised Ca<sup>++</sup>. Changes in the ionised fraction result in the signs and symptoms of hypo- and hypercalcaemia. Acidosis increases the ionised fraction by displacing calcium from albumin whereas alkalosis decreases it; rapid changes in plasma acid-base status can therefore result in symptomatic hypocalcaemia. Examples include hyperventilation resulting in tetany and hypocalcaemia from massive transfusion of citrated blood.

### **Symptoms of Hypocalcaemia**

1. In the early stages these include peripheral and peri-oral paraesthesiae and later tetany, carpo-pedal spasm, hyperreflexia, colicky abdominal pain, stridor due to laryngospasm and convulsions. In infants one may also see apnoeic spells and intermittent cyanosis.

### **Signs of Hypocalcaemia**

1. These include Chvostek's sign (spasm of the ipsilateral facial muscles when the facial nerve is tapped over the parotid nerve), Trousseau's sign (carpo-pedal spasm caused by the reduction of the blood supply to the hand when a BP cuff above systolic pressure is applied to the forearm for 3 mins) and ECG changes which include lengthening of the QT interval and arrhythmia's.
2. Hypocalcaemia may be associated with hypomagnesaemia and hypokalaemia; this can be of significance in Aboriginal children and is probably related to renal and gastrointestinal losses.

### **Pre-Flight and In-flight Management**

1. The flight priority usually will depend on the underlying condition, if the patient is symptomatic and requiring active treatment then the flight will probably be Priority 1 or 2 and doctor accompanied.
2. Hypocalcaemia should always be considered in critically ill patients with sepsis, burns, acute renal failure, those who have been transfused with citrated blood, pancreatitis and those with hypoalbuminaemia.
3. Wherever possible blood electrolytes, including Ca<sup>++</sup>, Mg<sup>++</sup>, K<sup>+</sup> and acid-base status should be known and all abnormalities corrected. The i-STAT analyser can provide valuable information and should be available in all cases where electrolyte and acid-base imbalances are present or are suspected. A 12-lead ECG should always be available as well.
4. In mild cases with minimal symptoms with no tetany oral replacement therapy is appropriate.
5. In more severe cases the treatment for adults is IV Calcium Gluconate or Calcium Chloride 10% solution 5-10 mL. Monitor the Pulse rate, BP and ECG.
6. For Infants use IV Calcium Gluconate 10% (0.22 mmol Ca<sup>++</sup>/mL) Give 0.5mmol/kg slowly over 10-20 mins. If bradycardia develops then the infusion should be ceased immediately.

## 2.3 HYPOCALCAEMIA (CONT.)

### **Special Notes**

1. Normal values for total plasma calcium (PathCentre) are 2.25-2.60 mmol/L and for ionised calcium is 1.12-1.32 mmol/L.
2. Calcium can precipitate or exacerbate digitalis toxicity therefore IV calcium must be given very slowly in patients on Digoxin and the ECG must be monitored continuously.

### **References**

Edmond K. *Guidelines for the investigation and treatment of children with diarrhoea and dehydration*. Department of Paediatrics, Royal Darwin Hospital. May 1997

Dunn R (Ed). *The Emergency Medicine Manual*, Dr Robert Dunn, Deakin ACT 1997

Rosen, Baker, Braen, Dailey and Levy, (Eds). *Emergency Medicine concepts and clinical practice*. Mosby

Saunders and Ho, (Eds). *Current Emergency Diagnosis & Treatment*. 4<sup>th</sup> Ed, Lange, 1992.

## SECTION THREE – GASTROINTESTINAL

### 3.1 ACUTE PANCREATITIS

#### *Theory*

1. A multi-systems disease due to inflammation of the pancreas. Gallstones and alcohol abuse account for 75% of cases. Other causes include, mumps, vasculitis, trauma, penetrating peptic ulcer and post ERCP. Overall mortality is 10%, up to 50% in patients with severe disease.
2. Signs and symptoms depend on the amount of glandular destruction.
  - A. Mild to Moderate:
    - Epigastric pain, often of rapid onset and relieved by sitting forward, abdominal distension, nausea and vomiting, raised amylase and lipase, pain radiating to back, fever, tachycardia and hypotension.
  - B. Severe:
    - Hypotensive shock secondary to intraperitoneal blood and fluid loss, respiratory failure, acidosis, hypocalcaemia, abdominal mass.
3. Mild to moderate pancreatitis is usually self-limiting in 1 week. Complications, however, include chronic pancreatitis, diabetes, pancreatic insufficiency, ascites and cholelithiasis.
4. Severe pancreatitis can be complicated by Acute Respiratory Distress Syndrome (ARDS), acidosis, acute tubular necrosis, disseminated intravascular coagulation, shock, ileus, pleural effusions, severe vomiting, haemorrhage, sepsis or necrosis of the pancreas.
5. Pseudocysts can form; these are encapsulated fluid collections full of enzymes. Often multiple, if they are <6cm they tend to resolve. They may erode into blood vessels. A ruptured pseudocyst is a surgical emergency as it can cause massive bleeding.
6. Operative interventions if they are required may include laparotomy, endoscopic sphincterectomy and stone extraction if cholelithiasis. Total parenteral nutrition may be required if necrosis or infection is present. Occasionally debridement of necrotic pancreatic tissue and drainage of pseudocysts may be indicated.
7. Useful diagnostic tests, where available include amylase, lipase, FBC, U&E & Creatinine, Ca<sup>2+</sup>, glucose, LFT's, bilirubin, arterial blood gases, coagulation studies, blood group and cross-match. A Chest XR may show a raised left hemi-diaphragm, pleural effusions, atelectasis or ARDS. CT Scan may show pancreatic necrosis or pseudocyst formation.

#### *Pre-flight and In-flight Management*

1. Flights are usually Priority 1 or 2 and doctor accompanied in severe cases.
2. Administer supplemental oxygen by mask;
  - Intubation should be considered prior to transfer if evidence of ARDS is present and high flow rates of oxygen are required at rest in the hospital.
3. Ensure adequate IV access prior to transfer, preferably with 2 IV lines.
4. A nasogastric tube is essential and urinary catheterization is desirable in all but the mildest of cases.
5. Treat shock according to guidelines for management of shock;
  - A decreasing haematocrit may indicate haemorrhagic pancreatitis – transfusion may be required.

### 3.1 ACUTE PANCREATITIS (CONT.)

6. Adequate analgesia is important. Narcotics should be given IV and titrated to effect. Maxolon 10 to 20 mg IV may be required for nausea/vomiting.
7. In-flight management of acid / base and electrolyte imbalances can be assisted by use of the i-STAT analyser. Insulin infusion should be considered if the blood glucose is >15 mmol/l. Also consider calcium gluconate for hypocalcaemia.
8. Antibiotics are rarely indicated in the acute phase as sepsis occurs later in the illness but if cholelithiasis is present give IV Amoxicillin and Cephalosporin.
9. ECG monitoring is recommended - non-specific ST-T wave changes and bradycardia due to toxins may be seen.

#### **References**

Dunn R. (ed) *The Emergency Medicine Manual*. Dr Robert Dunn, Deakin ACT 1997

Oh TE. (ed). *Intensive Care Manual*. 4<sup>th</sup> Ed, Butterworth Heinman, 1997

Fulde, Gordian. *Emergency Medicine. The Principles of Practice*. 3<sup>rd</sup> Ed.,

Saunders C, Ho M. *Current Emergency Diagnosis and Treatment* 4th Ed. Appleton & Lange 1992.

## 3.2 HAEMATEMESIS AND MELAENA

### *Theory*

1. Gastrointestinal bleeding is a common medical emergency with significant morbidity and mortality. Despite treatment advances, mortality for patients presenting with upper gastrointestinal haemorrhage remains around 5-10%.
2. Haematemesis indicates bleeding proximal to the ligament of Treitz and occurs in only 50–66% of patients with upper GI bleeding.
3. Melaena may mean haemorrhage from either the upper GI tract or proximal colon.
4. Gastro-oesophageal varices account for 2–15% of all upper GI bleeding. Bleeding will cease spontaneously in only 20–30% of cases but as bleeding is often more severe and recurrent, mortality approaches 25–40% for each episode of variceal haemorrhage.

### *Pre-Flight and In-flight Management*

1. Flights for patients will be usually priority 1 or 2. Flights where the patient has ongoing haemorrhage resulting in instability and/or requiring transfusion will be doctor accompanied.
2. Pre-flight management will include resuscitation of the patient and replacement of intravascular volume with isotonic crystalloid (Normal Saline or Hartmann's) or colloid (Gelofusine or Haemaccel).
3. Blood should be given if there is persistent haemodynamic instability despite 2 litres of crystalloid or colloid, if the initial Hb < 8mg/dL, if there is significant re-bleeding, and in those patients with co-morbidities making them unable to tolerate periods of hypoperfusion or anaemia.
4. Oxygen should be administered to all patients.
5. Continuous ECG monitoring, non-invasive blood pressure monitoring and pulse oximetry should be instituted.
6. Patients should all have adequate IV access (two large bore cannulas 14 or 16G)
7. Some patients may require inotropic support if still haemodynamically unstable despite adequate fluid therapy
8. If possible blood (ideally cross matched type specific or if unable then uncrossed O neg) should be taken on the flight.
9. Octreotide infusion only has a place in the management of variceal haemorrhage. Dose is 50–100 µg bolus then infusion of 25 – 50 µg per hour. (See Drug Infusion Guidelines).
10. Fresh frozen plasma should be given when the prothrombin time is 3 seconds greater than the control or when large transfusions are required. Platelet transfusion is rarely required unless platelet count is less than  $50 \times 10^9 /L$ .

### *Special Notes*

Balloon tamponade is not available to RFDS staff but occasionally patients from regional centres may have a Sengstaken-Blakemore tube or Minnesota tube in place. Effects of gas expansion during air transport must be considered.

### *References*

Dunn R.(ed) *The Emergency Medicine Manual*, 2<sup>nd</sup> Ed., Dr Robert Dunn, Deakin ACT 2000  
Cameron P et al *Textbook of Adult Emergency Medicine*, Churchill Livingstone, 2000

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### 3.3 INTESTINAL OBSTRUCTION

#### *Theory*

1. Intestinal obstruction may be caused by physical obstruction or absence of function (paralytic ileus).
2. Intestinal obstruction may occur in the small bowel or colon. Obstruction to the small bowel is acute; that of the colon, less so. Either may be partial or complete.
3. Patients with intestinal obstruction all have a quantity of gas trapped within the gut. Expansion of gas at altitude causes pain and may cause perforation of necrotic tissue. Patients with a complete intestinal obstruction, especially obstruction due to rigid external structures (eg. hernia), are even more at risk.
4. Vomiting is common and changes in pressurisation can precipitate further vomiting with its attendant risk of aspiration.
5. Prolonged obstruction is complicated by perforation, sepsis and fluid/electrolyte disturbance. Patients should be resuscitated with appropriate fluids, K<sup>+</sup> and antibiotics pre-flight.

#### *Pre-flight and In-flight Management*

1. The type and duration of the obstruction will determine the flight priority. Sicker patients, the very young and the very old may require a doctor accompanied flight.
2. All flights will require sea-level pressurisation. This in most cases will preclude intermediary landings or 'meets' at airstrips whose elevation is considerably higher than sea-level.
  - The major changes in atmospheric pressure occur closest to the earth's surface in the first few thousand feet – if a patient is to become compromised it will occur there.
  - As in all things, however, occasionally a compromise is required if the risks (eg extra time taken to fly to Carnarvon rather than Meekatharra) outweigh the benefits. In some instances a patient with a bowel obstruction may suffer some additional pain on ascent to altitude but otherwise no serious adverse effects.
3. All patients will be 'nil by mouth', and will require IV fluids with close attention to be paid to hydration status. Patients who are vomiting or who have a small bowel obstruction require a nasogastric tube (NGT), which should be kept on straight drainage and aspirated at regular intervals. Sicker or elderly patients may require an indwelling catheter to allow more accurate monitoring of their urine output and fluid balance.
4. Where patients have been obstructed for some time, an up-to-date Na<sup>+</sup>, K<sup>+</sup> levels and acid-base status can be provided by using the i-STAT analyser.
5. Analgesia should be provided with titrated IV narcotics. An anti-emetic is unnecessary and may be potentially harmful. Nausea and vomiting should be treated with NGT aspiration.

#### *References*

*MIMS Annual* 23rd Ed 1999, Medimedia Australia Pty Ltd, p. 3-339

Rosen P. et al, *Emergency Medicine, Concepts and Clinical Practice*. 2<sup>nd</sup> Ed, Mosby 1988

## SECTION FOUR – GENITOURINARY

### 4.1 ACUTE / CHRONIC RENAL FAILURE

#### **Theory**

1. Acute renal failure is defined as a rapid increase in metabolic waste products (urea, creatinine, K<sup>+</sup>) usually associated with marked decrease in urine output. Isolated acute renal failure has a mortality ≈ 10%, in the setting of multi-organ failure the figure approaches 60-100%.
2. Features of acute renal failure include;
  - A rise in creatinine of >100 μmol//day,
  - High K<sup>+</sup>, acidosis (exacerbates high K<sup>+</sup> and causes hypotension and nausea), low Ca<sup>2+</sup>, high Phosphate. More rapid in catabolic states (sepsis, GI bleed, rhabdomyolysis),
  - Uraemic symptoms – nausea, hiccoughs, drowsiness, flap, foetor, pericarditis, bruising / bleeding, itch, hypotension, coma,
  - Death due to arrhythmia (2° to high K<sup>+</sup>, pulmonary oedema, GI bleed, pericardial tamponade).

#### **Pre-flight and In-Flight Management**

1. Priority and the need for a doctor will need to be determined on an individual basis. Most patients in acute renal failure will be tasked as priority 1 or 2, doctor accompanied.
2. Determine the cause:
  - A. Pre-renal;
    - Absolute hypovolaemia – bleeding, vomiting, diarrhoea, diuresis, burns, inadequate intake,
    - Relative hypovolaemia – vasodilatation (sepsis, vasodilators), reduced oncotic pressure (cirrhosis, nephrosis, sepsis, malnutrition),
    - Reduced cardiac output – pulmonary embolism, pericardial tamponade, infarct / arrhythmia,
    - Reno-vascular – renal artery thrombosis, atheroemboli.
  - B. Renal:
    - Glomerulonephritis, acute tubular necrosis, acute interstitial nephritis.
  - C. Vascular:
    - Malignant hypertension, haemolytic uraemic syndrome, severe pre-eclampsia.
  - D. Post – renal:
    - Pelvocalyceal – ureteric ( solitary kidney, extrinsic (lymphoma), mural (stricture), luminal (stone, clot, sloughed papilla),
    - VUJ – bladder (Ca. Bladder, cervix, bowel, stone),
    - Bladder neck – urethra (blocked catheter, stricture, prostate).
3. Determine type of renal failure and volume status:
  - A. Oliguric vs. non – oliguric?
    - Oliguric - <20 mL/hr, 500 mL/day. Oliguric has a higher mortality, treat early and monitor U&E, volume.
  - B. Patient 'wet' vs. 'dry'?

#### 4.1 ACUTE / CHRONIC RENAL FAILURE (CONT.)

- Assess volume:
  - In chronic RF check weight daily as a marker of total body water (1 kilo = 1 litre).
  - Low Na<sup>+</sup> implies water overload *not* Na<sup>+</sup> deficiency
  - Extracellular fluid; oedema signifies > 2 kg of fluid overload.
  - Reduced skin turgor if dry (beware elderly)
  - intravascular volume;
    - JVP (aim for 2 cm at 45°),
    - BP (high if overloaded, postural drop present if dry),
    - Capillary return; increased if dry.
- 3. Prevent incipient Acute Renal Failure:
  - Maintain intravascular volume:
    - aim for a mean arterial BP of 75 – 80mmHg by replacing fluids (monitor JVP or CVP if available), +/- inotropes.
  - Drugs:
    - Dopamine at renal dose (see infusion guidelines) to improve renal perfusion and natriuresis / diuresis,
    - Diuretics (mannitol or Frusemide).
- 4. Manage complications:
  - Hyperkalaemia: See specific Clinical Guideline.
  - Fluid Overload: See guideline for Acute Pulmonary Oedema.

#### **Special notes**

1. For Chronic Renal Failure Patients on or nearing dialysis;
  - Avoid catheterisation where possible,
  - Avoid drips or blood letting in forearm veins (may be required for fistula),
  - No BP measurements, drips or venepuncture on arm with fistula.
2. CAPD complications:
  - Overload:
    - Hypertension, increased weight, pulmonary oedema.
      - Treatment – use more frequent bag changes (if getting back more fluid than instilled) and increase strength of glucose (max 2. 5%).
  - Dehydration:
    - Treatment - reduce glucose strength of bag.
  - Peritonitis:
    - Pain, fever, diarrhoea, cloudy bag,
      - Treatment:
        - Send whole bag for MC&S,
        - Give Vancomycin 30 mg/kg and Gentamicin 2 mg/kg in bag for 6 hour dwell (further treatment according to culture results).

#### 4.1 ACUTE / CHRONIC RENAL FAILURE (CONT.)

- Exit site infection:
  - Swab, then if Gram Pos. Vancomycin weekly for four weeks, or Flucloxacillin 500mg QID for 2 weeks. If Gram Neg. Ciprofloxacin 500mg orally for 3 weeks.

#### **References**

Dr Mark Thomas *Orientation Manual For Renal Unit Medical Officers*, RPH, current 1999.

Oh TE. (ed) *Intensive Care Manual*. 4th Ed, Butterworth Heinemann, 1997.

*CAPD Manual for Remote Nurses*, Royal Perth Hospital, current 1999.

## SECTION FIVE – INFECTIOUS DISEASES

### 5.1 BACTERIAL MENINGITIS

#### *Theory*

Acute bacterial meningitis is a life-threatening medical emergency. The current mortality rate is 10-30%, and survival depends on prompt recognition and early treatment.

#### *Symptoms and Signs*

1. Patients with meningitis present with fever, headache, nuchal rigidity, and mental dysfunction. Seizures and cranial nerve deficits are also common. Infants with meningitis may show only vomiting, lethargy, irritability, and poor feeding. Elderly patients may present only with low-grade fever and delirium. The headache of meningitis is continuous and throbbing and, though generalised, is usually most prominent over the occiput. The pain is increased by head shaking, jugular vein compression, or any other manoeuvre that increases intracranial pressure (eg, coughing, sneezing, and straining at stool). Neck stiffness and other signs of meningeal irritation must be sought with care.
  - Note: Do not perform lumbar puncture in patients with signs of intracranial infection who also have papilloedema or focal neurologic findings (other than cranial nerve deficits); these patients may have intracranial mass lesions, and herniation of the brain may occur if lumbar puncture is performed.
2. Patients with meningitis may be divided into 2 groups on the basis of the presentation of the disorder.
  - Acute presentation
    - Symptoms and signs have been present for less than 24 hours and are rapidly progressive. The causative organisms in these patients are usually pyogenic bacteria, and the mortality rate is about 50%.
  - Subacute presentation
    - Symptoms and signs have been present for 1-7 days. Meningitis in this group of patients is due to bacteria, viruses, or fungi, and the death rate in cases due to bacterial infection is much lower than in patients with acute presentation of disease.

#### *Pre-Flight and In-flight Management*

These flights would usually be doctor accompanied and priority 1 or 2.

1. Assess the airway. In a patient with significant central nervous system depression who has an impaired gag reflex or is hypoventilating, perform an elective orotracheal intubation.
2. Apply oxygen. Use 100% non-rebreather reservoir bag/mask if patient is severely ill. Monitor with pulse oximeter.
3. Attach electrocardiographic monitor, and watch closely for bradycardia.
4. Initiate an intravenous line with 5% Dextrose in half-normal saline in the child below 2 years of age and in normal saline for those older than 2 years.
5. Assess the patients' volume status. Hypovolaemia can compromise perfusion of the central nervous system. Aggressive rehydration is indicated if signs of hypovolaemia are present. If the patient is normovolaemic, give fluids at two-thirds of the normal maintenance rate until serum electrolyte results have been obtained. If there is evidence of SIADH, continue at two-thirds of the maintenance rate. If no SIADH is present, increase intravenous fluids to the normal maintenance rate.

## 5.1 BACTERIAL MENINGITIS (CONT.)

6. Administer antimicrobial therapy based on the patients' age and the most likely pathogens.

- Neonates: Gram negatives, Group B Streptococci, Staphylococcal and Listeria
- Children: Strep. pneumoniae, Neisseria meningitidis, (H. Influenzae is uncommon since vaccination has commenced)
- Adults: Strep. pneumoniae, Neisseria meningitidis, staphylococci

Empirical therapy that covers the three most common pathogens should be instituted. The penicillin may be omitted in patients aged between 3 months and 15 years because it is added to cover *Listeria* which is resistant to cephalosporins, and *Listeria* infection is unlikely in patients in this age group unless they are immunosuppressed.

- Cefotaxime 2 g (children: 50 mg/kg up to 2 g) intravenously, 6-hourly OR Ceftriaxone 2 g (children: 50 mg/kg up to 2 g) intravenously, 12-hourly for 7 to 10 days **plus either**
- Benzylpenicillin 1.8 g (children: 60 mg/kg up to 1.8 g) intravenously, 4-hourly for 7 to 10 days **or**
- Amoxicillin 2 to 3 g (children: 50 mg/kg up to 2 to 3 g) intravenously, 4- to 6-hourly for 7 to 10 days.

Either the penicillin or the cephalosporin should be ceased once the organism has been identified and susceptibility tests are available.

### Special Notes

1. Treat seizures aggressively with anticonvulsants.
2. The role of corticosteroids in the management of acute meningitis remains controversial. An initial dose of dexamethasone, before antibiotics are commenced, has been found useful in minimising the incidence of complications in children, but such a relationship in adults or neonates has not been proven.
3. In confirmed cases of Neisseria Meningitidis contacts will need antibiotic prophylaxis.
  - Only medical or nursing staff who have performed or attempted mouth to mouth resuscitation or intubation, or who are in prolonged contact with the infected patient are in this category. Other medical staff, ambulance officers and aeromedical crew are NOT at increased risk, and do not require prophylaxis unless they give mouth to mouth resuscitation.

### Medical Chest Items

Benzylpenicillin 600 mg (Item 167), Water for reconstitution (Item 168), Phenoxyethylpenicillin Suspension 250 mg/ 5 mL (Item 125), Phenoxyethylpenicillin tablets 500 mg (Item 170), Amoxicillin suspension 250 mg/ 5 mL (Item 130), Amoxicillin capsules 500 mg (Item 172), Cephalexin suspension 250 mg/ 5 mL (Item 174), Cephalexin capsules 500 mg (Item 175).

### References

Saunders C, Ho M. *Current Emergency Diagnosis and Treatment* 4<sup>th</sup> Ed. Appleton & Lange, 1992.

Fauci et al. *Harrison's Principles of Medicine* 14<sup>th</sup> Edition CD-ROM Version 1.2 McGraw-Hill Companies Inc.

Watson C et al. *Guidelines for control of meningococcal disease in Australia*. NHMRC, AGPS 1996.

Tierney et al. *Current Medical Diagnosis and Treatment* 2000. 39<sup>th</sup> Edition, McGraw-Hill Companies, Inc, 2000.

Therapeutic Guidelines Limited. *Therapeutic Guidelines :Antibiotics*. 10<sup>th</sup> Edition, Therapeutic Guidelines Ltd, 1998-99

## 5.2 MENINGOCOCCAL INFECTION

### **Theory**

1. *Neisseria meningitidis* is a gram negative diplococcus. Thirteen serogroups have been identified, but over 90 per cent of disease is caused by serogroups A, B or C. The organism is transmitted principally by respiratory droplets from the nose and throat of an infected person. It can be asymptotically carried by up to 25 per cent of the community, only a few of whom will go on to develop invasive disease.
2. The hallmark of meningococcal disease which permits presumptive diagnosis is the appearance of a petechial rash. The rash is usually typical, with progressively enlarging petechial spots which may coalesce into large ecchymotic lesions. The appearance of a petechial rash in association with fever, vomiting and drowsiness is highly suggestive of meningococcal meningitis. Alternatively, irrespective of meningeal symptoms, patients presenting with fever, and a characteristic or consistent rash should be evaluated for evidence of actual or incipient shock and a diagnosis of meningococcal septicaemia should be considered.

### **Pre-flight and In-flight Management**

1. Most if not all flights for suspected meningococcal infection should be priority 1, doctor accompanied.
2. When meningococcal infection is suspected, particularly when actual or incipient shock is evident, immediate empirical therapy in the absence of a formal diagnosis is indicated. Treatment should commence immediately and not be withheld until *N. meningitidis* or another organism has been identified; this is particularly important in patients with a haemorrhagic rash.
3. Antibiotic Treatment;
  - Empirical therapy should be given parenterally, preferably intravenously, unless intravenous access cannot be attained. Intramuscular administration of antibiotics is not preferred in this setting, as supervening shock and hypotension may lead to failure of absorption of the injected antibiotic from the injection site.
  - Collection of a blood sample for culture should be attempted prior to administration of antibiotics but should not delay treatment.
  - If *N. meningitidis* is strongly suspected on clinical grounds, administer an immediate dose of Benzylpenicillin 60 mg/kg (for all ages) up to 3 g IV or IM as a stat dose followed by Benzylpenicillin 60 mg/kg (for all ages) up to 1.8 g IV every 4 hours.
  - In remote areas or in patients hypersensitive to penicillin, additional treatment should include Cefotaxime 2 g (children 50 mg/kg up to 2 g) IV 6 - 8 hourly or Ceftriaxone 2 g (children 50 mg/kg up to 2 g) IV 12 hourly.
4. Shock;
  - General management of shock or hypotension should be instituted (see specific guidelines). Important measures include high-flow oxygen, intravenous fluids and monitoring of urine output. Inotropes should be considered. Restricted fluids should be considered, but not in the presence of shock.

## 5.2 MENINGOCOCCAL INFECTION (CONT.)

### **Special Notes**

1. Meningococcal infection is a notifiable disease.
2. All close contacts of a patient with meningococcal disease should be offered antibiotic chemo-prophylaxis. Antibiotic prophylaxis aims to eliminate nasopharyngeal carriage of the organism for asymptomatic contacts and therefore to prevent subsequent transmission and secondary invasive infections in further contacts. Prophylaxis is not guaranteed to prevent contacts from acquiring disease, and there is no evidence that prophylaxis can treat and thereby abort disease in those already incubating the infection. Rifampicin is the drug of choice for prophylaxis.
3. Those at risk who require prophylaxis include household members and contacts in nurseries or day care centres who have been exposed to the index case within 10 days of onset. Persons exposed to oral secretions (eg by kissing or by mouth to mouth resuscitation) are similarly at risk.
  - Prophylaxis is currently recommended for health care workers who have been engaged in mouth to mouth resuscitation.
  - Prophylaxis should be also be considered for staff involved in airway suctioning or endotracheal intubation or those involved in prolonged contact with the infected patient.

### **Medical Chest Items**

Benzylpenicillin 600 mg vials / water for injection (Items 167 / 168), Phenoxymethylpenicillin tabs 500 mg (Item 170), Phenoxymethylpenicillin Suspension 250 mg/ 5 mL (Item 125).

### **References**

1998 *MIMS Annual*, 22nd Ed, MIMS Australia, 1998.

NHMRC. *Guidelines for the control of meningococcal disease in Australia*. Oct. 1996.

Oh TE. (ed) *Intensive Care Manual*. 4th Ed, Butterworth Heinemann, 1997.

Immunisation Working Party of the NHMRC. *The Australian Immunisation Handbook*. 7<sup>th</sup> Ed, NHMRC 2000

Therapeutic Guidelines Limited. *Therapeutic Guidelines :Antibiotics*. 10<sup>th</sup> Edition, Therapeutic Guidelines Ltd, 1998-99

## 5.3 TUBERCULOSIS

### **Theory**

1. *Mycobacterium Tuberculosis* is transmitted in airborne droplet nuclei by people with pulmonary or laryngeal tuberculosis during expiratory efforts, such as coughing or sneezing. Even casual close exposure to an infectious case has been known to lead to infection in a contact.
2. As a general rule persons with sputum positive for AFB on microscopy are considered most infectious while patients with extra-pulmonary disease are not.
3. There is no evidence to suggest that the risk of transmission of TB on aircraft is greater than in any other confined space (including other forms of public transport) if the duration of transfer is the same. Risk of transmission seems particularly to be related to prolonged transfers (duration of flight > 8 hours).

### **Pre-flight and In-flight Management**

1. Isolation is *unnecessary* for patients with tuberculosis whose sputum is bacteriologically negative, who do not cough or who are known to be on adequate therapy (based on known or probable drug susceptibility and a clear clinical response to therapy).
2. If the patient has or is suspected to have active pulmonary disease and he/she has not been given adequate therapy, the following precautions should be observed.
  - Patient to wear a mask capable of filtering submicron particles and to use tissues to cover their mouth and nose when coughing or sneezing; the tissues should then be placed in a disposable plastic bag that can be sealed.
  - Staff and other patients to wear a mask capable of filtering submicron particles when with the patient in a confined space eg inside the aircraft or road ambulance.
  - People in an immunocompromised condition or on immunosuppressive therapy should not be carried on the same aircraft.
3. In suspected cases all undiagnosed patients with cavitations in the upper lungs should be considered as infectious in the absence of sputum results.

### **Special Notes**

1. RFDS currently stock masks capable of filtering submicron particles. The only drawback is that to be efficient they may make breathing difficult for a sick patient. For these patients a mask with a one-way valve so that the air is only filtered when breathed out may be more suitable.
2. For the very rare occasion of transferring a person with active Multi-drug Resistant TB, a full hood type of respirator fitted with HEPA filter will be required for the accompanying medical staff.
3. For further information contact the Perth Chest Clinic on 9325 3922.

### **References**

Chin J. (ed) *Control of Communicable Diseases Manual* 17<sup>th</sup> Ed, American Public Health Association 2000.

MMWR. *Exposure of Passengers and Flight Crew to Mycobacterium tuberculosis on Commercial Aircraft, 1992-95* Morbidity & Mortality Weekly Report, March 3,1995: 44(08);137-140, Centre for Disease Control, Atlanta 1995.

Centre for Disease Control, Atlanta. *Tuberculosis Risk on Aircraft* [http://www.cdc.gov/travel/tb\\_risk.htm](http://www.cdc.gov/travel/tb_risk.htm) , Mar 2000.

Pang, Dr Shing. Perth Chest Clinic – personal communication, Mar 2000.

## SECTION SIX – MENTAL HEALTH

### 6.1 TRANSFER OF MENTAL HEALTH PATIENTS

#### *Theory*

1. Mental Health patient refers to patients who are being transferred principally because of an acute psychiatric disorder. This does not include patients being carried for other medical or surgical conditions who have an incidental psychiatric condition which is well controlled.
2. Other patients acutely affected by alcohol, illicit drugs or withdrawal symptoms, or who appear to pose a threat to the safety of a flight should be managed in accordance with these guidelines also, although they are not covered by the Mental Health Act.
3. Our CASA-approved Operations Manual requires us to ensure the safety of passengers and crew during flight. Conditions are imposed on the carriage of patients at risk of becoming disturbed or violent in flight.
4. In the event of an in-flight emergency there are limited resources on-board an aircraft. This must be borne in mind when planning the 'least restrictive option' for the management of a patient (as outlined in the Mental Health Act 1996).
5. The term 'at risk' is used to refer to those patients judged to be at risk of behavioural disturbance or violence during flight.

#### *Pre-flight and In-flight Management*

##### **1. Flight Priority**

Generally, flights are all classed as Priority 3 (routine interhospital transfer). However, in smaller hospitals, nursing posts and remote communities that priority may be upgraded at the RFDS doctor's discretion.

##### **2. 'At risk' status**

The assessing RFDS doctor will determine if the patient is 'at risk' in conjunction with the referring doctor / mental health practitioner. Factors to be considered include past history, overt behavioural disturbance, agitation, confusion and delusional ideation. Most if not all patients with major affective disorders (especially schizophrenia and bipolar affective disorder) should be considered at risk.

- If not 'at risk' of in-flight behavioural disturbance, restraint (chemical or physical) is inappropriate and the patient does not require an escort other than a FNS. Alternative means of transport (eg routine public transport) should be considered for these patients.
- If 'at risk' the patient requires sedation, restraint and an additional escort. Only one such patient may be carried on an aircraft at any one time.

##### **3. Sedation (chemical restraint)**

IV access (cannula + bung) must be in place and well secured prior to transport. Our preferred regime for sedation is Midazolam 2.5 - 5 mg IV or Diazepam 2.5 - 5 mg IV supplemented with Haloperidol 5 mg IV titrated against the clinical response. Careful airway management must be observed, and the patient should be monitored (at least SaO<sub>2</sub>).

##### **4. Physical Restraints**

Mechanical bodily restraint must be authorised in writing by a doctor or a senior mental health practitioner. Restraint may only be used within the period for which the authorisation is given.

## 6.1 TRANSFER OF MENTAL HEALTH PATIENTS (CONT.)

### 5. Escorts

- All patients on a Form 3 (transport order) must be accompanied by a police officer.
- 'At risk' patients not on Form 3 require an alternative suitable escort provided by the referring location eg a community mental health practitioner, hospital nurse, hospital orderly or a relative of the patient.

### 6. Carriage of psychiatric patients at night

Mentally disturbed patients are not normally carried at night due to limited resources and for safety reasons (risks of disorientation and lack of landing options in an emergency). Also, many patients would benefit from early sedation and an opportunity to reduce their arousal prior to transfer the next day. However, in exceptional circumstances, particularly where resources at the referring location are limited, a night flight may be authorised.

#### **Special Notes**

1. Copies of the relevant Mental Health Act Forms appear in the following pages.
2. If a patient is classified as not 'at risk', yet appears to the RFDS crew on arrival as being 'at risk', then the duty RFDS doctor should be contacted and the procedures for 'at risk' patients followed.

#### **Medical Chest Items**

Diazepam 10 mg ampoules (Item 119), Diazepam 5 mg tabs (Item 152)

#### **Reference**

*Clinician's Guide to the Mental Health Act 1996*, Mental Health Division, Health Department of Western Australia

# Referral for examination by a psychiatrist

*Mental Health Act 1996*  
Section 29  
Form 1

<b>Person being referred</b>	Family name: .....
	Other names: .....
	Alias: .....
	Address: .....
	Postcode: .....
Date of birth: __ __ / __ __ / __ __	Patient reference no.:

<b>Examination by referring practitioner</b>	Name of referring practitioner: .....	
	Occupation of referring practitioner: .....	
	Place where person examined: .....	
	Date of examination: __ __ / __ __ / __ __	Time of examination: ..... am / pm
	Basis on which it is suspected that person should be an involuntary patient --	
	◆ Matters observed by referrer:	
◆ Matters communicated to referrer:		

<b>Place of referral</b>	Hospital or place to which person is referred:
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<b>Referral</b>	<p>I have examined the person being referred and, having regard to section 26 of the <i>Mental Health Act 1996</i>, suspect that the person should be made an involuntary patient. I therefore refer the person to the above hospital or place for examination by a psychiatrist.</p> <p>Signature of referrer: .....</p> <p>Date: __ __ / __ __ / __ __</p> <p>Time: ..... am / pm</p>
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<b>Receival into hospital or other place</b>	Date: __ __ / __ __ / __ __	Time received: ..... am / pm
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[Back of Form 1]

**NOTES FOR THE MEDICAL PRACTITIONER OR AUTHORIZED MENTAL HEALTH PRACTITIONER**

<b>Criteria for referral</b>	<p>A medical practitioner or an authorized mental health practitioner may only refer a person for examination by a psychiatrist if the practitioner has personally examined the person and has reasonable grounds to suspect that —</p> <ul style="list-style-type: none"> <li>◆ the person has a mental illness requiring treatment;</li> <li>◆ the treatment can be provided through detention in an authorized hospital or through a community treatment order and is required to be so provided in order to — <ul style="list-style-type: none"> <li>○ protect the health or safety of the person or any other person;</li> <li>○ protect the person from self-inflicted harm (being serious financial harm, lasting or irreparable harm to an important personal relationship, or serious damage to the reputation of the person); or</li> <li>○ prevent the person doing serious damage to any property;</li> </ul> </li> <li>◆ the person has refused or, due to the nature of the mental illness, is unable to consent to the treatment; and</li> <li>◆ the treatment cannot be adequately provided in a way that would involve less restriction of the freedom of choice and movement of the person than would result from the person being an involuntary patient.</li> </ul>
<b>Place of referral</b>	A referring practitioner must refer the person to an authorized hospital or some other place where, to the knowledge of the referring practitioner, the examination can be carried out. If the person is a voluntary patient in an authorized hospital, the practitioner must refer the person for examination in that hospital.
<b>Time limit of referral</b>	A referring practitioner must make a referral within 48 hours of examining the person.
<b>Time limits for receipt and examination</b>	<p>An authorized hospital must not receive a referred person if more than 7 days have elapsed since the referral was made. Once received into hospital the person may be detained there for up to 24 hours pending examination by a psychiatrist.</p> <p>An examination at any other place must not be carried out if more than 7 days have elapsed since the referral was made.</p>
<b>Availability of beds</b>	A practitioner referring a person to an authorized hospital should ensure that the hospital is able to accept the person. However, if the person is referred and the facilities available at that hospital are insufficient or inappropriate to accommodate or treat the referred person, the person in charge of the hospital may decline to accept the referred person. In that case, the referred person may be transferred to another authorized hospital.
<b>Information</b>	A referring practitioner may, but is not required to, give a copy of the referral to the person being referred. However sections 160 and 161 of the <i>Mental Health Act 1996</i> relating to access to personal records, and the laws relating to freedom of information, may allow the person to have access to the referral form.

# Transport order

Mental Health Act 1996  
 Section 34 (1), 41 (1), 71 and 84 (1)  
 Form 3

<b>Person to be apprehended</b>	Family name:	.....
	Other names:	.....
	Alias:	.....
	Address:	.....
	Date of birth: __ __/ __ __/ __ __	Postcode: ____ - ____ Patient reference no.:

<b>Practitioner making order</b>	Name of practitioner making order:	.....
	Occupation of practitioner making order:	.....

<b>Hospital or place</b>	Hospital or place to which person is to be taken:	.....
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<b>Order</b>  [Tick one box]	I have --	
	<input type="checkbox"/> referred the person to be apprehended to the above hospital or other place for examination by a psychiatrist; <input type="checkbox"/> ordered that person to be apprehended be received into, and detained in, the above hospital for further assessment by a psychiatrist; <input type="checkbox"/> revoked a community treatment order in relation to the person to be apprehended and ordered that the person be detained in the above hospital; or <input type="checkbox"/> ordered the person to be apprehended to attend the above hospital or other place for psychiatric treatment because the person has breached a community treatment order.	
	I therefore order that the person to be apprehended be apprehended and taken to the above hospital or place.	
	Signature of practitioner making order:	.....
	Date: __ __/ __ __/ __ __	Time: _____ am / pm

<b>Special factors or other important details</b>	.....
---	-------

**TO THE POLICE** You are authorized by this order to apprehend the person named in this order and take him or her to the hospital or place set out above.

(Back of Form 3)

## NOTES FOR THE PRACTITIONER MAKING THE ORDER

<b>Criteria for transport order</b>	<p>A practitioner may only make a transport order in respect of a person if —</p> <ul style="list-style-type: none"> <li>◆ within the last 7 days the person has been referred, under section 29 of the <i>Mental Health Act 1996</i>, for examination by a psychiatrist (section 34 and Form 1);</li> <li>◆ an order has been made for the person to be received into, and detained in, an approved hospital for further assessment by a psychiatrist (section 41 and Form 5); or</li> <li>◆ a community treatment order in relation to the person has been revoked and a psychiatrist has ordered that the person be detained in hospital as an involuntary patient (section 71 and Form 11),</li> </ul> <p>and the condition of the person is such that assistance is required to take the person to the specified place and no suitable alternative to apprehension is available.</p> <p>A psychiatrist may also make a transport order if the person has breached a community treatment order, an order to attend has been made and the person has failed to attend as ordered (section 84 and Form 14). In such a case a transport order is not to be made if there is a reasonably available alternative means of ensuring that the person attends for the treatment required by the order to attend.</p> <p>A transport order is not required if the person is already in police custody.</p>
<b>Transportation</b>	<p>A police officer who apprehends a person under a transport order must take the person to the specified place as soon as is practicable after apprehending them, and in any event before the order lapses.</p> <p>A transport order lapses —</p> <ul style="list-style-type: none"> <li>◆ if it was made following a referral for examination by a psychiatrist (section 34) — <ul style="list-style-type: none"> <li>○ if the referral is to an authorised hospital, 72 hours after the order is made; or</li> <li>○ if the referral is to another place, 24 hours after the order is made; or</li> </ul> </li> <li>◆ in either case, at the end of the 7<sup>th</sup> day after the referral was made, if that occurs first;</li> <li>◆ if it was made following an order that the person be received into, and detained in, an approved hospital for further assessment by a psychiatrist (section 41), 72 hours after the transport order was made; or</li> <li>◆ if it was made following the revocation of a community treatment order (section 71), 72 hours after the transport order was made.</li> </ul> <p>If a transport order is made because the person has failed to comply with an order to attend (section 84), the police officer must take the person to the place specified as close as is practicable to a time when the treatment can be given.</p>
<b>Detention</b>	<p>A person apprehended under a transport order may be detained until —</p> <ul style="list-style-type: none"> <li>◆ the order lapses; or</li> <li>◆ the person is received into hospital or is given the required treatment;</li> </ul> <p>whichever is first.</p>
<b>Information</b>	<p>A police officer apprehending a person under a transport order made under section 34, 41 or 84 must give a copy of the transport order to the apprehended person. A police officer apprehending a person under any other transport order may, but need not, give a copy of the order to the apprehended person.</p>
<b>Availability of beds</b>	<p>A practitioner making a transport order should ensure that the hospital which a person is to be taken is able to accept the person. However, if the person is taken to the hospital and the facilities available at that hospital are insufficient or inappropriate to accommodate or treat the apprehended person, the person in charge of the hospital may decline to accept the apprehended person. In that case, this order authorizes the police to transport the apprehended person to another authorized hospital.</p>

**Name of Facility****EMERGENCY PSYCHIATRIC TREATMENT***(Mental Health Act 1996- ss 113-115)*

This record of treatment needs to be completed if a person refuses or is unable to consent to psychiatric treatment and treatment is necessary to save the person's life or to prevent the person from behaving in a way that can be expected to result in serious physical harm to the person or any other person.

<b>Name of person receiving treatment or Patient label (if available):</b>
--

**Legal Status-**  
(circle)

Voluntary

Referred person

<b>Particulars of treatment:</b>		
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;">Time treatment given:</td> <td style="width: 50%; padding: 5px;">Place of treatment:</td> </tr> </table>	Time treatment given:	Place of treatment:
Time treatment given:	Place of treatment:	
<b>Reason for treatment:</b>		
<b>Effects of treatment (including any adverse reactions):</b>		
<p><b>Name of person giving the treatment:</b> <b>Designation:</b></p> <p><b>Signature-</b> _____ <b>Date-</b> _____</p>		
<b>Names and designations of other staff involved in the giving of the treatment:</b>		

A copy of this report must be forwarded to the Mental Health Review Board, GPO Box Y3063, East St George's Terrace, PERTH 6832 or Fax to 9219 3163. Should a critical incident arise out of the giving of Emergency Psychiatric Treatment the Chief Psychiatrist must be informed. In those circumstances contact Ms Janet Peacock, Manager, Office of the Chief Psychiatrist on 92224079 or e-mail [janet.peacock@health.wa.gov.au](mailto:janet.peacock@health.wa.gov.au)

## SECTION SEVEN – MISCELLANEOUS

### 7.1 ANAPHYLAXIS

#### *Theory*

1. The most common causes of an anaphylactic reaction are bee stings, drugs (including antibiotics, streptokinase and anaesthetic agents), vaccines, snake antivenom and blood or blood products.
2. The clinical presentation is acute collapse with any of the following features:
  - Cutaneous: burning sensation, itching of lips, mouth or throat, flushing, angioedema, urticaria, conjunctival injection or conjunctival oedema;
  - Cardiovascular: tachycardia, hypotension, shock;
  - Respiratory: rhinitis, bronchospasm, coughing, laryngeal oedema, choking sensation;
  - Gastro-intestinal: abdominal cramps, nausea, vomiting, diarrhoea;
  - CNS: apprehension, metallic taste in mouth, loss of consciousness, convulsions.

#### *Pre-flight and In-flight Management*

1. Anticipate. Always question carefully about allergies before administering any drugs and exercise extra caution in known atopic individuals (asthma, hay fever, eczema).
2. Confirm the diagnosis. Rule out other causes for the patient's signs and symptoms (eg vasovagal or hysterical reaction, asthma, pulmonary embolism, hypovolaemia, hypoglycaemia).
3. Adrenaline is the treatment of choice for severe allergic reactions.
  - The dose is 0.3 to 1.0 mg IM in adults (0.3 – 1.0 mL of 1:1,000).
  - The dose in children is 10 µg/kg IM (eg. 0.1 mL of 1:1,000 IM in a 10-kg child).
  - In severe shock or if IM injection has been ineffective use Adrenaline (1:10,000 Miniject) intravenously in similar doses. Monitor for arrhythmias and repeat Adrenaline as necessary.
4. Remove allergen.
  - Delay further absorption. Stop intravenous blood or drugs if suspected as cause.
5. Assess the airway.
  - If total obstruction intubate or create a surgical airway.
  - If airway obstruction with stridor give Adrenaline IM as above then Adrenaline 5mL 1:1000 nebulised.
6. Assess breathing.
  - Give Oxygen 6-10 litres/min via facemask, assist ventilation if necessary.
  - Treat bronchospasm with Adrenaline IM as above.
  - Follow this with Salbutamol 5mg nebulised every 15 minutes.
  - Consider other treatment modalities eg. further Adrenaline, Aminophylline or IV Salbutamol.
7. Assess circulation.
  - If no pulse treat as for cardiac arrest protocol.
  - If shocked and no parental Adrenaline already given, give Adrenaline IV as above.

## 7.1 ANAPHYLAXIS (CONT.)

- Give fluids: Haemaccel or Hartmann's solution 500 to 1000 mL IV stat for an adult (20 mL/kg in children), further fluids according to clinical response.
4. Monitor response, especially heart rate and blood pressure (good index of response to treatment).
  5. Consider other drugs to counteract histamine release and inflammatory response eg
    - steroids [Hydrocortisone 4 mg/kg (up to 200 mg) IV 6 hourly *or* Dexamethasone 0.1 - 0.25 mg/kg (up to 8 mg IM or IV)]
    - H<sub>2</sub> receptor blockers (protracted cases) [Ranitidine 50mg IV: 8-12 hourly].
    - Glucagon (especially for patients on  $\beta$  blockers who have more severe reactions) [1mg IV every 5 mins].
  6. Document on an Incident Report to permit follow up of blood crossmatch, medical records, and for patient advice and Medic Alert warning.

### **Medical Chest Items**

Adrenaline ampoules 1:1,000, 1mL (Item 99)  
Dexamethasone ampoules 8 mg in 2mL (Item 100)  
Promethazine mixture 5 mg/ 5 mL (Item 119)  
Loratadine tablets 10 mg (Item 157)  
Salbutamol Aerosol Spray 100 $\mu$ g/dose (Item 107)  
Aerosol Spacer (Item 228)  
Prednisolone tabs 5 mg (Item 151)  
Oxygen (where available).

### **References**

Oh TE. (ed) *Intensive Care Manual*. 4<sup>th</sup> Ed, Butterworth Heinemann, 1997.  
Advanced Life Support Group. *Advanced Paediatric Life Support*. 2<sup>nd</sup> Ed, BMJ Publishing Group 1997.  
Cameron P. Jelinek G. et al. *Textbook of Adult Emergency Medicine*. 1<sup>st</sup> Ed, Churchill Livingstone p637-642 2000.

## 7.2 HYPERKALAEMIA

### **Theory**

1. Potassium is the principal intracellular cation and is largely responsible for the maintenance of the resting membrane potential. Potassium is shifted out of the cell in acidotic states whereas insulin and  $\beta_2$  agonists promote potassium movement into the cell.
2. Hyperkalaemia is defined as a serum K > 5.0 mmol/l.
3. Causes include;
  - factitious (haemolysed specimen),
  - tissue damage (multi-trauma, burns, rhabdomyolysis),
  - decreased excretion (renal failure, Addison's disease),
  - drugs (Indomethacin, Spironolactone, A.C.E. inhibitors),
  - compartment shift (acidosis, insulin deficiency, Digoxin overdose, Suxamethonium, fluoride poisoning).
4. Clinical features include tingling, paraesthesiae, weakness and flaccid paralysis.
5. ECG features include peaked T waves, flattened P waves, prolonged P-R interval, widened QRS, sinus arrest or asystole.

### **Pre-flight and In-flight Management**

1. Treat the underlying cause,
2. For life threatening hyperkalaemia give 50 gm Dextrose (100 mL of 50% Dextrose) with 5-10 units Actrapid Insulin SC followed by;
3. IV Sodium Bicarbonate 50-100 mmol over 30 min (if acidotic);
  - avoid if patient has pulmonary oedema.
4. IV Calcium Gluconate 10 mL of 10% (2.2 mmol);
  - reduces the cardiotoxic effects of potassium,
  - administer by slow IV (max 2 mL/min), repeat if necessary.
5. Salbutamol – 2 x 5 mg nebs 30 mins apart will reduce serum K<sup>+</sup> by 1 mmol/l for 4 hours.

### **Special Notes**

1. Patients in renal failure need close attention to hydration status, consider diuresis with Frusemide or inducement of diarrhoeal with Sorbitol / lactulose.
2. Oral and rectal Resonium A 15-30 g 6/24 will reduce serum K<sup>+</sup> in less acute cases.

### **Medical Chest Items**

Salbutamol aerosol spray 100  $\mu$ g (item 107).

### **References**

- Oh TE. (ed) *Intensive Care Manual*. 4<sup>th</sup> Ed, Butterworth Heinemann, 1997.
- Dunn R. (ed) *The Emergency Medicine Manual*. Dr Robert Dunn, Deakin ACT 1997.
- Dr Mark Thomas Orientation Manual For Renal Unit Medical Officers, RPH, current 1999.
- CAPD Manual for Remote Nurses, Royal Perth Hospital, current 1999.

## 7.3 HYPOKALAEMIA

### **Theory**

1. Hypokalaemia is defined as a serum K < 3.5 mmol/l.
2. Potassium is the principal intracellular cation and is largely responsible for the maintenance of the resting membrane potential. Potassium is shifted out of the cell in acidotic states whereas insulin and  $\beta$ 2 agonists promote potassium movement into the cell.
3. Causes include;
  - abnormal losses (vomiting and diarrhoea, drugs especially diuretics and corticosteroids, Conn's Syndrome, Cushing's Syndrome),
  - inadequate intake,
  - compartment shift (alkalosis, insulin,  $\beta$ 2 agonists).
4. Clinical features include weakness, hypotonicity, depression, ileus and arrhythmias.
5. ECG changes include prolonged PR interval, T wave inversion, prominent U waves and atrial and ventricular tachyarrhythmias, especially torsade de pointes.

### **Pre-flight and In-flight Management**

1. IV infusion of Potassium Chloride;
  - Maximum rate: 40 mmol/hr (1 g = 13 mmol),
  - ECG monitoring is required at high infusion rates.

### **References**

- Oh TE. (ed) *Intensive Care Manual*. 4<sup>th</sup> Ed, Butterworth Heinemann, 1997.  
Dunn R. (ed) *The Emergency Medicine Manual*. Dr Robert Dunn, Deakin ACT 1997.

## 7.4 SHOCK

### *Theory*

1. Shock is defined as a state of inadequate tissue perfusion and oxygenation of tissues. In practice shock should be considered when systolic blood pressure is less than 90 mmHg.
2. Shock may be present due to hypovolaemia, reduced vascular tone and / or reduced cardiac output.
  - Causes of hypovolaemia (reduced intravascular volume), include haemorrhage (concealed or revealed), dehydration (loss of intra and extracellular fluids) due to losses or sequestration in the gut, excessive diuresis and excessive insensible losses (sweating).
  - Causes of reduced vascular tone include peripheral vasodilatation as occurs with septic shock, anaphylaxis, drugs, and autonomic neuropathy or spinal cord injury.
  - Causes of reduced cardiac output include: cardiac failure secondary to arrhythmias, myocardial infarction, valvular disease, pulmonary embolus or cardiomyopathies; and reduced venous return as in venacaval obstruction due to abdominal masses (eg. gravid uterus) or raised intrathoracic pressure (eg. PEEP in ventilated patients).

### *Pre-flight & In-flight Management*

1. Ideally shocked patients should be stabilized at the referring location prior to transfer. A patient that is unable to be stabilized due to inadequate local resources or ongoing problems should be a Priority 1 or 2 doctor accompanied flight.
2. If hypotension develops in-flight:
  - Assess if treatment is necessary; does the patient have signs of shock such as pallor, sweating, cool mottled extremities, tachycardia, depressed level of consciousness and a reduced urine output? Can the hypotension (systolic blood pressure less than 90 mmHg) be regarded as normal for the patient or secondary to treatment? Common drugs implicated include vasodilators, narcotics (eg. morphine), and antihypertensives. Falling blood pressure can occur in patients on Salbutamol infusions due to peripheral effects. Initial management may be to reduce the infusion or cease the suspected medication or observe further.
  - Administer high flow oxygen. A non-rebreathing mask should be considered.
3. Is patient hypovolemic, peripherally vasodilated or is there obstruction to venous return? Position supine and elevate lower limbs (eg. pillows).
  - Lie in lateral position if pregnant.
4. Is the patient bleeding? If so attempt to:
  - Control haemorrhage – dressings, packing cavities, pressure bandages, suturing, MAST.
  - Replace blood loss. Blood is preferable but sometimes not accessible. Two large bore intravenous lines (14 or 16 gauge) should be inserted and give Normal Saline (0.9% saline), Hartmann's solution or colloid (eg. Haemaccel). Infuse rapidly at first (eg. 500mL over 15 minutes) and continue until blood pressure improves, then reduce the rate.
  - Apply and inflate MAST where appropriate (see specific guidelines). Contraindicated in cardiogenic shock.
5. Is the patient dehydrated?
  - Replace fluids. Insert at least one large bore intravenous cannula. Give a bolus of crystalloid (eg. Normal Saline) or colloid (eg. Haemaccel) until blood pressure improves, then continue fluid replacement at a slower rate.

## 7.4 SHOCK (CONT.)

6. Is there reduced vascular tone?
  - Manage anaphylaxis with Adrenaline and fluids (see specific guidelines).
  - Manage septicaemia with fluids, antibiotics as indicated and inotropes if necessary. Inotropic infusions should only be used on doctor-accompanied flights. See guidelines on Meningococcal Infections.
  - Manage spinal cord injury with supine position and modest fluid replacement. See guidelines on spinal cord injury.
7. Is there reduced cardiac output?
  - Manage acute left ventricular failure (pulmonary oedema) with oxygen, upright posture, Frusemide and fluid restriction (see specific guidelines).
  - Manage arrhythmias (see specific guidelines).
  - Manage impaired venous return with patient positioning or reduction in intrathoracic pressure (eg. reduce ventilator pressures, PEEP or release tension pneumothorax).

### **Medical Chest Items**

Adrenaline ampoules 1: 1000, 1mL (Item 99).

### **References**

Oh TE. (ed) *Intensive Care Manual*. 4th Ed, Butterworth Heinemann, 1997

## SECTION EIGHT – NEUROLOGICAL

### 8.1 STATUS EPILEPTICUS

#### *Theory*

1. Status epilepticus is a clinical or electrical seizure lasting at least 15 - 30 minutes, or a series of seizures without complete recovery over the same period of time. After 30 minutes, the brain begins to suffer from hypoxia and acidosis, with depletion of local energy stores, cerebral oedema, and structural damage. Eventually, pyrexia, hypotension, respiratory depression, and even death may occur.
2. There can be a variety of causes of status epilepticus. Common causes include anticonvulsant withdrawal, alcohol withdrawal, cerebrovascular accident, metabolic derangement (hypoxia, hyponatremia [ $< 120$  mmol/l] hypoglycaemia, hyperosmolality [ $> 300$  mosm/L]), trauma, drug toxicity (amphetamines, cocaine, salicylates, methanol, ethanol), CNS infection, hyperthermia ( $> 41-42^{\circ}\text{C}$ ) or tumour.
3. Search carefully for seizure activity in the comatose patient. Manifestations may be subtle, eg, deviation of head or eyes, repetitive jerking of fingers, hands, or one side of the face.

#### *Pre-Flight and In-flight Management*

Flights for patients with Status Epilepticus will usually be doctor accompanied and priority 1 or 2 depending on the facilities of the referring location.

1. Protect the Airway:
  - Roll the patient onto one side if possible. Endotracheal intubation may be necessary. Do not waste time trying to insert a tongue blade through clenched teeth, as it does not protect the airway and may cause broken teeth.
2. Obtain IV access:
  - If possible, take bloods for FBE, glucose, electrolytes, magnesium, and calcium determinations; hepatic and renal function tests; as well as extra tubes of blood for possible toxicology screen or drug levels (including anticonvulsants if patient is known or suspected to be taking them).
3. If IV access cannot be obtained:
  - Diazepam may be given rectally at a dose of 0.2 – 0.7 mg/kg or
  - Midazolam can be given intranasally at a dose of 0.2 mg/kg (max dose 10 mg) or
  - Midazolam can be given intramuscularly at a dose of 0.1 – 0.4 mg/kg (max dose 10 mg).
4. Rule out hypoglycaemia:
  - Give Glucose, 50 mL of 50% solution intravenously over 5 minutes.
  - If malnutrition is suspected, give Thiamine, 100 mg intravenously slowly prior to, or at the same time as, glucose.
5. Give Diazepam or Midazolam:
  - Give Diazepam 5-10 mg (paediatrics 0.3-0.5 mg/kg) IV over 1-2 minutes. This treatment is effective in 80-90% of cases of status epilepticus, although apnoea, bradycardia, or hypotension may rarely result.
  - Alternatively, intravenous Midazolam may provide control of refractory status epilepticus; the suggested loading dose is 5 – 10 mg (paediatrics 0.2 mg/kg), followed by 0.05-0.2 mg/kg/hr.

## 8.1 STATUS EPILEPTICUS (CONT.)

6. Administer a loading dose of Phenytoin - regardless of the effect of Diazepam, a maintenance drug is required:
  - Give Phenytoin (Dilantin) in normal saline, 15-18 mg/kg by intravenous infusion at a rate of 50 mg/min (paediatrics 2 mg/kg/min) or slower.
  - Infusion of Phenytoin at more rapid rates (especially if given into centrally placed intravenous lines) can precipitate cardiac arrhythmias or hypotension.
  - Phenytoin orally or intravenously should be given to all patients except those who have a short-term metabolic condition known to cause seizures, such as alcohol withdrawal or hypoglycaemia, which does not require or respond to phenytoin.
7. If these measures fail, general anaesthesia with ventilatory assistance and neuromuscular junction blockade will most likely be required. Use a rapid sequence induction technique with cricoid pressure, Thiopentone (3 - 5 mg/kg) and Suxamethonium (1.5 mg/kg).
8. Measure Arterial Blood Gases and pH:
  - Arterial blood PCO<sub>2</sub> is a sensitive indicator of the adequacy of ventilation (hypercapnia is present in proportion to the degree of hypoventilation). Metabolic acidosis due to lactic acidosis resulting from status epilepticus is commonly present for as long as 1 hour after a seizure, depending on the duration and vigour of muscular activity. This acidosis requires no treatment. Acidosis lasting longer than 1 hour should prompt a search for other causes of acidosis

### Special Notes

1. Consider Meningitis:
  - Commence appropriate antibiotics if meningitis is suspected, especially if fever (body temperature > 38.5° C) or nuchal rigidity is present. However, the muscle activity of status epilepticus alone produces transient fever higher than 38.5° C in 25% of patients. Status epilepticus may also produce a mild transient cerebrospinal fluid pleocytosis (< 100 cells/micro/L).
2. Prevent injury to the patient during the seizure by padding the environment. Do not use rigid restraint (fractures may result) or insert objects into the patient's mouth during the seizure.

### Medical Chest Items

Diazepam ampoules 10 mg/ 2 mL (Item 98), Diazepam tablets 5 mg (Item 152).

### References

Saunders C, Ho M. *Current Emergency Diagnosis and Treatment* 4<sup>th</sup> Ed. Appleton & Lange, 1992.

Hay et al (Eds). *Current Paediatric Diagnosis and Treatment*. 14<sup>th</sup> Ed. Appleton & Lange, 1999.

Tierney et al. *Current Medical Diagnosis and Treatment 2000*. 39<sup>th</sup> Edition, McGraw-Hill Companies, Inc, 2000.

Dunn R. (ed) *The Emergency Medicine Manual*. Dr Robert Dunn, Deakin ACT 1997.

Lahat E et al. Comparison of intranasal midazolam with intravenous diazepam for treating febrile seizures in children: prospective randomised study. *BMJ* 2000; 321: 83-86

## 8.2 SUBARACHNOID HAEMORRHAGE

### **Theory**

1. Defined as bleeding into the subarachnoid space. Seventy percent are due to rupture of an aneurysm in the Circle of Willis. Other causes are arteriovenous malformations, mycotic aneurysms and trauma.
2. Up to 80% of patients have a small “warning bleed” which precedes the major bleed. From the major bleeds, 50% of patients will die or be permanently incapacitated. A further 30% will die if not treated.
3. Important clinical symptoms and signs include: sudden onset of severe “worst ever” headache, vomiting, transient loss of consciousness, depressed conscious state and hypertension. Seizures occur in 20% but focal neurological signs are uncommon. Diagnosis is confirmed by CT scan (95% sensitive) and/or lumbar puncture.
4. Early neurosurgical intervention and the use of Nimodipine (a calcium channel blocker which reduces vasospasm in cerebral arteries) give excellent outcomes for patients with warning bleeds and less severe SAH.

### **Pre Flight and In-flight Management**

1. The priority assigned will be determined by the severity of the patient’s illness and accuracy of diagnosis. Most flights will be Priority 2. Some critically ill patients in smaller centres may be Priority 1.
2. Flights should be doctor accompanied if there is a significantly depressed conscious state, seizures or severe hypertension. Many patients with these criteria will benefit from early intubation and IPPV.
3. All patients should receive oxygen and be fully monitored. An IDC may be appropriate for very drowsy patients. Where possible, patients should be nursed with 30° head elevation to reduce cerebral oedema. Actions that induce sudden rises in intracranial pressure (e.g. coughing on ETT, vomiting or seizures) should be avoided as much as possible. Prophylactic antiemetics and anticonvulsants may be appropriate for individual patients.
4. Moderate rises in blood pressure are necessary to maintain cerebral perfusion pressure, and do not require treatment. Severe hypertension should be treated initially with sedation and analgesia. If blood pressure remains grossly elevated, control with IV Hydralazine 5-10 mg prn or IV Atenolol 1 mg/min (until target heart rate reached). In patients with severe hypertension, invasive arterial pressure monitoring is helpful.
5. Nimodipine is not stocked by RFDS and is best left to a tertiary hospital ICU to give as its administration is very complex.

### **References**

Dunn R. (ed) *The Emergency Medicine Manual*. Dr Robert Dunn, Deakin ACT 1997.

Oh, T.E.(ed) *Intensive Care Manual 4<sup>th</sup> Ed*, Butterworth-Heinemann 1997

Victorian Drug Usage & Advisory Committee. *Therapeutic Guidelines: Neurology 1<sup>st</sup> Ed*. Therapeutic Guidelines Ltd 1998

Victorian Drug Usage Advisory Committee. *Therapeutic Guidelines: Cardiovascular 2<sup>nd</sup> Ed*. Therapeutic Guidelines 1996.

## 8.3 DELIRIUM TREMENS

### *Theory*

1. Delirium tremens occurs as a result of withdrawal from alcohol. It is an acute organic psychosis that is usually manifest within 24-96 hours after the last drink, but may occur up to 7-10 days later. Delirium tremens is characterised by mental confusion, tremor, sensory hyperacuity, visual hallucinations (often terrifying), autonomic hyperactivity, diaphoresis, dehydration, electrolyte disturbances (especially hypokalaemia and hypomagnesaemia), seizures and cardiovascular abnormalities. Fever may be present.
2. Central nervous system depressant drugs are important in the treatment of delirium tremens. This applies whether the syndrome is the primary reason for transport of the patient, or whether it is a downstream effect of restricted access to habitual alcohol due to some other illness or injury.

### *Pre Flight and In-flight Management*

1. Priority will vary depending on the patient's primary problem and the degree to which risks to the patient's health are compounded by this severe alcohol withdrawal syndrome. A doctor-accompanied flight may be necessary if the patient is severely ill or if symptoms are difficult to control.
2. Pre-flight and in-flight management aims to provide supportive care: Thiamine and multivitamin therapy; fluid, electrolyte and glucose support, and benzodiazepine-based control of symptoms. Give Diazepam 10 mg to 20 mg every 1 to 2 hours until control of symptoms is satisfactory and moderate sedation occurs. Doses may need to be high and extra supplies of benzodiazepines may need to be carried.
3. Intravenous Diazepam 5 – 10 mg or Midazolam 2.5-5 mg IV may be needed to gain control of symptoms.
4. Other drugs with some potential application in delirium tremens include  $\beta$ -blockers (eg Atenolol 100 mg per day when the heart rate is above 100bpm and 50 mg per day for heart rates between 50 and 100 bpm). Antiepileptic medication is not required unless there is an underlying seizure disorder. If an antipsychotic medication is required Haloperidol or Droperidol may be useful. Clonidine (eg 5 $\mu$ g/kg every two hours) has also been used for anxiolysis and to suppress cardiovascular symptoms.

### *Medical Chest Items*

Diazepam 10 mg/ 2 mL (Item 98), Diazepam tablets 5 mg (Item 152).

### *References*

Tierney LM, McPhee SJ and Papadakis MA (Eds.) *Current medical diagnosis and treatment*. 41st Ed, McGraw Hill, 2002

Victorian Drug Usage Advisory Committee, Therapeutic Guidelines: Psychotropic Drug Guidelines, V, 4, Therapeutic Guidelines Limited 2000

## SECTION NINE - OBSTETRIC

### 9.1 PRETERM LABOUR AND TOCOLYSIS

#### *Theory*

1. Premature Labour is defined as onset of labour before the 37th week of gestation. For our purposes, we refer particularly to those women of gestational age less than 35 weeks, where adequate paediatric management is not possible outside King Edward Memorial Hospital (KEMH).
2. Perinatal morbidity and mortality for low and extremely low birthweight infants is significantly improved by delivery and resuscitation in a tertiary centre.
3. Tocolysis is used to suppress labour and prevent delivery in flight. Postponing delivery also enables fetal lung maturation to be accelerated with steroids. There is good evidence not to routinely employ tocolytics for longer than 48 hours, or for gestations greater than 34 weeks, other than to allow transport.
4. Corticosteroids enhance lung maturation and decrease the risk of neonatal intracerebral haemorrhage and necrotising enterocolitis.
5. Nifedipine has a similar tocolytic activity to betamimetics such as Salbutamol but a lower incidence of side effects. It must be given orally and should not be given concurrently with Salbutamol. Most studies of its use have been for gestations < 34 weeks and cervical dilatation < 4cm.
6. The best results in postponing delivery are in patients with intact membranes who are <5cm dilated. However, ruptured membranes or excess dilatation are not absolute contraindications to treatment or transfer.
7. With careful assessment, prompt transport and aggressive tocolytic therapy in flight, the majority of patients in premature labour can be transported to an appropriate centre where optimal conditions exist for delivery and resuscitation of the neonate.

#### *Pre-flight & In-flight Management*

8. Labour is diagnosed on the basis of regular contractions (at least one per ten minutes) which are associated with effacement and / or dilatation of the cervix. Careful assessment pre-flight is required. This includes:
  - Parity
  - Frequency / strength of contractions
  - Cervix dilatation
  - Ruptured membranes
  - Foetal HR
  - Presentation
9. A vaginal examination (speculum or gentle digital) is always required.
10. The absence of fetal fibronectin (fFN) in the cervical secretions is a useful negative predictor of imminent birth.
11. Trans-vaginal ultrasound which identifies a cervical length of >30mm or an undilated internal cervical os, is another useful negative predictor of imminent birth.
12. The decision to attempt air transport to a regional hospital or KEMH is a judgement by the duty RFDS doctor based on the information given above, in consultation with the referring doctor and the receiving institution.
13. Corticosteroids. Give Betamethasone (Celestone Chronodose) 11.4mg (2 ampoules) up to 34th completed week of pregnancy to aid fetal lung maturity, if there is no evidence of chorioamnionitis.

## 9.1 PRETERM LABOUR AND TOCOLYSIS (CONT.)

14. Commence tocolysis, unless contraindicated by imminent birth. Even patients in very advanced labour can often be transported safely if aggressive tocolysis is used.

### Gestation < 34 weeks and cervical dilatation < 4cms.

#### First line tocolysis - Nifedipine

- Give an initial dose of 20mg of Nifedipine orally.
- Do not use slow release Nifedipine.
- Crush and dissolve in water to increase onset of action.
- After 30 minutes, if contractions persist, give another 20mg oral dose.
- After a further 30 minutes, if still contracting, follow up with a further 20mg orally.
- The maximum dose of Nifedipine is 120mg/day.
- Onset of tocolysis should be in 30 – 60 minutes.

#### Second line tocolysis - Salbutamol

- Salbutamol may be used as a second line tocolytic, if 90 minutes after commencement of Nifedipine, the patient is still contracting and transfer is to take place. Stop further oral Nifedipine.
- Commence infusion in accordance with RFDS Drug Infusion Guideline for Salbutamol – Obstetric.

### Gestation more than 34 weeks or cervical dilatation greater than 4cms.

#### First line tocolysis – Salbutamol

- Commence infusion in accordance with RFDS Drug Infusion Guideline for Salbutamol – Obstetric.

#### Alternative tocolytics include:

- Glyceryl Trinitrate (GTN). Apply 5 – 10mg transdermal GTN patch.
- Nifedipine
- Indomethacin. Administer 100mg rectal suppository followed by a 25mg oral dose every 4 hours for 48 hours. If regular uterine contractions persist 1–2 hours after the initial 100mg suppository, give an additional 100mg suppository before beginning oral therapy.

15. Nurse patient in the (left) lateral position and give oxygen by simple facemask at 6 l/min during flight.

16. Consider antibiotics in presence of prolonged rupture of membranes, risk of Group B Streptococcus or urinary tract sepsis. Benzylpenicillin 1.2gm IV stat, then 600mg IV 4hrly.

17. Patients actively contracting or with a drug infusion still running will usually require an RFDS nurse or medical escort from the airport into the receiving hospital.

## 9.1 PRETERM LABOUR AND TOCOLYSIS (CONT.)

### **Special Notes**

Absolute contraindications to tocolysis include fetal death and massive maternal haemorrhage. Relative contraindications to tocolysis (ante-partum haemorrhage, pre-eclampsia, chorioamnionitis and fetal distress) may be ignored if it is considered that the risks associated with delivery in the transport environment outweigh the risks associated with the suppression of labour.

Nifedipine is a calcium channel blocker that inhibits both prostaglandin and oxytocin induced contractions. Contraindications to the use of nifedipine include:

- Cardiac disease including cardiac conduction defects and left ventricular failure.
- Hypotension
- Concomitant use of betamimetics such as Salbutamol (does NOT preclude later administration of Salbutamol but care must be taken as hypotension may result) or concomitant use with MgSO<sub>4</sub>.

*Side effects.* Facial flushing, Headache, Nausea, Tachycardia, Dizziness, Hypotension (this is unusual in normotensive patients), Cardiac failure

Salbutamol is contra-indicated in the presence of:

- Maternal or fetal cardiac disease
- Insulin dependent diabetes
- Active thyroid disease

Salbutamol is associated with maternal tachycardia, hypotension, tremor, pulmonary oedema, hyperglycaemia and hypokalemia. Patient (and foetus) must be appropriately monitored.

#### *Precautions*

- Baseline maternal blood sugar level; repeat 4 hourly if abnormal
- No additional intravenous fluids to avoid fluid overload
- Half hourly maternal pulse, BP and respiratory rate until the maintenance dose is reached
- Reduce infusion if maternal pulse > 140 bpm
- CEASE infusion and request medical review immediately if chest pain or dyspnoea or respiratory rate >30/min
- Baseline fetal heart rate monitoring
- Do not exceed 48 hours of salbutamol therapy.

*Side effects.* Tachycardia, Tremor, Nausea, Dizziness, Hypotension, Pulmonary oedema and Cardiac failure, Hypokalemia,

Glyceryl Trinitrate (GTN) is a nitric oxide donor and causes smooth muscle relaxation via the metabolite nitric oxide (NO) which acts as a 2nd messenger to increase Ca<sup>++</sup> uptake. Nitric oxide promotes uterine quiescence in pregnancy. Use with care in conjunction with Salbutamol or MgSO<sub>4</sub>, as hypotension may occur. *Side effects.* Headache, Facial flushing, Hypotension, Tachycardia,

Indomethacin use may be indicated in association with the insertion of a cervical suture at pre-viable gestations. Theoretical risks of fetal pulmonary hypertension (2° to early closure of PDA) and reduced renal function are debatable in short term use but clear in the event of extended use.

### **References**

Obstetric Clinical Care Unit, KEMH. *Management of Preterm Labour. Guideline Number 3.3.* Revised June 2003.

King JF et al. *Calcium channel blockers for inhibiting preterm labour: a systematic review of the evidence and a protocol for administration of Nifedipine.* ANZJOG 43(3):192-8 June 2003.

Tsokas N, Newnham J, Langford S. *Intravenous Tocolytic Therapy for Long Distance Aeromedical Transport of Women in Preterm Labour in Western Australia.* Asia-Oceania J. Obstet. Gynaecol. Vol 14, No.1:21-25 1988.

Enkin M et al. *A Guide to Effective Care in Pregnancy & Childbirth.* 2<sup>nd</sup> Ed. Oxford Uni. Press 1995.

*Antibiotic Guidelines.* 12th Ed. Therapeutic Guidelines Ltd. 2003.

GW/SAL

## 9.2 PRE-ECLAMPSIA

### **Theory**

1. Hypertension in pregnancy is defined as;
  - Systolic blood pressure  $\geq$  140 mmHg and/or diastolic blood pressure  $\geq$  90 mmHg *or*
  - Rise in systolic pressure  $\geq$  25 mmHg and/or rise in diastolic pressure  $\geq$  15 mmHg from 1st trimester reading (confirmed by 2 separate readings).
2. Pre-eclampsia is characterised by;
  - Hypertension developing after 20 weeks of pregnancy,
  - Normal blood pressure before pregnancy (or in first trimester),
  - Absence of a history of hypertension or renal disease *and*
  - Return of blood pressure to normal within 3 months post-partum.
3. Severe pre-eclampsia can be differentiated from mild pre-eclampsia by the following criteria:
  - blood pressure  $\geq$  160 - 170 mm Hg systolic and/or  $\geq$  110 mm Hg diastolic,
  - proteinuria  $>$  0.3 g in a 24-hour period or  $\geq$  '2+' on dipstick testing,
  - increased serum creatinine,
  - neurological involvement;
    - persistent headaches (often frontal, may be occipital and resistant to relief with ordinary analgesics. A severe headache almost invariably precedes the first eclamptic convulsion), visual disturbances and hyperreflexia and/or clonus,
  - hepatic involvement;
    - epigastric / right upper quadrant pain and/or elevated liver enzymes,
  - thrombocytopenia (platelet count  $<$ 100,000/mm<sup>3</sup>),
  - retinal haemorrhages, exudates, or papilloedema and
  - pulmonary oedema.
4. Our aim in transport is to prevent convulsions and control blood pressure during transfer to a secondary or tertiary centre for delivery.

### **Pre-Flight and In-Flight Management**

1. Flights for patients with severe pre-eclampsia will usually be priority 1 or 2, doctor accompanied. Flights for patients with mild pre-eclampsia will usually be priority 2, not doctor accompanied.
2. If laboratory facilities are available check the platelet count, uric acid, hepatic transaminases, clotting screen and 24 urinary protein estimation.
3. Ensure IV access and administer oxygen therapy.
4. Consider anti-hypertensive treatment
  - in milder cases give oral Alpha methyldopa 250 mg tds or Labetalol 100 mg bd.
  - For severe hypertension (diastolic  $>$ 110 mm Hg) consider use of Hydralazine, 5 mg IV over 10 minutes or 5 – 10 mg IM, followed by intermittent boluses or infusion of 5 to 20 mg/hr according to response.

## 9.2 PRE-ECLAMPSIA (CONT.)

5. IV fluids need to be given with care to avoid fluid overload. Usually 100 mL/hr is a satisfactory compromise. In patients with severe disease, monitor urine output hourly and consider central venous monitoring.

Consider anticonvulsant prophylaxis with Magnesium Sulphate.

- Indications for anti-convulsant therapy at King Edward Memorial Hospital are as follows;
  - Women with severe pre-eclampsia in whom hypertension has been inadequately controlled AND have any of the following:
    - Altered mental state,
    - persistent headache or neck ache,
    - persistent epigastric pain or vomiting *or*
    - sustained clonus (even if BP has been well controlled).
  - The decision to commence prophylactic treatment with Magnesium outside the secondary or tertiary hospital setting needs to be made bearing in mind both the risks associated with an eclamptic fit versus the risks associated with the inadvertent overdose of the drug (respiratory, cardiac and CNS depression). Refer to the Magnesium Sulphate infusion guidelines before using.
  - There is good evidence that Magnesium prevents a 2<sup>nd</sup> seizure in a patient who has already had a fit but the trial to determine the efficacy of Magnesium in preventing eclampsia has yet to be completed.

### References

DeCherney A, Pernoll M (Eds). *Current Obstetrics and Gynaecology Diagnosis and Treatment*. 8<sup>th</sup> Ed, Appleton & Lange 1994.

Williams *Obstetrics*. 20<sup>th</sup> Ed, Appleton & Lange, 1997.

Beischer, Mackay and Colditz. *Obstetrics and the Newborn* 3<sup>rd</sup> Ed, W B Saunders, 1994.

King Edward Memorial Hospital. *Clinical Guidelines*. King Edward Memorial Hospital, 1998.

Council of the Australasian Society for the Study of Hypertension in Pregnancy. *Management of Hypertension in Pregnancy: Executive Summary*. National Heart Foundation of Australia, July 1994.

Dr Brian Roberman, Chairman of Obstetrics, KEMH. Personal communication, July 2000.

## 9.3 ECLAMPSIA

### **Theory**

1. Eclampsia is a generalized tonic-clonic convulsion as a consequence of pregnancy-related cerebral hypoxia.
2. Early diagnosis and active treatment of preeclampsia will enable the avoidance of eclamptic fits in the majority of cases.
3. Prodromal features include severe headache, visual disturbances, drowsiness, irritability, restlessness and twitching or jitteriness. There may be other features reflecting intense vasospasm elsewhere in the body (eg epigastric pain).
4. Incidence is in the order of 1 in 1500 deliveries, in 50% of women it precedes the onset of labour, the remaining 50% are divided between intra and post partum periods. Maternal death occurs in 3-15% of women with eclampsia and perinatal death occurs in 10-15%, due mainly to hypoxia and prematurity. In surviving women there is usually complete recovery of function.

### **Pre-Flight and In-Flight Management**

1. Flights for patient with eclampsia will usually be priority 1, doctor accompanied.
2. The aim of management is;
  - provision of initial first aid for the convulsion then control convulsions and control blood pressure,
  - stabilisation as for pre-eclampsia to prevent further convulsions.
3. Initial resuscitation;
  - Control the airway (oropharyngeal airway or endotracheal tube),
  - High flow O<sub>2</sub> via face mask, bag & mask or endotracheal tube,
  - Establish venous access (if not already present).
4. Control seizures;
  - If already on a Magnesium Sulphate infusion then give 2 g IV over 5 minutes, otherwise give
  - Diazepam 5 – 20 mg IV.
  - Prevention of further fits is best obtained by commencement of magnesium sulphate infusion with a loading dose of 4 gm over 20 minutes (as per protocol).
5. Control blood pressure;
  - Give Hydralazine 5 mg over 10 minutes then 5 –20 mg/hour as required, aiming for a diastolic of 90 –100 mm Hg.
6. Monitor urine output hourly; use care with IV fluid replacement, as pulmonary oedema is a risk.
7. If available, check platelet numbers, clotting function, uric acid, renal and liver function tests as for preeclampsia.
8. Monitor for complications such as cerebrovascular accident, placental abruption, renal shutdown, disseminated intravascular coagulation, liver failure and cardiac arrest.

### **References**

Beischer, Mackay and Colditz. *Obstetrics and the Newborn*, 3<sup>rd</sup> Ed 1997 W B Saunders  
King Edward Memorial Hospital. *Clinical Guidelines*. King Edward Memorial Hospital, 1998.

## 9.4 POST PARTUM HAEMORRHAGE

### *Theory*

1. Seen in 3-5% of all pregnancies. Causes 5% of all maternal deaths.
2. Two types:
  - a. Primary Post Partum Haemorrhage (PPH) – These occur within 24 hours of delivery and are a true emergency;
    - Aetiology - Atonic uterus, retained placenta or membranes, uterine, cervical or vaginal tears.
  - b. Secondary PPH – These occur 1-6 weeks after delivery;
    - Aetiology - Endometritis (mostly anaerobes, streps and enterococci), lacerations, carcinoma of cervix, choriocarcinoma, coitus, haematological disorders.

### *Pre-Flight & In-Flight Treatment*

1. Take a good history to determine if PPH is Primary or Secondary;
  - Prior to departure ensure that a thorough examination has been done to exclude a lower genital tract laceration, that the bladder has been emptied and that the uterus has been firmly massaged.
2. All flights for Primary PPH should be Priority 1 or 2, doctor accompanied.
3. Initial Stabilization:
  - Lie patient flat, feet up if in shock,
  - Supplementary oxygen to maintain saturation >95 %,
  - Monitor circulation, blood pressure, PR, ECG, temperature, O<sub>2</sub> saturation and perineal loss,
  - Two large bore IV lines are ideal if patient critical.
  - Replace fluids;
    - Intravenous fluid resuscitation according to the guidelines for shock,
    - Have blood available, preferably cross-matched blood, but O neg is a suitable alternative and generally is available from regional hospitals. FBC and coagulation studies are helpful if they are available.
  - monitor urine output (urinary catheterization may be necessary).
  - Examine for evidence of hypovolaemia, retained placenta, tears, etc. (Primary PPH) or fever, offensive lochia, boggy enlarged uterus (Secondary PPH).
4. If haemodynamically unstable:
  - Control Haemorrhage. May need a combination of A, B and C below.
    - A. Mechanical;
      - Uterine massage,
      - Catheterise the patient – an empty bladder promotes separation and delivery of placenta if retained,
      - If the placenta is retained, further attempts to remove the placenta by controlled cord traction or the Dublin method of fundal pressure (if cord avulsed) should be made,
      - Bimanual compression (a compressed fist placed in the anterior fornix with the other hand placed abdominally behind the fundus)

Note this procedure is painful for the patient and tiring for the obstetrician.

## 9.4 POST PARTUM HAEMORRHAGE (CONT.)

- B. Chemical: Oxytocin 5-10 units Syntocinon IV stat, followed by 20 – 30 units Syntocinon in 500 mL Normal Saline over 30 - 60 mins, *or* Ergometrine 0.25-0.5 mg IV stat. This may need to be repeated *or* alternatively inject PGF<sub>2</sub> alpha 1-2 mg in 5-10 mL N. Saline, into the cervix or fundal myometrium via abdominal wall.
- C. Operative: A range of procedures that may need a General Anaesthetic. eg. suturing, manual removal of placenta, hysterectomy.

5. If Haemodynamically stable:

- Take cervical and vaginal swabs.
- Best antibiotics for infection are: Ampicillin 1 gm 8 hourly IV and Metronidazole 500mg 8 hourly IV (Plus or minus Gentamicin). Analgesia PRN.
- Other management may involve the need for ultrasound or a D&C.

### **Special Notes**

1. All patients could develop hypovolaemia shock, neurogenic shock, anaphylactic shock, cardiogenic shock, or septic shock. In all cases beware of tissue hypoxia and disseminated intravascular coagulation (DIC). Monitor for amniotic fluid embolism, which can lead to dyspnoea, cyanosis, restlessness, DIC and death.
2. Treat shock with fluid replacement, vasoconstrictor drugs and fresh frozen plasma or platelets in DIC.

### **Medical Chest Items**

Ergometrine Maleate / Oxytocin ampoules 0.5 mg/ 5 IU / 1 mL (Item 162).

### **References**

American College of Surgeons Committee on Trauma, *Advanced Trauma Life Support for Doctors: Student Course Manual*, 6<sup>th</sup> Ed, American College of Surgeons Chicago, 1997.

Beischer, Mackay and Colditz. *Obstetrics and the Newborn* 3rd Ed, W B Saunders, 1994

## 9.5 EPIDURALS IN FLIGHT

### *Theory*

A small number of patients each year are transported with epidural catheters in situ. It is not recommended to use the epidural route in-flight for the following reasons:

1. Risk of movement of the catheter with patient transfer, with subsequent risk of intravascular or intrathecal injection; and
2. Sub-optimal resuscitation conditions in the case of an inadvertent total spinal or toxic event.

### *Pre-Flight & In-Flight Treatment*

1. Preferably arrange for the epidural to be topped up in hospital prior to flight.
2. If the flight is “doctor accompanied”, use of the epidural route can be considered, bearing in mind the risks outlined above. Drugs should be administered in small increments only.
3. Alternatively use narcotics or anti-inflammatory drugs intravenously.

## SECTION TEN – PAEDIATRICS

### 10.1 PAEDIATRIC UPPER AIRWAY OBSTRUCTION

#### **Theory**

1. Mostly confined to children 6 months to 5 years of age.
2. Most common causes are croup (viral laryngotracheobronchitis), epiglottitis, laryngeal FB. All should be considered imminently life threatening – rapid deterioration is likely.
3. Aim is to transport to a suitable facility for definitive treatment and ability to deal with complications.

#### **Pre-flight and In-flight Management**

1. The pre-flight assessment should be able to determine the aetiology. Advice on the administration of steroids (oral Dexamethasone 0.2 mg/kg or oral Prednisolone 1 mg/kg) or adrenaline nebulisers (1:1000 Adrenaline 0.5 mg/kg, max 5 mL made up to 5 mL with N/saline) can be given where croup is a strong possibility. Otherwise, relatively inexperienced personnel should be advised against attempting to examine the child's throat, inserting IV's or other manoeuvres that could distress the child and precipitate complete obstruction. Information should be obtained regarding local availability of anaesthetic facilities and expertise.
2. Flight will usually be Priority 1 and must be doctor accompanied. Where possible, an anaesthetist should be carried instead of or as well as the RFDS doctor.
3. Children with severe respiratory distress or suspected epiglottitis should not be brought to the airstrip. They should be assessed in the hospital or nursing post in good light with resuscitation facilities at hand.
4. Children in whom obstruction is imminent will usually be intubated for transfer. As they require a careful inhalational induction, this can only be carried out if an anaesthetic machine is available. Anaesthesia may allow removal of a FB under direct laryngoscopy and the child may then be awakened.
5. Children who are intubated should then be cared for during the transfer as any other ventilated patient. The anaesthetist may prefer however to allow the child to breathe spontaneously on the tube. Meticulous positioning of the child's head, suctioning and humidification is essential to prevent tube displacement or obstruction. Placement of a NGT and full monitoring should be commenced. Children with epiglottitis should receive IV Ceftriaxone 100 mg/kg.
6. Where intubation under inhalational anaesthesia is not possible, or a skilled anaesthetist is not available, the child should be transported rapidly to definitive care. Usually the child will be nursed on the mother's lap. Oxygen should be considered but removed immediately if it distresses the child. No attempt should be made to insert an IV. Monitoring should consist of SaO<sub>2</sub>. A sudden drop in heart rate will occur if obstruction threatens to become complete, and this will precede desaturation.
7. Resuscitation equipment should be at hand, including needle cricothyroidotomy. If complete obstruction occurs, the child should be placed supine on a stretcher and gently bagged with 100% O<sub>2</sub>. It is usually possible to keep the child pink. If not, intubation may be attempted with a size smaller endotracheal tube than usual. If unsuccessful, needle cricothyroidotomy will be required urgently to save the child's life. Once in place, bagging with 100% O<sub>2</sub>, full monitoring, IV access & sedation is required.
8. The flight doctor should discuss the child's condition with the PMH duty ICU consultant (9340 8165 or 9340 8222) either in-flight or immediately on landing, to enable appropriate preparations to be made to receive the child.

#### **References**

Strange G. et al *Paediatric Emergency Medicine*. McGraw-Hill 1996.

Advanced Life Support Group. *Advanced Paediatric Life Support*. 2<sup>nd</sup> Ed, BMJ Publishing 1997.

## 10.2 PAEDIATRIC LEAK ADAPTOR FOR INFANT VENTILATION USING DRAGER OXYLOG

### *Description*

Cylindrical aluminium connection with a small hole drilled through one wall. The hole is sited between ridges to prevent accidental obstruction. The device has a 22mm female connection at one end for connection to the ventilator and a 15mm female/22mm male connector for connection to the circuit.

### *Theory*

1. This device was produced for use with the original Oxylog ventilator. It is not appropriate for use with the Oxylog 2000 ventilator due to the leak detection alarm built into that ventilator.
2. At a set rate of 30 breaths per minute and the lowest minute ventilation setting, the tidal volume delivered by the Oxylog ventilator is approximately 100mL. This limits use of the ventilator to infants of approximately 10kgs or greater.
3. Insertion of a 'deliberate' leak into the circuit allows delivery of smaller tidal volumes. Using the leak, PMH staff have ventilated infants down to 4kgs.
4. The volume of gas leaked will be determined by the airway pressures and inspiratory time.
5. The device is recommended for use when ventilating infants less than 10kgs. It is the responsibility of the medical practitioner caring for the infant to ensure safe use of the device, ventilator circuitry and ventilator, and for the adequacy of ventilation.

### *Technique*

1. The device is inserted between the ventilator and patient circuit.
2. As with all infant mechanical ventilation, a ventilation rate is set and then the minute ventilation increased gradually from the minimum setting until adequate ventilation is achieved, gauged by degree of chest expansion, airway pressure, auscultation and capnometry.
3. The device does not remove the need for frequent re-assessment of the adequacy of ventilation and readjustment of parameters as required.

### *Reference*

Prepared by: Dr D. McConville, RFDS Western Operations, Port Hedland Base.

Reviewed by: Dr A. Duncan, ICU, Princess Margaret Hospital, Perth.



Fig. 10.2.1 Paediatric Leak Attachment

## 10.3 GASTROENTERITIS / DEHYDRATION IN CHILDREN

### Theory

Signs and symptoms of dehydration	MILD <5%	Moderate 5-10%	Severe >10%	NOTES
Decreased urine output	+	+	+	Beware watery diarrhoea making nappies appear 'wet'
Dry mucous membranes	+/-	+	+	Mouth breathers are always dry
Sunken eyes	-	+	+	
Sunken fontanelles	-	+	+	Crying increases pressure
Decreased skin turgor	-	+/-	+	Beware the thin, use several sites
Tachypnoea	-	+/-	+	Metabolic acidosis and pyrexia worsen this
Tachycardia	-	+/-	+	Hypovolaemia, pyrexia and irritability cause this
Mental state	alert	Irritable	drowsy	

### Pre-Flight and In-flight Management

- Flights for children with moderate – severe dehydration will usually be Priority 1 or 2, doctor accompanied, depending on the facilities at the referring institution.
- Assess the degree of dehydration clinically.
- Calculate fluid requirements.
  - Dehydration:*
    - Estimate according to the clinical picture.
    - Use last known body weight when well (if available & recent) and current weight to calculate % dehydration.
    - A useful formula for fluid deficit is
      - Fluid Deficit (mL) = [% dehydration] x [weight (kg)] x 10
      - Eg 10 kg child, 7.5% dehydrated, deficit = 7.5 x 10 x 10 = 750 mL
    - Aim to replace ½ fluid over first 8 hours and ½ over next 16 hours (except with hypernatremia, aim to replace over 36-48 hrs).
  - Maintenance requirements:*
    - First 10 kg body wt – 4 mL/kg/hr
    - Second 10 kg body wt – 2 mL/kg/hr
    - Every kg > 20kg – 1 mL/kg/hr
  - Ongoing losses:*
    - difficult to estimate, therefore frequently review clinically and adjust rates accordingly.
  - Total Fluid Requirements = A + B + C*

### 10.3 GASTROENTERITIS / DEHYDRATION IN CHILDREN (CONT.)

#### 4. Method of Rehydration;

- A. <5% dehydrated – usually able to rehydrate orally or via NGT using oral rehydration solution (ORS)
- B. 5-10% dehydrated - NGT (ORS) or IV (2.5%Dext / 0.45 NS)
- C. >10% dehydrated

*If shocked:*

- Oxygen
- 20 mL/kg Hartmann's or 5% Albumin or Normal Saline, repeated if necessary
- If IV access is difficult then the intraosseous route should be used(see Part 3 Section 2.1)

*Once stabilised or if not shocked:*

- 2.5% Dextrose / 0.45% Normal Saline

#### 5. If no improvement consider:

- Sepsis, cardiac, metabolic disorder, diabetic ketoacidosis, intussusception or ongoing gastroenteric losses

#### 6. Investigations

- Quantify BSL (hypoglycaemia), pH (acidosis), K<sup>+</sup> (hypokalaemia), Na<sup>+</sup> (hypo & hypernatremia), Calcium (Hypocalcaemia), Mg (hypomagnesaemia) and adjust management according to results.

#### **Medical Chest Items**

Gastrolyte Effervescent Tablets (Item 76)

#### **References**

Advanced Life Support Group. *Advanced Paediatric Life Support*. 2<sup>nd</sup> Ed , BMJ Publishing 1997.

Kalgoorlie Regional Hospital. *Guidelines for the treatment of gastroenteritis / dehydration*.

## 10.4 NEONATE RETRIEVALS

### *Theory*

Generally patients up to 28 days of age are regarded as Neonates.

### *Pre-Flight & In-Flight Treatment*

Assessment of neonate retrievals is usually carried out by Jandakot medical officers (or Derby or Port Hedland medical officers if the flight is to be conducted by those bases). However, any RFDS medical officer may be requested to carry out the assessment and will therefore need to be aware of the following:

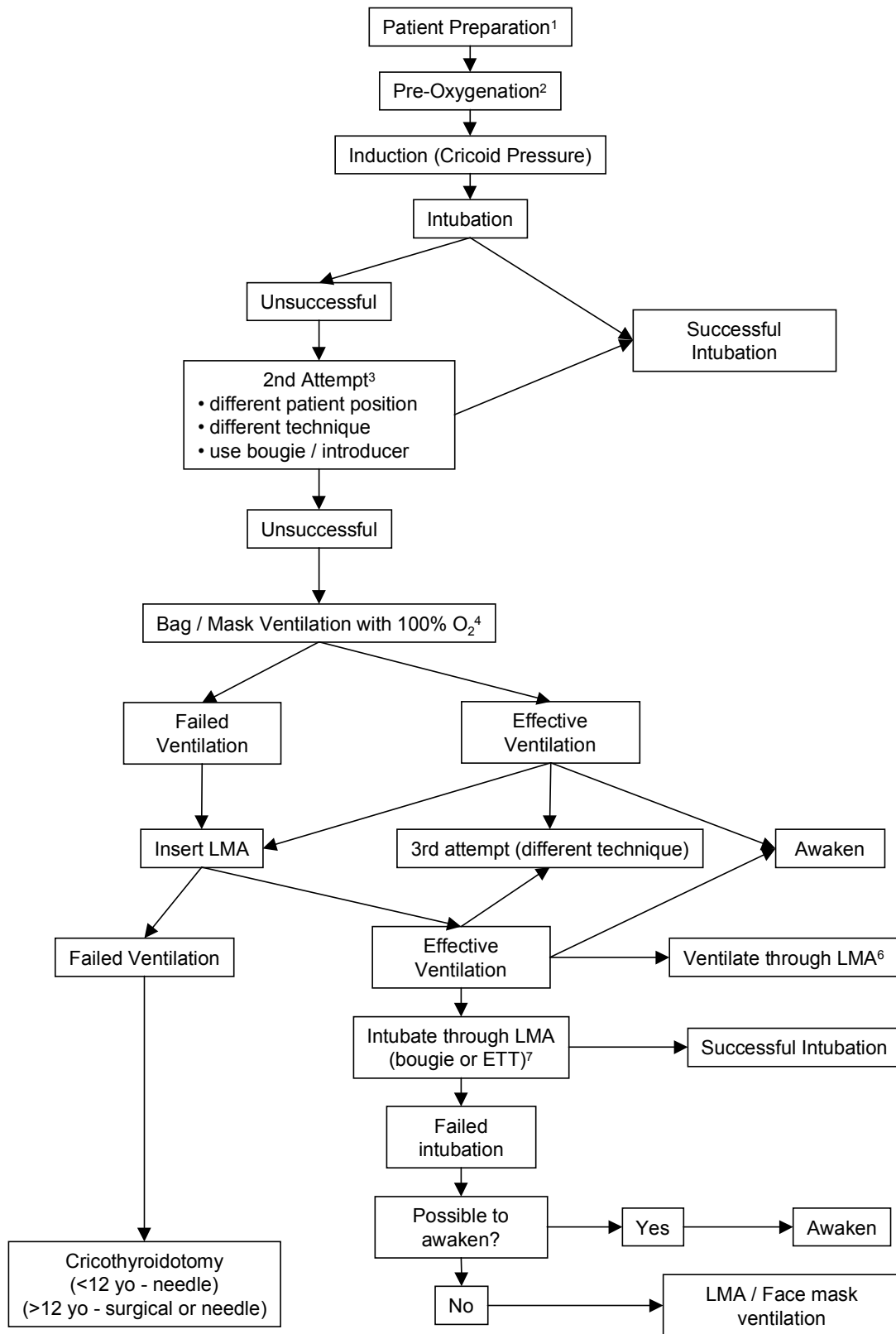
1. The referral to RFDS is usually from the PMH Neonate Unit, either a doctor or senior nurse. The authorisation of the flight is the responsibility of the assessing RFDS medical officer, not PMH. If the request does not appear appropriate, consult the Medical Director.

If the request is for an unborn baby with mother in advanced labour, it is the RFDS doctor's decision whether an attempt is made to transfer the baby in-utero or allow the mother to be delivered. Most of the time these are best done as Priority 1 "doctor accompanied" flights with or without a neonatal registrar and cot.

2. Occasionally PMH will request either a flight nurse alone or accompanied by an RFDS doctor to retrieve a less sick infant. If this seems appropriate, we will undertake the flight, otherwise PMH should be requested to send their neonatal registrar.
3. PMH usually have few details on the baby and may not know the condition of the mother, so it is usual to contact the referring country doctor for more details, especially regarding the mother.
4. Most flights will be Priority 2. Priority 1 flights are limited by the time taken for the neonatal registrar to arrive at Jandakot (rarely under an hour and a half). Sea level pressurisation should be requested for the usual indications, the paediatrician will always need to go into the hospital with the cot, the pilot should be requested to avoid turbulence if the baby is very preterm or unstable. Meets are contraindicated in neonate retrievals.
5. The RFDS medical officer should decide whether the mother can accompany the baby to PMH. PMH have a small number of beds for mothers of sick neonates and have a visiting midwife. A mother can only stay there if a bed is available and she has had a normal delivery and is completely self-caring without complications. Otherwise it is usually best for the mother to remain in the country until discharged, then she can make her own way down. Sometimes sick mothers will be transferred to KEMH, but the baby still goes to PMH. If the mother is well, she travels as a passenger as she is not actually admitted to PMH.
6. The RFDS medical officer should also consider interim management when discussing the baby with the referring GP as he may or may not have received advice from PMH (for instance, he may only have spoken to a nurse). Advice regarding oxygen therapy, checking blood sugar levels, fluid requirements and antibiotics may be required or the doctor can be referred back to PMH.

## SECTION ELEVEN – RESPIRATORY

### 11.1 DIFFICULT AIRWAY ALGORITHM



## 11.1 DIFFICULT AIRWAY ALGORITHM (CONT.)

### **Theory**

1. If a difficult airway is anticipated (eg upper airway obstruction) the safest techniques are awake fiberoptic intubation or gaseous induction with a volatile agent eg Sevoflurane. In most situations faced by RFDS doctors neither of these options is available. A decision needs to be made balancing the importance of securing the airway for transport versus the risks associated with a difficult / failed intubation.
2. The attached algorithm has been created as a guideline. It is not a didactic protocol to be rigidly adhered to. Doctors have different levels of expertise and deviations from these guidelines may be very reasonable.
3. Important rules when having difficulty with intubation:
  - *Always* provide adequate oxygenation and suction between attempts,
  - *Always* try something different with each new attempt,
  - *Communicate* well and use your assistant(s) optimally,
  - In-line cervical spine immobilisation is essential in cases of suspected spinal trauma, but this must be abandoned if the patient is unable to be satisfactorily oxygenated.

### **Pre-flight and In-flight Management**

1. Preparation
  - A. Equipment check-list:
    - Selection of face masks and Guedel airways,
    - Two laryngoscopes (light bulbs checked),
    - Endotracheal tube, with spare tube checked, lubricated and with introducer inserted,
    - Suction,
    - Self inflating bag primed and ready to use,
    - Monitors (capnography, oximetry and ECG),
    - Circuits and ventilators,
    - Extra doses of Suxamethonium, Atropine and induction agent drawn up,
    - Tracheal Tube Introducer and Gum Elastic Bougie,
    - Laryngeal Mask Airway (LMA),
    - Size 6 uncut cuffed ETT (unopened),
    - Equipment for needle or surgical cricothyroidotomy.
  - B. Patient check-list:
    - positioning (neck flexed, head extended – except spinal trauma, see note above),
    - ensure adequate fluid loading.
2. Pre-oxygenation
  - Apply a mask gently but with an airtight seal and administer oxygen at 10-15 L/min for a **minimum** of three minutes. If the patient talks or the mask comes off, even momentarily, the three minutes starts again.

## 11.1 DIFFICULT AIRWAY ALGORITHM (CONT.)

### 3. Second attempt at intubation

#### A. Patient position

- Recheck neck is adequately flexed, head is extended (see note re trauma above)

#### B. Technique

- ensure tongue has been positioned completely to left of laryngoscope,
- if the larynx is not visualised the view will often be improved by getting assistant to alter the angle of cricoid pressure backwards, upwards and rightwards pressure ('BURP'),
- if cords are in view but the ETT can't be passed get your assistant to momentarily release cricoid pressure (cricoid pressure can occasionally squash closed the cords),
- Use aids for intubation
  - Gum elastic bougie – this is placed in the trachea, then an ETT is railroaded over the top whilst the laryngoscope is still in position. It often helps to twist the ETT anticlockwise as it passes through the cords,
  - Introducer – a well-lubricated introducer is inserted into the ETT with the tip curved into a hockey stick shape.

### 4. Bag / Mask Ventilation

- Effective bag/mask ventilation is vital between attempts. Points to note:
  - Correct size mask and airway must be used. A common problem is using a Guedel Airway that is too small,
  - The jaw thrust manoeuvre should result in the mandible being positioned slightly anterior to the top jaw,
  - DON'T HESITATE to hold the mask with TWO hands with the assistant doing the bagging.

### 5. Considering a third attempt

- A third attempt should only be considered if there is a real possibility of success using a different manoeuvre.
- A second dose of Suxamethonium (half the original dose) may be required but Atropine 0.3-0.6 mg (0.01 mg/kg in children) must be given prior to this to avoid the potentially fatal bradyarrhythmias associated with Suxamethonium. The second dose of Suxamethonium should only be given if manual ventilation is effective.
- Awakening the patient should always be considered from this point onwards. Cricoid pressure is maintained, the patient put in left lateral position and manual ventilation continued until the patient is spontaneously breathing and awakes. If adequate ventilation cannot be achieved in the lateral position return the patient in the dorsal position.

### 6. Ventilation through the LMA.

- If effective ventilation is achieved through a LMA with reasonable airway pressures i.e. <26cm H<sub>2</sub>O, the practitioner may opt to continue transport using a muscle relaxant and positive pressure ventilation through the LMA. There are several points to be considered;
  - the LMA does not prevent passive or active aspiration of gastric contents into the trachea,

## 11.1 DIFFICULT AIRWAY ALGORITHM (CONT.)

- patients with “stiff” lungs (pulmonary oedema, pneumonia, asthma etc) or who are obese may require high airway pressures to achieve adequate ventilation. The LMA works well at low pressures but is liable to leak at high pressures. This may have the effect of causing gradual gastric inflation and further increase the incidence of regurgitation and aspiration,
- studies have shown that good ventilation through an LMA is often compromised by the instigation of cricoid pressure, hence in some situations effective cricoid pressure may not be possible.

### 7. Intubate through the LMA using a bougie or ETT

#### A. Bougie Technique

- A bougie is passed down the LMA to “blindly” intubate the trachea. Often the assistant providing cricoid pressure will feel the bougie “bumping down the tracheal rings if intubation is successful. A laryngoscope is then inserted and the LMA is carefully removed whilst the Bougie is held in place. The Bougie can be dislodged from the trachea if not careful at this stage. The ETT is then railroaded over the top of the bougie in the usual way.

#### B. ETT Technique

- A well lubricated uncut, cuffed size 6 ETT can be passed directly down a size 3 or 4 LMA. When the ETT reaches the LMA grid (20 cm in size 3 LMA or 21 cm in size 4 LMA) the ETT must be rotated 90 degrees anticlockwise so it slides through the large central grid. There are several potential problems with this technique;
- the epiglottis can fold forward deflecting the ETT away from the cords. (This is also a problem with the Bougie technique however the Bougie is more easily manipulated to get around the obstruction),
- the distance from the vocal cords to the LMA aperture (grid) is up to 3.6 cm, implying that in some patients, even with the ETT fully inserted through the LMA the ETT cuff will not reach beyond the cords. This can compromise the seal and make it more likely to be dislodged out of the trachea.

## References

Benumof JL. *The ASA Difficult Airway Algorithm*. Anesthesiology, V84 N3:686-699, 1996.

Gaba et al. *Crisis Management in Anesthesiology*. Churchill Livingstone, 1994.

Rosenblatt, Murphy. *The Intubating Laryngeal Mask: Use of a New Ventilating-Intubating Device in the Emergency Department*. Annals of Emergency Medicine 33:2 Feb 1999

## 11.2 PULMONARY EMBOLISM

### **Theory**

1. The patient with pulmonary embolism may present with dyspnoea, tachypnoea, pleuritic chest pain, non-productive cough or haemoptysis. Predisposing factors include immobilisation, surgery and coagulation defects. Physical signs are usually non-specific and include tachypnoea, tachycardia and mild pyrexia. A friction rub may be heard and signs of pulmonary hypertension (prominent 'a' wave, a right atrial gallop and a prominent pulmonary second sound) will be present in patients with large emboli. ECG rarely shows the classic S1, Q3, T3 pattern but more often sinus tachycardia. Patients with severe embolism have persisting tachycardia, hypotension, right heart failure and severe hypoxemia.
2. The aim of treatment during transport is to correct hypoxia, support the circulation and prevent further thrombus formation.

### **Pre-flight and In-flight Management**

1. Pressurisation not required.
2. Oxygen by mask.
3. Circulatory support. Elevation of the lower limbs will increase venous return and augment right ventricular filling (this may be detrimental in the presence of pulmonary hypertension). If hypotensive, start colloid infusion and consider Dopamine or Adrenaline infusion.
4. Analgesia may be required for pleuritic chest pain (eg Pethidine 25 mg IV boluses).
5. Anticoagulation. Heparin 5,000 Units IV stat (15,000 - 20,000 Units if massive) followed by an infusion at 1,000 - 1,500 Units/hr.
6. Thrombolytic agents such as Streptokinase have not been shown to improve mortality but may have a role in buying time to allow a patient with severe pulmonary embolism to be transferred to a major centre. In the case of severe embolism consider the use of Streptokinase 250,000 Units IV over 30 minutes followed by an infusion at a rate of 100,000 Units/hr or r-TPA 100 mg over 2 hours.

### **Reference**

Oh TE. (ed). *Intensive Care Manual*. 4th Ed, Butterworth Heinemann, 1997.

Victorian Drug Usage Advisory Committee. *Therapeutic Guidelines: Respiratory*. 1<sup>st</sup> Ed, Therapeutic Guidelines Limited, 1994.

## 11.3 ACUTE ASTHMA

### *Initial Assessment of Severity of Asthma Attack*

	<b>Mild</b>	<b>Moderate</b>	<b>Severe</b>
<b>Talks in</b>	Sentences	Phrases	Words
<b>Use of accessory muscles</b>	Absent	Moderate	Marked
<b>Sternal retraction (in young children)</b>	Absent	Moderate	Marked
<b>Central cyanosis</b>	Absent	Absent	Present
<b>Wheeze on auscultation</b>	Present	Present	Present / absent
<b>Pulse rate (adults)</b>	< 100	100 – 120	> 120
<b>Pulsus paradoxus (children)</b>	Not palpable	May be palpable	Palpable
<b>Initial Peak Expiratory flow (% best or % predicted)</b>	> 60%	40 - 60%	< 40% or < 100 l/min in adults
<b>Physical exhaustion</b>	No	No	Yes
<b>Altered consciousness</b>	No, agitated	No, agitated	Yes / possibly
<b>O<sub>2</sub> sat (on air)</b>	> 93%	91 - 93%	< 90%
<b>P<sub>a</sub>O<sub>2</sub> mmHg (on air)</b>	test not necessary	> 60 mmHg	< 60 mmHg
<b>P<sub>a</sub>CO<sub>2</sub> mmHg</b>	test not necessary	< 40 mmHg	> 40 mmHg

### *Pre-flight and In-flight Management*

- Pressurisation is required for severe asthmatics because of risk of pneumothorax with air trapping.
- Flights are usually Priority 1, doctor accompanied, depending on the facilities at the referring location.

#### **A. Mild Asthma**

- Sit the patient up (aids intercostal and accessory muscles of respiration).
- Oxygen (if required) 6 -12 l/min via facemask to ensure an O<sub>2</sub> saturation > 93%.
- Salbutamol 5 - 10 mg via nebuliser prn (2-4/24 in mild, continuous if necessary in severe up to 25 mg every hour) (Paediatrics 2.5 mg for mild, 5 mg for moderate and severe, diluted up to 4 mL with Normal Saline).

#### **B. Moderate Asthma**

To the above add:

- Ipratropium 500 µg diluted to 2 - 3 mL in Normal Saline via nebuliser every 2-6/24 (Paediatrics 250 µg);
- Steroids: Prednisolone 1mg/kg (up to 50 mg) orally or Hydrocortisone 4 mg/kg (up to 200 mg) IV 6 hourly or Dexamethasone 0.1 - 0.25 mg/kg (up to 8 mg IM or IV).

## 11.3 ACUTE ASTHMA (CONT.)

### C. Severe Asthma

Continue with the above (especially O<sub>2</sub> and frequent nebulised Salbutamol) and consider:

- Salbutamol intravenously 4 µg/kg (eg 250 µg) (5 µg/kg in children) over 10 minutes followed by a Salbutamol infusion;
- Aminophylline: Give a loading dose of 3 mg/kg over 20 mins (withhold if the patient is already on theophylline) followed by an infusion. Toxic effects include headache, vomiting, arrhythmias and convulsions;
- Adrenaline 0.2 - 1.0 mg (2 - 10 mL of 1:10,000 solution) IV, 0.2 - 0.5 mg (0.2 - 0.5 mL of 1:1,000 solution) SC or 0.5 mg transtracheally can be tried in extremis or if IV access is not possible (Paediatric doses: 0.05 - 0.1 mL/kg of 1:10,000 solution IV, 0.01 mg/kg [0.01 mL/kg of 1:1,000 solution] SC, 0.1 mL/kg of 1:1,000 solution transtracheally);
- Ketamine has been used as a bronchodilator in severe asthma.
- Assisted ventilation should be instituted if, despite maximal medical therapy, complete exhaustion, severe deterioration in mental state or cardiac arrest occurs.

### Precautions and Special Notes

1. Severe asthma (especially in the setting of mechanical ventilation) may be complicated by:
  - pneumothoraces or
  - hypotension secondary to increased intrathoracic pressure and decreased venous return, sedation or pneumothoraces. If significant hypotension develops in the ventilated patient reduce ventilation (decrease respiratory rate) and give a fluid load.
2. Initially hand ventilation with an anaesthetic bag (where available) is preferable to using a mechanical ventilator such as the Oxylog. Ventilate initially at a low level of minute ventilation ( $\leq 115$  mL/kg/min or  $< 10$  l/min in 70 kg adult) by using a low tidal volume ( $\leq 8$  mL/kg), a high inspiratory flow rate, and a rate adjusted to achieve the desired minute ventilation ( $\leq 14$  breaths/min). Maintain humidification, avoid PEEP, and use Midazolam, Fentanyl, Vecuronium or Pancuronium instead of histamine releasing drugs such as Morphine and Atracurium. High inflation pressures may be required.
3. Nebulised Salbutamol can be introduced into the ventilator circuit by a special adaptor carried in the Oxylog bag.
4. Consider pneumothorax as a cause of failure to respond to treatment or as a cause of sudden deterioration in the asthmatic patient, especially those on mechanical ventilation. Other causes of sudden deterioration include oxygen supply failure, ventilatory failure, and mechanical obstruction of the endotracheal tube or intrathoracic gas trapping.

### Medical Chest Items

Salbutamol Aerosol Spray 100 µg/dose (Item 107), Aerosol Spacer (Item 228), Prednisolone tabs 5 mg (Item 151), Dexamethasone amps 8 mg in 2 mL (Item 100), Adrenaline amps 1:1000, 1 mL (Item 99).

### References

Oh TE. (ed) *Intensive Care Manual*. 4th Ed, Butterworth Heinemann, 1997.

Shann F. *Drug Doses*. 9<sup>th</sup> Ed, Intensive Care Unit, Royal Children's Hospital, Melbourne, 1996.

Victorian Drug Usage Advisory Committee. *Therapeutic Guidelines: Respiratory*. 1<sup>st</sup> Ed, Therapeutic Guidelines Limited, 1994.

## 11.4 BRONCHIOLITIS

### **Theory**

1. Inflammation and obstruction of the small airways (bronchioles) in infants. Mostly due to viral infection with RSV, parainfluenza or adenoviruses.
2. Clinical features include tachypnoea, tachycardia, respiratory distress, apnoeas and fine crepitations and wheezes on auscultation of the lungs.
3. Indications for transfer are an inability to drink, increasing oxygen requirements and apnoeas.
4. Gas expansion at altitude and hypoxia during air transport poses a risk to patients with significant air trapping or hypoxemia.
5. The airway needs to be secured prior to transport as the confined space makes in-flight intubation difficult.

### **Pre-flight and In-flight Management**

1. Pre-flight assessment should confirm the diagnosis and oxygen requirements of the child. Most flights will be Priority 2 and will be doctor-accompanied if child is very young, respiratory distress is severe or recurrent apnoeas are a problem.
2. Smaller babies are best nursed in a Thermocot where oxygen concentrations and temperatures are more easily controlled. Older infants may be nursed on a parent's lap with oxygen delivered by facemask. In both situations oxygen should be titrated to keep  $\text{SaO}_2 \geq 95\%$  and to reduce respiratory distress.
3. Due to significant air trapping, children with more than mild bronchiolitis should be flown at sea level pressurisation.
5. In severely ill infants intubation and ventilation may be necessary, possibly requiring assistance from an anaesthetist or paediatrician. Ventilation may be postponed in some children by administering aminophylline 10 mg/kg bolus IV. It reduces respiratory muscle fatigue, stimulates the respiratory centre and prevents apnoeas.

### **Special Notes**

1. Children who are unable to drink should receive IV fluids.
2. There is an overlap between bronchiolitis and asthma. Older infants who have had recurrent episodes or who have a strong family history of asthma should be considered for a trial of bronchodilator (eg Ventolin  $\pm$  Atrovent neb). Generally infants < 9 months have not yet developed the receptors to respond to these drugs and nebulisers should be withheld as they can make younger infants severely hypoxic.

### **References:**

Strange et al *Paediatric Emergency Medicine. A Comprehensive Study Guide*. McGraw-Hill 1996.

Vaughan et al *Nelson's Textbook of Paediatrics*. W.B. Saunders Co.

## SECTION TWELVE – TOXICOLOGY

### 12.1 PARAQUAT POISONING

#### *Theory*

1. Paraquat is a chemical herbicide available as a liquid in various concentrations up to 40+%. It also comes in water-soluble granules and as an aerosol (0.44%).
2. Serious poisoning by accidental or suicidal ingestion is nearly always fatal. Poisoning by other routes (eg. skin absorption, inhalation) rarely causes fatalities.
3. Lethal dose is tiny - less than a mouthful (15mL) of the 20% solution is lethal. Death is due to pulmonary fibrosis (and this is made worse by the administration of oxygen which increases free radicals to attack the lungs) and renal failure.
4. Acute toxicity may be:
  - mild - patients asymptomatic or develop vomiting and diarrhoea, recovery is usual,
  - moderate - severe (eg ingestion of <15mL 20% solution),
    - vomiting and diarrhoea is followed by renal and hepatic failure and then pulmonary fibrosis,
    - death occurs in the majority but may be delayed for two to three weeks,
  - acute fulminant - nausea, vomiting, extensive ulceration of oropharynx with acute multi-organ failure resulting in death from predominantly cardiogenic shock usually within one to four days.
5. Serum Paraquat levels are important prognostically. Urine levels can also be performed.
6. There is no antidote for Paraquat poisoning.

#### *Pre-flight and In-flight Management*

1. Pre-flight assessment should record specific details such as: time of ingestion, circumstances of poisoning, name and concentration of formulation, co-ingestants, whether substance was diluted prior to ingestion, amount ingested, timing of vomiting and last meal in relation to ingestion.
2. Patients who have ingested Paraquat should receive either Fuller's earth or activated charcoal orally. Those who have been exposed should have been thoroughly decontaminated with soap and water, and removal of contaminated clothing.
3. Flights may be Priority 1 or 2 depending on resources available on the ground. Patients already showing symptoms of poisoning should be doctor-accompanied. There are no requirements for sea level pressurisation.
4. Patients should be fully monitored but must not receive supplementary oxygen in flight unless used to relieve dyspnoea in likely fatal cases. Lung transplantation for pulmonary fibrosis is ineffective due to fibrosis occurring in the newly transplanted lungs.
5. Treatment is that of complications (eg. hypotension, pulmonary oedema, seizures or arrhythmias) and meticulous supportive care.
6. Ice cold fluids are used to relieve pain from oral ulceration - if not possible due to climatic conditions try diluted 1% Lignocaine applied topically.
7. Death in-flight is unlikely but possible and should be handled as a Coroner's case, plus incident reporting procedures as usual.

*Note:* Poisoned patients do not excrete Paraquat and are therefore not a risk to others, even through close contact within the confines of the aircraft.

#### *References*

Ellenham MJ, *Medical Toxicology Diagnosis and Treatment of Human Poisoning* 2nd Ed. 1997, Williams & Wilkins, Baltimore.

Ho, MT and Saunders, CE, *Current Emergency Diagnosis and Treatment*, 4th Ed. 1992, Appleton & Lang, Connecticut.

## 12.2 RED-BACK SPIDER BITE

### **Theory**

1. The Australian Red-back Spider (*Lactrodectus mactans hasselti*) is widespread throughout Australia, both in bushland and around gardens and homes. Only bites from the female cause envenomation in man. The venom causes the release of neurotransmitters from the NM junction, plus widespread release of catecholamines. Symptoms include a sharp pricking sensation followed by development of intense pain, redness and sweating at bite site. Pain may spread along a limb or commence at other sites (eg opposite limb) and is frequently associated with bizarre patches of sweating. Severe envenomation can involve severe hypertension, tachycardia, muscle fasciculations or weakness, and incoordination. Symptoms in infants include persistent screaming, tachycardia and redness. In pregnant women red-back spider bite (RBSB) has been known to precipitate pre-term labour.
2. Morbidity is high and illness may become chronic in the absence of antivenom. Antivenom can be given days - weeks later for persistent symptoms. Deaths have been ascribed to RBSB prior to 1960 (when no antivenom was available). No deaths have occurred since 1960.

### **Pre-flight and In-flight management**

1. Not all patients with RBSB are envenomated, and many can be treated with antivenom locally. Flight requests are most likely to come from stations and nursing posts without antivenom. RBSB is rarely life threatening, and never immediately, so flights will generally be Priority 3, or occasionally 2.
2. Pre-flight assessment should cover areas such as recommended first aid (local crushed ice and water pack ± simple analgesics), need for antivenom and advice on how to give it.
3. Flight needs to be doctor accompanied if there is consideration being given to administering antivenom in flight (seriously envenomated patients only).
4. RFDS does not carry Red-back Spider antivenom, so this must be accessed from the regional or city hospital prior to departure.
5. In flight, all patients receiving antivenom require continuous ECG/NIBP/SaO<sub>2</sub> monitoring, and IV access. Those with prior exposure to horse serum should be premedicated with Adrenaline 0.25 mg (0.005 mg/kg) SC ± steroids. Antivenom is administered as a single dose of 1 ampoule (=500 units) given intramuscularly. It is common to require more than one ampoule so this dose should be repeated in 1-2 hours if symptoms persist. Antivenom is administered intravenously to those seriously envenomated or those patients in whom multiple IM doses have been incompletely effective.
6. Patients who have received antivenom should be watched or followed up at 24 hours prior to discharge, as symptoms necessitating further antivenom may recur.
7. In the event of an allergic reaction to antivenom, CEASE ANTIVENOM IMMEDIATELY, then follow the guideline on "Acute Anaphylaxis".
8. Other treatment may include analgesics, Diazepam and Tetanus prophylaxis.

### **References:**

Sutherland, S. "Australian Animal Toxins: The Creatures, Their Toxins and Care of the Poisoned Patient", Oxford University Press, 1983.

Dunn R. (ed) *The Emergency Medicine Manual*. Dr Robert Dunn, Deakin ACT 1997.

Personal communication with Dr George Jelinek, Professor of Emergency Medicine, University of Western Australia, 1997.

## 12.3 SNAKE BITE

### *Theory*

Australian snake venoms are particularly rich in neurotoxins and coagulants. Correct use of pressure immobilisation delays spread of venom for many hours permitting transport to appropriate treatment centres. Therefore correct pre-flight advice regarding First Aid management is essential.

### *Pre-flight and In-flight Management*

1. All patients with suspected or proven snake bite needed to be evacuated to a centre with appropriate laboratory facilities and anti-venom stocks. All flights should be doctor accompanied, whether or not signs of envenoming are present. Priority will be 1 or 2 depending on the level of treatment available at the referring location.
2. Obtain adequate history and examination findings and confirm:
  - Oxygen has been given and intravenous access obtained;
  - assisted ventilation and circulatory support have been administered where indicated;
  - whether a pressure bandage has been correctly applied (broad bandage over the site and up the limb as high as possible, as tight as for a sprained ankle) and the limb splinted as firmly as possible and the patient rested;
  - presence of signs or symptoms of envenoming (vomiting, abdominal pain, hypotension, drowsiness or altered conscious state, ptosis or blurred vision, muscle weakness, coagulopathy); NB asymptomatic patients may still be severely envenomed;
  - that the bite site has not been washed (use for venom detection);
  - whether venom detection kit has been used or the snake reliably identified by a herpetologist;
  - whether antivenom is available.
3. Take snake venom detection kit, Polyvalent and/or monovalent snake antivenom from base stores or from the local hospital.
4. In-flight – On arrival, confirm appropriate pressure dressing is in place. If not, apply additional dressings over the site. Do not remove pressure dressings during transport. Check for presence or absence of signs of envenomation and monitor as for a head injured patient.
5. Antivenom should be administered immediately if there is any clinical or laboratory evidence of envenoming.
  - Specific indication for antivenom:
    - Coagulopathy: active bleeding from gums, nose or bite site, or marked abnormalities of laboratory coagulation parameters. In the absence of formal laboratory tests, the “whole blood clotting test” may be used. Place 5 –10 mL of patient’s blood in a glass test tube/container and leave stationary for 20 minutes (do not agitate). At 20 minutes tilt once. If the blood has not clotted, the test is positive and the patient has significant coagulopathy;
    - Neurotoxicity: initially manifests as diplopia and ptosis. May progress to generalised paralysis with respiratory failure;
    - Rhabdomyolysis: dark urine, rising creatine kinase.
  - Regional lymphadenitis, nausea, headache or sweating alone are not considered indications for antivenom.

## 12.3 SNAKE BITE (CONT.)

### 6. Selection of antivenom type and dose:

- If the patient is envenomed and the identification of the snake is uncertain consider selection of combinations of monovalent antivenom based on the geographic location and the clinical and laboratory picture - obtain specialist advice (13 11 26);
- For all suspected Brown Snake envenoming give 5 ampoules as a starting dose and consider using 10 in serious envenoming.

### 7. Draw up adrenalin prior to administration of antivenom. Treat allergic reactions by cessation of infusion and in accordance with guidelines for the treatment of anaphylaxis. Once the reaction has been treated, recommence antivenom cautiously.

### 8. Administer antivenom intravenously diluted 1:10 in normal saline over 20 minutes. In unstable patients especially those in cardiac arrest, antivenom may be given undiluted as an IV push whilst resuscitation efforts continue. Smaller fluid volumes are appropriate in children but the dose of antivenom is the same as that for an adult. Further doses of antivenom may be needed if signs and symptoms do not resolve completely.

### 9. Tetanus prophylaxis should be administered.

### **Special Notes**

1. Advice regarding management of snake bites can be obtained from a clinical toxicologist through the Poisons Information Centre (13 11 26).
2. Asymptomatic patients may have a serious coagulopathy: do not underestimate the potential seriousness of the case.
3. If any doubt exists as to the snake's identity, treat as an unidentified snake (discuss the appropriate antivenom schedule with the duty clinical toxicologist).
4. Antivenom must only be given under direction of an RFDS Medical Officer due to its expense and risk of reactions.
5. Renal failure may occur in cases of envenoming.

### **References**

- Sutherland S, King K. *Management of snakebite injuries*. Royal Flying Doctor Service of Australia, Monograph Series No. 1. 1992.
- MIMS Annual 2003. CSL Product Information, MIMS 2003.
- Dunn R. (ed) *The Emergency Medicine Manual*. 2nd Ed. Dr Robert Dunn, West Beach South Australia 2000
- Cameron P, Jelinek G et al. *Textbook of Adult Emergency Medicine*. Churchill Livingstone 2000
- Murray L, *Personal Communication*. March 2004

## 12.4 IRUKANDJI SYNDROME

### **Theory**

The Irukandji syndrome is a collection of hypercatecholaminergic symptoms arising from jellyfish envenomation.(1)

Signs and symptoms include severe generalised pain, associated with autonomic effects, cardiomyopathy and cardiogenic pulmonary oedema. (1,2)

The syndrome is well documented in northern Queensland and in the Northern Territory, caused by the small jellyfish *Carukia barnesi*, amongst others. *C. barnesi* has not been found in Western Australia, but Irukandji syndrome is a significant clinical issue around the beaches of Broome and the Dampier Peninsula.(1) The causative jellyfish in this region is yet to be identified.

Note the large box jellyfish, *Chironex fleckeri*, which causes big welt marks with severe, immediate pain and can be fatal, is a separate entity and has not been found in Western Australia.

### **Mechanism of envenomation**

Nematocysts are the stinging cells on the tentacles and bodies of jellyfish. These contain venom and a hollow shaft, which penetrates the skin of the victim upon contact, delivers the venom.

### **Symptoms and Signs of envenomation**

Symptoms: Generally minimal discomfort for 20-30 minutes after the sting, then symptoms are variable: severe generalised pain involving particularly back, abdomen, chest and muscles; nausea, vomiting, headaches, anxiety, agitation and a feeling of impending doom.

Signs: may include erythema at the sting site, diaphoresis, tachycardia, hypertension. Cardiac involvement in severe cases: ECG changes (T wave inversion and ST segment depression), progressing to myocardial depression with elevated troponin then cardiogenic pulmonary oedema and cardiogenic shock.

The generalised pain usually takes 6-12 hours to resolve, and cardiac involvement may require ICU supportive care for 2-3 days.

### ***Pre-Flight and In-Flight Management***

#### **First Aid:**

1. Apply vinegar-soaked combine to the sting site for at least one minute, as vinegar can neutralise venom in nematocysts which have not been discharged.
2. Then immerse in hot water or hot shower.
3. If in a suitable location, skin scrapings can be taken for identification after the vinegar application. Skin scrapings are placed in 1-4% formalin for microscopy.

#### **Treatment for local symptoms only:**

Treat symptomatically. If no systemic symptoms after 1 hour the patient can be discharged +/- oral analgesia and antiemetic, with instructions to return if symptoms recur.

**Treatment for systemic symptoms:**

1. Give Fentanyl 0.5 microgram/kg IV or Morphine 0.05 mg/kg IV every 10 mins until pain is controlled.
2. Give Promethazine up to 25mg IV/IM for nausea
3. Observe 15-minutely pulse BP, RR, SaO<sub>2</sub>

**Further management if pain or symptoms not controlled:**

1. Perform ECG, CXR, Troponins, U&E.
2. If hypertensive despite opiate, consider GTN infusion IV.
3. If pain not settling consider magnesium bolus and infusion (discuss with toxicologist).
4. Be vigilant for pulmonary oedema and treat as per pulmonary oedema guidelines.
5. Repeat Troponin 6 hourly

**Indications for transfer to tertiary facility:**

1. Signs or symptoms of pulmonary oedema.
2. ECG/ biochemical evidence of cardiac dysfunction.

**Transport of patients with Irukandji syndrome**

1. Flights should be doctor-accompanied, priority 2 or 1. There is a likelihood of massive opiate requirements for pain and a possibility of evolving pulmonary oedema and cardiac dysfunction.
2. RFDS doctors are advised to make contact with the on-call Toxicologist through the hospital switchboard or Poisons Information (ph 131126).
3. The patient may require ventilation for cardiogenic pulmonary oedema, or to counteract respiratory depression from massive opiate requirements for severe pain.
4. Magnesium infusion is still contentious and should be discussed with the on-call toxicologist.

**References**

- Bailey PM, Little M, Jelinek GA, Wilce JA. Jellyfish envenoming syndromes: unknown toxic mechanisms and unproven theories. *MJA* 2003; 178: 34-37
- Makrocianis CJ, Hall NL, Mein JK. Irukandji syndrome in Northern Western Australia: an emerging health problem. *MJA* 2004; 181 (11/12): 699-702
- Ibitser GK, Managing injuries by venomous sea creatures in Australia. *Aust Presc* 2007;30:117-21
- Broome District Hospital Emergency Department protocol, 2006

## 12.5 SEROTONIN SYNDROME

### **Theory**

1. A drug induced disorder characterised by altered cognitive behaviour, altered autonomic nervous system function and altered neuromuscular activity.
2. Aetiology;
  - Any drug combination that increases serotonin levels at postsynaptic serotonin-1A brain stem receptors (and perhaps serotonin-2 receptors also). Selective serotonin uptake inhibitors (SSRI's) and Monoamine Oxidase Inhibitors (MAOI's) are the most common combination to cause this syndrome.
  - The syndrome occurs when a dose increase is made to a potent serotonin agonist (MAOI or SSRI) or soon after the addition of a second serotonergic agent. (eg. Lithium, amphetamines, Cocaine, Levodopa, Bromocriptine, Pethidine, Dextromethorphan and Venlafaxine).
  - Note: Morphine and Fentanyl are considered safe alternative IV analgesics rather than Pethidine but should be used in lower doses. Nonsteroidals, salicylates and Paracetamol are safe with serotonin agonists.
3. Signs and Symptoms;
  - Rapid onset, non-specific, most commonly agitation, anxiety, restlessness, sinus tachycardia, mild hypertension, diaphoresis, hyperreflexia, myoclonus, shivering, tremor, diarrhoea and muscular rigidity. Less common symptoms include coma, seizures, VT, hyperthermia, decreased blood pressure, death.
4. Diagnosis is clinical and one of exclusion of other medical and psychiatric conditions. There are no laboratory tests and drug levels if assayed are generally normal.

### **Pre-flight and In-flight Management**

1. Treatment is usually symptomatic and supportive if mild. Dramatic improvement generally occurs within 24 hours.
2. Monitor ECG, O<sub>2</sub> saturation. Cease all serotonergic drugs.
3. Monitor for and treat hyperthermia.
4. There are no accepted guidelines for the use of serotonin antagonists, however, benzodiazepines are non-specific serotonin antagonists and can be used to decrease patient discomfort. Other agents that may be useful in moderate to severe cases include Cyproheptadine, Methysergide and Propranolol. Cyproheptadine is the most potent. Dose. 4-8 mg orally. Repeat dose 4-6 hourly if needed. Maximum dose 0.5 mg/kg/day (32mg/day).
5. Barbiturates, neuromuscular paralysis, intubation and thermal control may be required.

### **Special Notes**

Neurolept malignant syndrome is a differential diagnosis.

### **References:**

Tintinalli, Ruiz, and Krime *Emergency Medicine*, 4th Edition  
Fulde, Gordian. *Emergency Medicine The Principles of Practice*, 3<sup>rd</sup> Ed.  
Dunn R. (ed) *The Emergency Medicine Manual*, Dr Robert Dunn, Deakin ACT 1997

## SECTION THIRTEEN – TRAUMA

### 13.1 BURNS

#### *Theory*

1. Burns may be either;
  - superficial (involving the epithelium) – pink, red and painful.
  - partial thickness (epithelium and part of the dermis) – mottled pink, painful, with hairs intact, red, blistered or oedematous.
  - full thickness (through the skin to the underlying structures) – may be black or white and leathery, painless, no hairs, may have thrombosed blood vessels.
2. Partial and full thickness burns lose copious amounts of fluid and electrolytes, especially in the first few hours, which can result in hypovolemic shock.
3. Associated conditions may include carbon monoxide poisoning, cyanide poisoning (from burning plastics), smoke inhalation, trauma from explosions and falling debris, etc.
4. Calculation of area involved by the burn. NB erythema alone is not included;
  - Adults, older children - “Rule of Nines”:
    - 9% for head, each upper limb,
    - 18% for anterior trunk, posterior trunk, each lower limb,
    - 1% for perineum.
  - Infants, small children – Lund-Browder Chart:
    - figures below are for 1 year olds. For each additional year, subtract 1% from the head and add to lower extremes;
      - 19% head,
      - 12.5% each lower limb,
      - other percentages as above.

#### *Pre-flight and In-flight Management*

5. Pre-flight management and advice will be directed at removing the offending agent, the ABC's, cooling the burns and establishing IV access and commencing fluid replacement. The patient should be covered to prevent heat loss.
6. Flights may be Priority 1 or 2 and may be doctor accompanied depending on the age of the patient, the extent of the burns and the medical facilities available locally.
7. Dressings;
  - For transport, all burns should be dressed with SSD cream (not to the face), gauze, sheets or non-stick dressings and crepe bandages. Wet dressings and Gladwrap slide off predisposing the patient to infection and hypothermia,
  - Facial burns should be dressed with Vaseline or sterile emollient, with Chloromycetin ointment to the eyes and eyelids.
8. Fluid management (Parkland formula);
  - 2-4 mL/kg/%SA of burn in addition to maintenance fluids.
  - Give ½ in first 8 hours from time of burn. Give remainder over 16 hours.
  - Give all as crystalloid or half-crystalloid (Hartman's) and half colloid (Haemaccel).
  - Aim to maintain urine output >0.5mL/kg/hr (>1mL/kg/hr in children).
  - All patients with major burns should have an IDC inserted.

## 13.1 BURNS (CONT.)

### 9. Analgesia:

- Burns are very painful and administration of sufficient analgesia may necessitate intubation to protect the airway. IV morphine should be titrated or given by infusion pump.

### 10. Management of airway burns;

- suspect if there are substantial facial burns, oral erythema or blistering, carbonaceous sputum, hoarse voice or stridor.
- Management includes early intubation before oedema makes this impossible. Suxamethonium can be used in a rapid sequence induction provided burns are < 5 days old.

### 11. Escharotomy;

- must be performed if circumferential burns are preventing adequate perfusion of the extremities, or are impairing respiration. The eschar is split longitudinally with a scalpel, down to bleeding tissue. No analgesia / anaesthesia is required.

### 12. Persistent hypotension, myocardial ischaemia or arrhythmias;

- suspect and treat for carbon monoxide and cyanide poisoning.

### 13. All burns patients require tetanus prophylaxis.

### 14. Admission to a hospital with a specialist burns facility is recommended for;

- burns > 10% BSA,
- circumferential partial thickness or full thickness burns,
- chemical or electrical burns or
- burns to special areas i.e. face, neck, hands, feet, perineum, joints or inhalational burns.

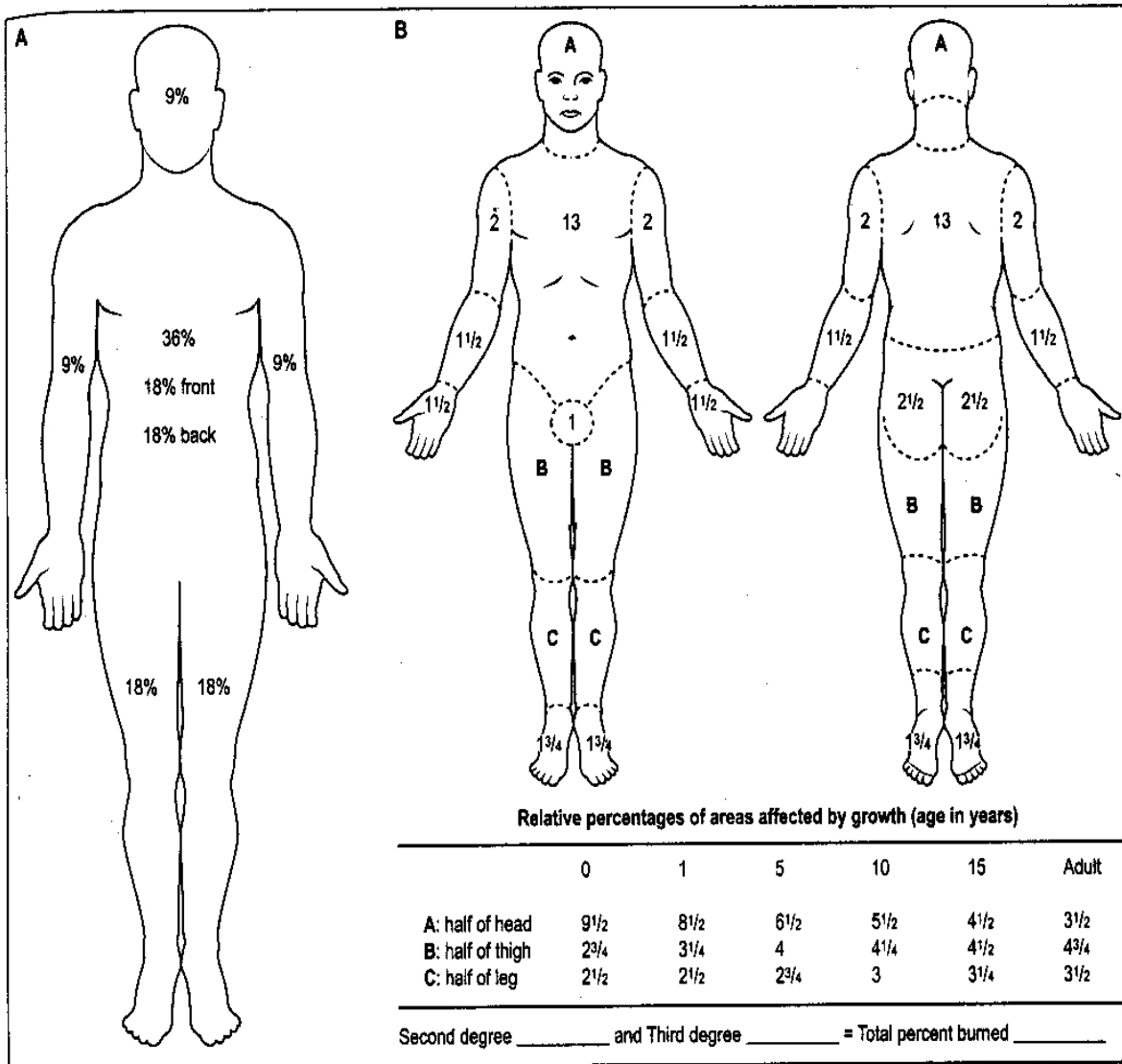
### **Medical Chest Items**

Silver sulphadiazine / Chlorhexidine Gluconate cream 1% / 0.2% / 100 gm (item 144).

### **References**

Dunn R. (ed) *The Emergency Medicine Manual*. Dr Robert Dunn, Deakin ACT 1997.  
Barnden L. Assessment and treatment form for adult burn victims. Royal Perth Hospital, 1995.  
Personal communication, CNS Joy Fong, Burns Unit, Royal Perth Hospital, 2000

13.1 BURNS (CONT.)



Lund-Browder Chart

## 13.2 HYDROFLUORIC ACID BURNS

### **Theory**

1. Hydrofluoric acid (HF) is a strong inorganic acid often used to clean metal and in glass etching.
2. On contact with skin HF is absorbed systemically where it rapidly binds with calcium to form an insoluble precipitate. It lowers the plasma calcium level and can cause demineralisation of bone. It causes deep necrotic burns to skin and soft tissues.
3. Fatalities from systemic poisoning have occurred with as little as 2.5% body surface area exposure. Death is due to myocardial depression and arrhythmias secondary to intractable hypocalcaemia.

### **Pre-flight and In-flight Management**

1. Pre-flight management advice should include copious lavage with water and the application of calcium gluconate gel topically. This will also provide pain relief.
2. Flights will usually be Priority 2. Where the burns are more than very minor, the flight should be doctor accompanied.
3. All patients should receive cardiac monitoring.
4. Continuing symptoms despite topical calcium gluconate indicates systemic absorption and further treatment should be commenced. This includes injection of 10% Calcium Gluconate subcutaneously with a 26G needle.
5. Severe or extensive burns require intra-arterial calcium gluconate titrated against the pain (via arterial lines to affected areas). Infuse 10mL Calcium Gluconate diluted with 40mL N/S into arterial line over 4/24. Follow with heparin flush. These patients require intensive care management.
6. Monitor serum calcium level with I-STAT and give IV Calcium Gluconate as required. Amputation of a limb may be necessary to save life when hypocalcaemia is intractable.

### **References:**

Dreisbach R and Robertson W, *Handbook of Poisoning*, Appleton and Lange 1987  
Saunders C and Ho M, *Current Emergency Diagnosis & Treatment*, Lange 4<sup>th</sup> Ed, 1992  
Ellenhorn H et al, *Ellenhorn's Medical Toxicology*, Williams & Wilkins, 2<sup>nd</sup> Ed 1997

### 13.3 IDENTIFICATION AND MANAGEMENT OF PELVIC FRACTURES

#### **Theory**

The sacrum, ilium, ischium and pubis, along with a large number of ligamentous complexes, comprise the pelvis. Fractures and ligamentous disruptions of the pelvis suggest that major forces were applied to the patient, eg. Ejection from a motor vehicle, crushing injury, pedestrian struck by moving vehicle or motorcycle collision. Pelvic fractures have a significant association with injuries to intra and retroperitoneal visceral and vascular structures. Therefore, hypotension may or may not be related to the pelvic fracture itself when blunt trauma is the mechanism for injury. Blood loss in a pelvic fracture is from the ends of the fractured bones, associated injuries to pelvic muscles, presacral veins and pelvic arteries

#### **Pre-flight and In-flight management**

1. These patients would usually be Priority 1 or 2 depending on the referring location and amount of pre transfer stabilisation. If there multiple injuries or the patient is unstable then the flight is likely to be doctor accompanied.
2. After checking airway, breathing and circulation ensure adequate intravenous access and fluid resuscitation, add supplemental Oxygen.
3. Inspect the pelvic area for ecchymosis, perineal or scrotal haematoma, or blood at the urethral meatus.
4. Inspect for leg-length discrepancy or rotational deformity.
5. If circumstances permit, in a male perform a rectal examination, as a high riding prostate gland is a sign of a significant pelvic fracture, note any palpable fracture, or the presence of gross or occult blood in the stool. In a woman perform a vaginal examination, noting palpable fractures, the size and consistency of the uterus, or the presence of blood. Remember that women of childbearing age may be pregnant.
6. Palpate the bony pelvis to identify painful areas.
7. Determine pelvic stability by gently applying anterior-posterior compression and lateral-to-medial compression over the anterosuperior iliac crests. Testing for axial mobility by gently pushing and pulling on the legs will determine stability in a cranial-caudal direction. This should only be performed once as repeated testing for instability may dislodge clots from coagulated vessels and result in fatal haemorrhage.
8. Cautiously insert a urinary catheter if no blood is seen at the urethral meatus, otherwise a retrograde urethrogram will be needed.
9. Interpret the pelvic x-ray, giving special consideration to those fractures that are frequently associated with significant blood loss, eg, fractures that increase the pelvic volume.
  - Systematically evaluate the film for:
    - Width of the symphysis pubis - greater than 1 cm separation signifies significant posterior pelvic injury.
    - The integrity of the superior and inferior pubic rami bilaterally.
    - The integrity of the acetabula, as well as femoral heads and necks.
    - Symmetry of the ilium and width of the sacroiliac joints.
    - Symmetry of the sacral foramina by evaluating the arcuate lines.
    - Fracture(s) of the transverse processes of L-5.

### 13.3 IDENTIFICATION AND MANAGEMENT OF PELVIC FRACTURES (CONT.)

- The pelvis is a ring that rarely sustains an injury in only one location. Displacement of ringed structures implies two fracture sites.
  - Remember, fractures that increase the pelvic volume, eg vertical shear and open-book fractures, are often associated with massive blood loss.
10. Techniques to Reduce Blood Loss from Pelvic Fractures.
- Avoid excessive and repeated manipulation of the pelvis.
  - Internally rotate the lower legs to close an open-book type fracture. Pad bony prominences and tie the rotated legs together. These manoeuvres may reduce a displaced symphysis, decrease the pelvic volume, and be used as temporary measures until definitive treatment can be provided.
  - Apply and inflate the MAST and place on a vacuum mattress for transport
  - Obtain early surgical and orthopaedic consultation to determine priorities.(Royal Perth Hospital Trauma line 1800-631-798)
11. Place sandbags under each buttock if there is no indication of spinal injury and other techniques to close the pelvis are not available.

#### **References:**

American College of Surgeons Committee on Trauma, *Advanced Trauma Life Support for Doctors: Student Course Manual*, 6<sup>th</sup> Ed, American College of Surgeons Chicago, 1997.

## 13.4 CRUSH SYNDROME

### **Definition**

The systemic manifestations of muscle ischaemia secondary to compartment syndrome.

### **Theory**

1. First described in civilians buried under debris from collapsed buildings during the London Blitz in World War II. Other causes include earthquakes, mining accidents and prolonged unconsciousness (e.g. drug overdose) where the patient's limbs are compressed by his own body weight. The diagnoses should be suspected in these circumstances.
2. The clinical presentation includes the following:
  - Signs of compartment syndrome: swollen, tense muscle compartments; pain in conscious patients, especially on passive stretching of affected muscles.
  - Pressure marks, including clothing patterns.
  - Reduced perfusion to peripheries. N.B. Peripheral pulses disappear late.
  - Cardiovascular: hypertension, tachycardia, arrhythmias secondary to hyperkalaemia.
  - Metabolic: metabolic acidosis, hyperkalaemia, and acute renal failure secondary to myoglobinuria, DIC.

### **Pre-Flight and In-flight Management**

1. These would usually be Priority 1 or 2 and Doctor-accompanied, depending on the facilities at the referring location.
2. There should be a low threshold for suspecting the diagnosis and treating early. Hyperkalaemia and metabolic acidosis can be confirmed using i-STAT. Urine may be discoloured dark red-brown from myoglobin, with dipstick positive for blood.
3. Good intravenous access with preferably two 16g cannulae, urinary catheterization, supplemental oxygen and splinting of any associated fractures should also be ensured.
4. Maintenance of high urinary output (>2 mL/kg/hr) with IV fluids (usually 1 litre/hr for first 4 hours) and IV mannitol,  $\pm$  dopamine infusion, unless anuric.
5. Urinary alkalinisation with  $\text{NaHCO}_3$  1mmol/kg.
6. Correct hyperkalaemia with 50% Dextrose 25mL and Actrapid insulin 5 units IV.
7. Transport early for definitive care, which includes haemodialysis, fasciotomy and debridement of dead muscle, and ICU management.

### **References:**

Dunn R. et al *The Emergency Medicine Manual*, 2<sup>nd</sup> Ed, Dr Robert Dunn, Deakin ACT 1997

## 13.5 FRACTURED NECK OF FEMUR

### **Theory**

1. Orthopaedic surgeons in Western Australia have indicated their desire to be able to have a patient with a fractured neck of femur on the operating table within four hours of the injury occurring, to maximise the success rate of maintaining the viability of the head of the femur.
2. In the real world obviously, this ideal is not always attainable, especially considering the long distances involved, and also the fact that often we are not notified by the referring location until well after this four hour period has passed.

### **Pre-flight Management**

1. Check time of injury – if the fracture has occurred recently and it is feasible for us to retrieve the patient within four hours then it should be assessed as a priority 2 flight.
  - We still will not be able to get the patient to the operating table in four hours but this will minimise the delay – clinically it is not justified to make it a priority 1 flight based on an uncomplicated isolated fracture alone.
2. Check IV access – desirable to be able to use IV boluses without risk of needle-stick injury in flight and analgesia will be far more effective if titrated to patients needs. The patient should be fasting with appropriate maintenance fluids IV running.
3. Sometimes a femoral nerve block can effectively augment IV analgesia – it is worth asking if the LMO would consider a FNB prior to our retrieval.
4. Indwelling catheter – is recommended due to restricted mobility with this injury.
5. Splinting – ensure buddy splinting to the opposite leg. ***NB*** Hare traction splints are not effective for # NOF – as the ring at the top sits directly under the fracture site. A vacuum mattress is an effective form of immobilisation during transfer.
6. Check that the neurovascular status of the leg distally is not compromised.

### **In-flight management**

1. Routine monitoring with Propaq monitor.
2. Supplemental oxygen via Hudson's mask as required.
3. Intravenous analgesia titrated to patient needs – usually Morphine or Pethidine boluses IV prn.
4. Antiemesis may need to be considered.

### **References**

Dr's S A Langford & C.S. Lee. *Fractured NOF Study*, RFDS Western Operations 1998  
Personal communication with various orthopaedic surgeons, WA., 2000

## 13.6 SCREENING ADULTS WITH SUSPECTED CERVICAL SPINE INJURY

### **Theory**

1. The presence of paraplegia or quadriplegia is presumptive evidence of spinal instability.
2. Assessment of the patient depends on their conscious state, neurological status and the presence or absence of midline tenderness.
3. Cervical spine injury is highly unlikely in patients with blunt trauma if the following 5 criteria are met:
  - A normal level of alertness,
  - No evidence of intoxication,
  - Absence of a focal neurological deficit,
  - Absence of tenderness at the posterior midline of the cervical spine and
  - The absence of clinically apparent pain that might distract the patient from the pain of a cervical spine injury.
4. Patients who fit the above criteria can be safely transferred without cervical immobilisation. All other patients should be transferred with the spine immobilised with a stiff neck collar until full radiographic assessment can be made.
5. Cervical spine radiographs should be assessed for
  - A. bony deformity,
  - B. fracture of the vertebral body or processes,
  - C. loss of alignment of the posterior aspect of the vertebral bodies (anterior extent of the vertebral canal),
  - D. increased distances between the spinous processes at one level,
  - E. narrowing of the vertebral canal, and
  - F. increased prevertebral soft-tissue space (>5 mm opposite C3).

### **References**

American College of Surgeons Committee on Trauma, *Advanced Trauma Life Support for Doctors: Student Course Manual*, 6<sup>th</sup> Ed, American College of Surgeons Chicago, 1997.  
Hoffman et al, *Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma*. NEJM 2000;343:94-9.

## 13.7 ACUTE SPINAL CORD INJURIES

### *Theory*

1. The commonest presentation of acute spinal cord injury (SCI) (in the conscious patient) is neck or back pain with flaccid paralysis below the level of injury. The damage occurs at the time of injury. There is little that can be done to impact on this other than health promotion campaigns focussing on prevention and legislation to reduce the injury impact eg use of seatbelts.

It is the secondary damage that occurs in the subsequent hours following initial injury that has been the focus of much research within the SCI field over the last few years. The secondary damage occurs following a complex biomechanical cascade of events, resulting ultimately in a process called lipid peroxidation, with subsequent further neurological deterioration. Additionally, the inflammatory process will result in oedema to the spinal cord, which has the ability to ascend the neurological deficit. The emphasis of research has therefore been to attempt to influence various points within this cascade and so positively affect outcomes for the patient.

2. The aim of treatment is to reduce or minimise cord oedema and prevent further cord damage.
  - A cord lesion is presumptive evidence of spinal fracture/dislocation which is **unstable**. All patients should be transferred with full spinal precautions immobilizing the entire spine.
  - Secondary cord damage can be minimised by ensuring adequate oxygenation, adequate spinal cord perfusion (adequate blood pressure) and the administration of Methylprednisolone (although this is controversial).
  - Neural tissue can be further damaged by high blood sugar levels so it is important to control this and avoid Dextrose containing IV fluids
3. Methylprednisolone is the only drug so far to have shown some benefit in acute spinal injuries. Researchers speculate that the drug has at least two main effects:
  - a. Suppresses the vigorous inflammatory responses at the site of injury, which may worsen its impact; and
  - b. Block the formation of free radicals. These charged, highly energetic ions can disrupt the membranes of cells (i.e. lipid peroxidation).

As spinal cord injuries are not common, there are few good large randomised trials, and its use is controversial. If used, it must be given in the first 8 hours after injury.

### *Pre-flight Management*

1. Most flights will be Priority 2 and may not require a doctor. A doctor should accompany the flight if the cord lesion is high (and increasing oedema may affect innervation of respiratory muscles), if there are associated injuries requiring a doctor or patient is shocked. Pilots should be requested to avoid turbulence.
2. Pre-flight advice should include the immobilization of the entire spine, best done by placing the patient in a correctly applied Stifneck cervical collar and placed on a vacuum mattress with universal head immobilizer. Patients should receive adequate analgesia and/or sedation to allow them to lie still. Antiemetics, NGT and IDC are strongly recommended. Prophylaxis against gastric stress ulceration is also recommended. All patients should be transferred to Royal Perth Hospital.
3. Spinal shock occurs in cervical cord lesions where there is unopposed vagal response causing hypotension and bradycardia. It is important to distinguish from hypotension due to haemorrhagic shock, which usually causes peripheral shutdown and tachycardia. Spinal shock often does not respond to fluids and excess fluids can precipitate pulmonary oedema. If patients are very hypotensive they may require inotropes.
4. All patients should receive oxygen.

### 13.7 ACUTE SPINAL CORD INJURIES (CONT.)

5. Methylprednisolone should be administered as soon as possible after the injury. If in doubt consult Spinal Unit consultant urgently. It is administered as a bolus dose of 30mg/kg IV over 15 minutes, followed by 5.4 mg/kg IV over 23 hours. See drug infusion guidelines for details. It is contraindicated in open cord injuries.
6. Full spinal precautions should be maintained throughout all transfers.
7. Protect the skin – pressure relief and protection of bony prominences are important from the outset during transfer.
8. Check blood sugar levels four hourly if administering steroids – consult Spinal Unit consultant if elevated.

#### **References**

American College of Surgeons Committee on Trauma, *Advanced Trauma Life Support for Doctors: Student Course Manual*, 6<sup>th</sup> Ed, American College of Surgeons Chicago, 1997.

Bracken MB. *Pharmacological Interventions for Acute Spinal Cord Injury* (Cochrane Review). In: the Cochrane Library, Issue 1, 2001. Oxford.

Personal Communication with Mr Ker, Senior Spinal Unit Consultant, Royal Perth Rehabilitation Hospital, Shenton Park, Perth.

See also RFDS Western Operations Clinical Manual 13.6 Guidelines for Screening Adult Patients with Suspected Cervical Spine Injury.

## 13.8 HEAD INJURY

### *Theory*

The aims of patient management in severe head injury are to identify and treat life-threatening injuries and prevent secondary brain injury. Most morbidity results from delay in diagnosis and treatment of an intracranial haematoma or from failure to correct hypoxia and hypotension. Referral to a neurosurgical team improves outcome and this service should be consulted early.

### ***Pre-flight and In-flight Management***

1. Pre-flight information and advice is directed at airway management (with cervical spine control) and correction of hypovolaemia. Flights will usually be Priority 1 or 2, depending on facilities at the referring location and the severity of the injury. Any patient who may require intubation or other intervention must be doctor-accompanied.
2. Patients with open head injuries or pneumocephalus require sea level pressurisation. Whether sea level pressurisation is also required for patients with a fractured base of skull is controversial. Closed head injuries do not require pressurisation to sea level.
3. Assessment and resuscitation is carried out according to priorities taught in the EMST. Difficulties with intubation should be anticipated early as cervical spine stabilisation will be necessary. There may be significant facial injuries, foreign bodies in the airway and distortion of airway structures at laryngoscopy. Patients should be transferred when life-threatening extracranial injuries are controlled and there is no persisting hypotension.
4. Intubation is indicated to protect the airway from aspiration, correct hypoxia, allow controlled hyperventilation to reduce cerebral oedema, and to control the combative patient to facilitate CT scanning or transport. Patients with a GCS  $\leq 8$  have been shown to benefit from early intubation, but the above criteria may include patients with GCS 8 – 12 as well. Rapid sequence induction and oral endotracheal intubation, with in-line stabilisation of the cervical spine, is the preferred method of intubation.
5. The induction agent of choice is Thiopentone as this has been shown to assist in reduction of raised intracranial pressure, and its effects are predictable. Smaller doses than previously described are now recommended to avoid hypotension, eg 0.5–3.0 mg/kg. Other agents (Midazolam or Propofol) can be used, but are less predictable in their effects and quite hypotensive.
6. To prevent the rise in intracranial pressure associated with laryngoscopy, Lignocaine is no longer recommended as it has not been shown to be effective. Fentanyl, in doses of 200 $\mu$ g or higher has been shown to improve outcomes. In the hypotensive patient smaller doses of Thiopentone and larger doses of Fentanyl (eg. 1 mg or more) are very effective and less likely to drop the BP.
7. Deteriorating conscious state, development of focal neurological signs, papilloedema or Cushing's reflex (hypertension and bradycardia) are evidence of raised intracranial pressure and may be treated with:
  - (a) intubation and controlled hyperventilation
  - (b) 30° head elevation (ensure also the IJV has not been kinked by turning the head)
  - (c) Mannitol - 0.25 – 1.0 g/kg IV over 15 mins.
  - (d) Steroids are not useful in the management of acute head injury.
8. Positioning the patient's head up thirty degrees reduces ICP without reducing CPP. Circumferential ETT ties are best avoided (use tape to face) as they increase ICP. Avoid pressure on Internal Jugular Vein. Keep the patient well sedated and paralysed to reduce cerebral oxygen demand and prevent coughing.

## 13.8 HEAD INJURY (CONT.)

9. Hypovolaemia must be aggressively corrected to maintain cerebral perfusion pressure (CPP). The intracranial pressure (ICP, n = 5-15mmHg) cannot be measured in flight and thus the CPP can only be estimated (CPP = MAP – ICP). The MAP should be positioned to allow maintenance of CPP in the range 80-100mmHg.
10. Ensure adequate monitoring through invasive arterial blood pressure and central venous pressure measurement, oxygen saturation and cardiac monitors, use of expired air CO<sub>2</sub> analyser, frequent ABG and blood glucose estimations, and hourly urine measure.
11. Patients with open head injuries require antibiotic prophylaxis. Flucloxacillin 1G IV 6 hourly is recommended.
12. Anticonvulsant prophylaxis may be indicated in severe neurotrauma. Give Phenytoin 15-18mg/kg IV over 30-60 minutes.
13. Give Thiamine early for cerebral protection in case glucose-containing IV solutions are required.

### **Special Notes**

1. Aim for CVP = 10-12mmHg, MAP = 90-120mmHg, PaO<sub>2</sub> > 100mmHg, PaCO<sub>2</sub> = 35-40mmHg, normoglycaemia (use Insulin/Dextrose if necessary), urine output > 0.5mL/kg/hr.
2. The actual PaCO<sub>2</sub> will be higher than the (expired air) CO<sub>2</sub> indicated on the monitor, regardless of where the probe is positioned (the difference is less if the probe is close to the patient).
3. Where ICP appears to be increasing (papilloedema, bradycardia, hypertension, loss of pupil reflexes) the use of hyperventilation to PaCO<sub>2</sub> of < 35mmHg (reduces ICP but may reduce CPP) and the use of Mannitol (reduces ICP but may cause cerebral oedema) should be discussed with the neurosurgical service.

### **References**

Cameron P., Jelinek G. et al (Ed) *Textbook of Adult Emergency Medicine*. Churchill Livingstone 2000. Chapter 2.2 Neurotrauma. Pp 47 – 51.

Monaghan M. Intravenous *Lignocaine as Pretreatment for Intubation of Patients with Acute Severe Head Injury*. *Emergency Medicine* 2000. 12,pp337 - 343.

Allman K and Wilson I. *Oxford handbook of anaesthesia*. Oxford University Press 2001.

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## SECTION FOURTEEN – AIRWAY & VENTILATION

### 14.1 INTUBATION OF PATIENTS - OVERVIEW

#### *Theory*

1. Indications for intubation are:
  - (a) severe upper airway obstruction (eg epiglottitis, severe croup)
  - (b) inability to clear or maintain the airway (e.g. depressed conscious state, profuse bleeding from airway)
  - (c) respiratory failure (e.g. trauma – flail chest, severe asthma)
  - (d) to facilitate controlled ventilation (e.g. the management of head injury).
2. Minimum requirements for anaesthesia and intubation:
  - (a) an assistant
  - (b) bed/stretchers capable of being placed head down
  - (c) O<sub>2</sub> supply bag and face mask
  - (d) suction apparatus
  - (e) laryngoscope x 2 (1 spare in case of failure) and appropriate sized blades.
  - (f) Magill's forceps
  - (g) endotracheal tubes in range of sizes
  - (h) introducer +/- gum elastic bougie
  - (i) drugs – for induction of anaesthesia, muscle relaxants, maintenance of anaesthesia, emergency drugs
  - (j) knowledge of failed intubation drill.

In the emergency setting, moribund patients can often be intubated without drugs. Other patients (and especially those with head injuries) should receive appropriate sedation and muscle relaxants. All emergency patients should have a rapid sequence induction with cricoid pressure to prevent aspiration of stomach contents.

3. Technique for rapid sequence induction:
  - (k) prepare drugs and equipment:
    - draw up drugs in advance as set doses, based on patient's body weight (eg Midazolam 0.15mg/kg, Fentanyl 1-5 µg/kg)
    - monitor patient
    - brief assistant
    - review failed intubation drill and equipment
  - (l) pre-oxygenate patient (anaesthetic bag and mask + high flow O<sub>2</sub> with good seal) for three minutes.
  - (m) assistant applies cricoid pressure
  - (n) administer drugs as rapidly as possible, in rapid sequence, along with Suxamethonium 1-2 mg/kg (muscle relaxant of choice except in rare exceptions). Do not titrate drugs slowly as the idea is to provide a rapid onset of anaesthesia so that the patient can be intubated as soon as possible, lessening the time he/she is at risk of aspiration.

- (o) wait for patient to stop muscle fasciculations (from Suxamethonium) then intubate. Patient must not be bagged in the meantime as this fills the stomach with air, increasing the risk of aspiration.
- (p) inflate cuff and confirm correct placement – attach ETCO<sub>2</sub> monitor, auscultate the axillae:
- (q) secure ETT
- (r) release cricoid pressure
- (s) ventilate patient
- (t) administer long acting sedation and muscle relaxants.

## 14.2 RAPID SEQUENCE INDUCTION

### *Theory*

1. Defined as the administration of an induction agent followed immediately by a neuromuscular (NM) blocker, to induce a rapid onset of unconsciousness and paralysis to allow tracheal intubation. The "Gold standard" for emergency airway management.
2. Both the induction agent(s) and NM blocker are given as bolus, pre-determined doses (NOT titrated), in rapid sequence to cause rapid onset of best possible intubating conditions. This minimizes the time between loss of consciousness and airway reflexes, and intubation, reducing the risk of aspiration of gastric contents.
3. All emergency patients requiring intubation should be assumed to have full stomachs and hence require a rapid sequence induction (RSI) of anaesthesia.
4. Refer also to Clinical Guidelines "Preparation of Ventilated Patient for Transport", "Difficult Airway Algorithm" and "In-flight Checklist for Ventilated Patient" and Procedure "Adult Oral Intubation".

### *Procedure*

#### **PREPARATION**

1. Assess patient's airway for potential difficult intubation.
2. Apply monitoring equipment (ECG, NIBP, SaO<sub>2</sub>). ETCO<sub>2</sub> monitor should be warmed up and ready.
3. Brief assistants.
4. Check equipment. Minimum requirements are:
  - Laryngoscopes X 2
  - BVM and oxygen
  - Suction
  - Range of ETTs, introducer + 10ml syringe
  - IV line and fluids
  - Induction agents, NM blocker and emergency drugs
  - Resuscitation equipment

#### **PREOXYGENATION**

Administer 100% oxygen for 3 mins.

Patient should breathe spontaneously.

If respirations inadequate doctor should assist ventilation with cricoid pressure in situ.

#### **PARALYSIS & ANAESTHESIA**

Induction - assistant gives induction agent(s) immediately followed by NM blocker as IV push into running IV line.

Cricoid pressure – apply as soon as patient starts to lose consciousness

Wait for loss of consciousness and onset of paralysis (once fasciculations have ceased if using Suxamethonium).

DO NOT BAG (VENTILATE) PATIENT – doing so increases the risk of aspiration. If properly pre-oxygenated will not require bagging.

**PASS THE TUBE (INTUBATE) – as soon as patient fully relaxed.**

## CONFIRM POSITION OF TUBE

Gold Standard is:      a) seeing tube pass through cords  
                                 b) continuous ETCO<sub>2</sub> waveform

Other methods are unreliable.

## SECURE ETT

Secure with tape for transport.

Measure and record cm from teeth. (Lips may swell from trauma giving false measurement.)

## POST – INTUBATION MANAGEMENT

- Doctor's first priority is always the safety of the tube
- Ongoing maintenance of anaesthesia and relaxation
- Continuous monitoring of vital signs and ETCO<sub>2</sub>. Consider Arterial Blood Gases.

## PACKAGE FOR TRANSPORT

Refer to Clinical Guideline "Preparation of the Ventilated Patient for Transport"

### ***Choice of Drugs for Rapid Sequence Induction***

## INDUCTION AGENTS

*Thiopentone* – dose 1 – 3 mg/kg

- Gold standard for RSI due to rapid onset and predictable
- degree of anaesthesia
- main side effect is hypotension (can be overcome by combining smaller doses with an opiate such as Fentanyl)
- beneficial in head injuries?(lowers ICP; anticonvulsant)

*Propofol* – dose 0.5 – 2 mg/kg

- profound respiratory depressant
- more hypotensive compared with Thiopentone (therefore not suitable for most emergency inductions)
- useful as ongoing sedation for ventilated patient

*Midazolam* – dose 0.15 mg/kg

- slow onset of action and hypotension has resulted in it no longer being considered suitable for RSI
- has amnestic and anticonvulsant properties
- useful in ongoing sedation of ventilated patient

*Ketamine* – dose 1-2 mg/kg

- dissociative anaesthetic (causes state of profound analgesia and anaesthesia where patient may appear awake)
- airway reflexes are NOT preserved at induction doses
- causes increase in sympathetic activity resulting in increased BP, increased ICP and bronchodilation
- indications: acute asthma, profound hypovolaemic shock (eg. AAA)
- contraindications: head injuries, IHD

**Fentanyl** - dose 3µg/kg

- short-acting opiate; profound respiratory depressant
- useful in combination with other induction agents (allows smaller doses to be used, causing less hypotension)
- avoid in shocked patients who are relying on their sympathetic drive to maintain their BP as Fentanyl abolishes this and can result in severe hypotension
- prevents the rise in ICP from laryngoscopy in head injured patients
- high doses can cause muscle wall rigidity and difficulty in ventilation( treat with Suxamethonium)

**Morphine** – dose 0.1 – 0.2 mg/kg

- sometimes used as an adjunct to other induction agents
- less reliable respiratory depression and suppression of airway reflexes, slow onset and hypotension has meant it is no longer recommended for RSI
- useful with Midazolam as ongoing sedation of ventilated patient

**NEUROMUSCULAR BLOCKERS****Suxamethonium** – dose 1 -2 mg/kg

- non-competitive depolarizing NM blocker
- IV administration leads to fasciculations 10 – 15 sec
- max. paralysis 30 – 60 sec
- return of spontaneous respirations 3 – 5 mins
- full ventilatory capacity 8 -10 mins

## Side effects:

- fasciculations leading to increased intragastric, intraocular & intracranial pressures (possible clinical significance)
- increased serum K<sup>+</sup> (up to 0.5 mmol/l in average patient; up to 5-10mmol/l in patients with burns or crush injuries > 48 hrs, or those with NM disorders;
- patients with renal failure who are not hyperkalaemic can be given Suxamethonium)
- bradycardia (especially children or repeated doses in adults)
- Scoline apnoea (congenital absence of pseudocholinesterase results in prolongation of paralysis (hrs) – not a contraindication in most ventilated patients as ventilated longer than this)
- Malignant hyperthermia ( genetic skeletal muscle abnormality triggered by inhalational anaesthetics and Suxamethonium leads to muscle rigidity and breakdown, ANS instability, ↑K<sup>+</sup> & ARF. Often fatal.)

**Vecuronium** – dose 0.3 mg/kg (intubating dose); 0.1 mg/kg (ongoing relaxation)

- competitive, non-depolarizing blocker
- indications: intubation in patients where suxamethonium contraindicated, ongoing relaxation in ventilated patient
- IV administration → onset of paralysis 90 sec.
- max. paralysis 2<sup>1</sup>/<sub>2</sub> mins.
- return of spontaneous respirations 45 mins.
- full ventilatory capacity ~ 60 mins.
- no significant side effects or contraindications (difficult airway?)

## **Special Cases**

### **Head injured patient (need to avoid)**

#### *Hypoxia*

- Increased intracranial pressure - 2<sup>o</sup> to laryngoscopy; aborted by Fentanyl but not lignocaine(?)
- hypotension (BP < 90 mmHg systolic)
- best choice : Thiopentone/Fentanyl/Suxamethonium

#### *Haemodynamically unstable patient*

- aggressive fluid resuscitation +/- inotropes PRIOR to induction
- best choice: small dose Thiopentone ± Fentanyl/Suxamethonium or Ketamine/Suxamethonium

#### *Hyperkalaemia*

- aggressive management of potassium level PRIOR to induction
- AVOID Suxamethonium
- best choice: any induction agent/high dose vecuronium

#### *Children*

- ensure well-oxygenated at all times
- appropriately smaller doses of all drugs
- pre-treat with ATROPINE 0.02 mg/kg (high risk of bradycardia 2<sup>o</sup>suxamethonium./intubation)

#### *Acute severe asthma*

- ensure well pre-oxygenated sitting up
- once LOC occurs – lie down and intubate
- ensure well sedated and paralysed post-intubation
- best choice: Ketamine/Suxamethonium or thiopentone/fentanyl/suxamethonium

#### *Upper airway obstruction*

- RSI CONTRAINDICATED
- transport to specialist anaesthetist ASAP
- consider surgical airway if obstruction imminent and hand ventilation /intubation fails

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Compiled by Dr G Wilson (2008)

## 14.3 PREPARATION OF VENTILATED PATIENT FOR TRANSPORT

### *Theory*

1. All ventilated patients by definition are critically ill and require careful attention to detail in supporting and monitoring all bodily functions.
2. Continuous monitoring of HR, BP, ventilator settings, SaO<sub>2</sub> and ETCO<sub>2</sub> is essential and must not be disrupted during preparation of the patient for transport or while loading/unloading patient from aircraft or ambulance.
3. Refer 

a) Clinical Guideline	7.6.1 Ventilated Patient - Rapid Sequence Induction
b) Clinical Guideline	7.6.3 In flight Checklist for Ventilated Patient
c) Procedures	1.5 Adult Oral Intubation

### **Pre- Flight and In- Flight Management**

1. All ventilated patients must be doctor-accompanied. A flight nurse must also be on the flight.
2. No more than one ventilated patient to be carried on aircraft at one time. In an emergency a 2<sup>nd</sup> ventilated patient may be carried if a 2<sup>nd</sup> RFDS doctor is available and on board.
3. Priority will depend on diagnosis and patient's condition PLUS local resources. (eg Ventilated trauma patient in small hospital may be Priority 1 whereas stable ventilated patient with overdose in regional hospital may be Priority 2 or 3).
4. RFDS doctor and flight nurse will usually go into the referring hospital to package patient for transport and escort patient to airport. This is especially important if patient is unstable, requires intubation or other procedures. However, if patient is TIME-CRITICAL referring doctor **should be requested to bring patient to airport.**
5. Packaging of patient for transport

### **AIRWAY**

- Safety of endotracheal tube (ETT) is doctor's 1<sup>st</sup> priority at all times.
- Check ETT position, patency and cuff pressure.
- Confirm ETT position (clinically, ETCO<sub>2</sub>, consider CXR).
- Ensure ETT is well secured (consider bite block).
- Immobilize cervical spine as required

### **BREATHING**

- Connect ETT to flexible connector then to ventilator hose.
- Heat and moisture exchanger (HME) should be positioned closest to ETT, with ETCO<sub>2</sub> sensor between HME and flexible connector, to prevent fogging.
- Check all connections are secure.
- Check Oxylog ventilator settings and set alarms as required before transferring patient to Oxylog.

### *ADULT*

- As a guide, for an adult : RR 8-10 breaths/min. TV 6-7 ml/kg BW and adjust according to SaO<sub>2</sub>, ETCO<sub>2</sub> and/or ABGs.
- Check airmix (FiO<sub>2</sub> 0.6)/ no airmix (FiO<sub>2</sub> 1.0) is set as required.

- Observe and record airway pressures.
- PEEP is added by connecting PEEP valve to expiratory valve of ventilator circuit after setting amount of PEEP required. Note Oxylog pressure gauge will not show PEEP due to non-return patient connector valve.

#### *CHILD*

- To ventilate a CHILD consider adding paediatric leak valve if child < 10 kg. It should be placed between Oxylog and ventilator hose. RR and pressure limits should be set according to child's size. Note MV readings become inaccurate with leak valve in place, so need to judge clinically degree of chest inflation and match with SaO<sub>2</sub>, ETCO<sub>2</sub>, pressures and/or ABGs.
- In small children the head/neck should be immobilized as flexion may result in R main bronchus intubation and extension in accidental extubation.

#### *TRANSFERRING BETWEEN VEHICLES*

- To transfer to ambulance, the O<sub>2</sub> line from the Oxylog must be disconnected from the hospital wall O<sub>2</sub> and transferred to ambulance portable O<sub>2</sub> supply.
- Once in the ambulance the O<sub>2</sub> should be connected to the ambulance 'D' cylinders, saving Oxyviva or spare cylinder for transfer to aircraft.
- Before transferring to any O<sub>2</sub> supply CHECK CONTENTS is sufficient and supply is ON. Constantly monitor O<sub>2</sub> availability.

### **CIRCULATION**

- Ensure two peripheral IVs, patent and well-secured are in place. Rapid access in transit must be possible.
- Consider central and/or arterial lines as required. Note risk of pneumothorax with Central Venous Lines (Consider CXR availability)
- STOP HAEMORRHAGE wherever possible
- Where necessary aggressive fluid resuscitation and/or inotropic support should be carried out to improve haemodynamic stability prior to moving the patient. If the patient is time-critical this should be carried out during transport.
- Does the patient require blood?
- HR/ECG should be monitored continuously, BP as required.

### **DRUGS**

- Continuous infusion of sedation and muscle relaxants is preferable to intermittent bolus doses.
- All ventilated patients should be adequately sedated and paralysed throughout the transfer. Usual choices include:
  - a) Morphine : Midazolam infusion (Ref. Drug Infusion Guidelines)
  - or
  - b) Propofol 1 mg/hr in adult
  - and
  - c) Vecuronium infusion (Ref. Drug Infusion Guidelines)
- Note all drugs should be titrated to effect.
- Other drugs may include inotropes, antiarrhythmics etc.
- If patient develops bronchospasm, in-line Ventolin puffer can be inserted into circuit as close to ETT as possible. Drug should be administered timed with inspiration.

## ENVIRONMENT

- Monitor temperature (consider temperature probe inserted into oesophagus).
- All ventilated patients require a nasogastric or orogastric tube to reduce gastric distension and risk of aspiration and prevent splinting of diaphragm, which can reduce venous return (especially children).

## FLUIDS

- All ventilated patients require an IDC to monitor urine output and prevent incontinence.
  - Strict recording of fluid balance is required
  - Ideally urine output should be maintained at 0.5 – 1 ml/kg/hr (adults) or 2ml/kg/hr (children)
6. During ALL phases of transport, doctor must have access to alternative means of ventilating patient in case of ventilator or oxygen failure (eg bag valve mask) PLUS intubation equipment and suction in case of dislodged or blocked ETT or cuff failure.
  7. Escorts – all ventilated patients require 2 persons (one a doctor) to escort them at all times. If stable, doctor can escort patient with ambulance paramedic from Jandakot to tertiary hospital. If unstable, doctor should consider getting flight nurse to accompany him/her.
  8. Communications – good communications between referring doctor and RFDS doctor; and RFDS doctor and receiving hospital ED or ICU is essential for a smooth transfer. RFDS doctor should consider early contact with receiving hospital and contact again with updated ETA and patient's condition on landing at Jandakot.

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## 14.4 VENTILATED PATIENTS – CONTINUING MANAGEMENT

### *Pre-flight and In-flight Management*

1. All flights will be doctor accompanied but priority may vary according to diagnosis and local facilities.
2. It is usually advisable to go into the hospital to get a handover and package patient for transport. (In some cases it may be necessary to resuscitate patient first.) However under some circumstances (such as time-critical patients), the patient may be accepted at the airstrip, especially if the referring doctor has the skills to accompany the patient to the strip and facilities at the airstrip are reasonable.
3. Management is as per the following checklist plus any other management specific for that patient:

### VENTILATED PATIENT CHECKLIST

#### Endotracheal tube

- (a) Position:
  - auscultate axillae and epigastrium
  - look for misting in tube on exhalation
  - ETCO<sub>2</sub>: continuous waveform is gold standard for confirming ETT position
  - length (cm at teeth) note and record
  - position on CXR (just above carina).
- (b) Cuff:
  - saline can be used to fill cuff to minimise expansion during air transport or air-filled cuffs can be adjusted. Clamp cuff port with guarded artery forceps if any doubt about cuff leakage.
  - children should have uncuffed ETT's.
- (c) Security:
  - tie in place with linen tape around neck (do not obstruct IJV)
  - add adhesive tape to face (unless bearded)
- (d) Patency:
  - determine need for suctioning
- (e) Throat pack:
  - should be tied to ETT and written on a piece of tape applied to patient's forehead, to prevent pack being accidentally left behind.

#### Connections

- (a) Follow along all connections to ventilator
- (b) Check all connections are tight with no leaks
- (c) ETCO<sub>2</sub> sampler is best connected close to ETT to give most accurate results.
- (d) Check HME/bacterial filter is in place. Place immediately between ETT and ETCO<sub>2</sub> sensor to prevent excessive moisture interfering with ETCO<sub>2</sub> readings.

#### Ventilation

- (a) Confirm symmetrical chest expansion, airflow from exhaust valve, movement of pressure gauge and capnograph pattern.
- (b) Tidal volume/minute volume – use Wright's spirometer to determine TV/MV precisely. These may increase by 10-20% with increasing cabin altitude. Overall, the correct tidal volume is one that gives the desired PaO<sub>2</sub> / PaCO<sub>2</sub> / SaO<sub>2</sub> / ETCO<sub>2</sub>. Normal tidal volumes are 7-10 mL/kg.

Paediatric ventilation of infants < 10kgs uses an intentional leak valve placed in circuit. Ventilator settings then become meaningless. (See separate clinical guideline)

- (c) Pressures
- check airways pressures for maximum and minimum pressures.
  - increasing: suggests patient not relaxed, obstruction (blocking/kinking of ETT), pneumothorax
  - falling: suggests leak in circuit, failing O<sub>2</sub> supply or cuff deflated.
- (d) PEEP valve
- read/set settings as along side of valve. Valve is then attached to exhaust gas outlet. Pressures will not register on Oxylog pressure gauge.

### Oxygen Supply

- (a) Select FiO<sub>2</sub> – 100% oxygen (no air-mix, FiO<sub>2</sub> = 1) or 60% oxygen (air-mix, FiO<sub>2</sub> = 0.6).
- (b) Check O<sub>2</sub> supply hose from wall outlet or cylinder to ventilator.
- (c) Check O<sub>2</sub> cylinder contents, estimate rate of consumption and likely need to change cylinders.

### Back up

A means of manual ventilation must be to hand, in case of oxygen failure, ventilator failure or extubation (e.g. Laerdal bag-valve-mask, demand resuscitator). Means of re-intubating the patient must also be carried, i.e. laryngoscope and spare ETT's. These requirements also apply to ambulance transfers.

### IV access

- (a) Two working, well secured lines.
- (b) Spare injection port for administering drugs.

### Drugs

- (a) Sedation – usually Morphine: Midazolam (1mg:1mg:1mL) rate 2-5 mL/hr infusion
- (b) Muscle relaxants:
- Vecuronium infusion rate 5-10 mg/hr or boluses
  - Pancuronium boluses
- (c) Ranitidine – is used routinely by ICU's to provide prophylaxis against stress ulceration and ventilator-acquired pneumonia. The dose is 50mg slowly IV 8-12 hourly.
- (d) Others – inotropes, antibiotics, GTN

### Other considerations

- Fluid balance
  - NGT & IDC placement and contents
  - Confirm placements and drainage
  - Vital signs – check and recheck patient's vital signs frequently
  - Eyes taped closed
  - Cervical spine immobilisation (as required)
  - Pressure area care – especially on long flights.
4. On landing at Jandakot, the medical officer should contact the receiving hospital (usually the duty ED consultant or senior registrar) to give them an update, an ETA and confirm arrangements for the patient's arrival).

## 5. Rapid references for ventilated patients.

- ETT size: adult average male diameter: 8-9mm; length 23 cm at teeth  
average female diameter: 7.5–8.5mm; length 21 cm at teeth  
child ETT diameter:  $\frac{\text{age}}{4} + 4\text{mm}$   
length:  $\frac{\text{age}}{2} + 12$  (oral) cm  
 $\frac{\text{age}}{2} + 15$  (nasal) cm
- Tidal volume: 7 –10 mL/kg
- O<sub>2</sub> cylinder capacity: size C (Oxyviva) 490L (max)  
size D (aircraft, ambulance) 1640L (max)

**Approximate Duration of O<sub>2</sub> cylinder (in minutes)**

Size	Flow Rate (L/Min)					
	4	5	6	7	8	15
C	120	90	80	70	60	30
D	400	320	270	230	200	100

For quick calculations\* with Oxylog, for average adult use:

Approximately 8 L/min in “Airmix” mode

Approximately 15 L/min in “No Airmix” mode

Venturi (Twin-O-Vac) Suction uses 25 L/min O<sub>2</sub>.

For safety, oxygen requirements should be calculated at:

Flow rate X 1½ journey time in minutes.

\* Actual consumption is Minute Volume X FiO<sub>2</sub> plus 1-2 L/min for driving gas.

**References:**

Aitkenhead, A. & Smith, G. (Ed). *Textbook of Anaesthesia* 3<sup>rd</sup> Edition, Churchill Livingstone 1996.

## 14.5 NON-INVASIVE VENTILATION (NIV)

### *Theory*

1. In selected patients, non-invasive ventilatory support may prevent the need for intubation and mechanical ventilation. Complications of failed intubation, ventilator acquired pneumonia, tracheostomy and respiratory muscle wastage are avoided and the patient can continue to communicate. Positive pressure reduces the work of breathing and increases functional residual capacity by recruiting collapsed alveoli. Improvements in lung compliance can also be gained.

Left ventricular function can be improved by reduction in preload and afterload.

2. Two forms of NIV can be delivered with the Oxylog 3000: CPAP (Continuous Positive Airway Pressure) and BIPAP (Biphasic Positive Airway Pressure). CPAP is preferred for the management of acute pulmonary oedema whereas hypoventilatory respiratory failure (eg. from COPD) may benefit from BIPAP or CPAP with pressure support.
3. Traditionally NIV has not been considered in transport medicine due to lack of suitable equipment and the risk of intubation during transport if NIV fails. The Oxylog 3000 in RFDS service, now provides the opportunity to deliver NIV to selected patients.

### *Pre-Flight and In-flight Management*

1. Consider the opportunity for NIV when assessing the flight request. Patients already undergoing NIV should prompt consideration of using this technique for ventilatory support. The technique is likely to be less suitable for longer flight times as risk of failure increases with time.
2. **PREPARE TO GO IN TO THE REFERRING HOSPITAL AND TAKE THE OXYLOG 3000, CPAP MASK (*WITH ATTACHMENT POINTS*) AND A HARNESS.**
3. Time in the hospital is required to establish if treatment will work (at least ½ hour). Does the patient tolerate it, do parameters such as blood gases improve, is patient likely to become fatigued? NIV may not be a good option with restricted pilot hours.
4. Gas consumption during NIV is greater than that for IPPV (eg. up to 30L/min). Have you got enough oxygen?

### **PATIENT SELECTION**

#### CONTRAINDICATIONS

1. Not fully conscious or cooperative.
2. Risk of, or actual, airway obstruction or deterioration in conscious state.
3. Facial abnormalities, trauma, recent surgery or burns.
4. Suffering from excessive secretions, vomiting or bowel obstruction.
5. Having a high oxygen requirement or suffering life threatening hypoxia.
6. Profoundly academic.
7. Haemodynamically unstable, suffering dysrhythmias or other severe co-morbidities.
8. Pneumothoraces (unless ICC in situ).
9. Recent upper GI surgery.

#### INDICATIONS

1. Acute pulmonary oedema.
2. Obstructive sleep apnoea.
3. Acute exacerbation of COPD.
4. Ventilator weaning.
5. Respiratory failure in immunocompromised (eg Neutropaenic) patients at high risk of ventilator acquired pneumonia.
6. Other acute respiratory failure where no contraindications.
7. Chronic respiratory failure e.g. Neuromuscular disease where it is desirable to avoid intubation as weaning would be difficult.

## COMPLICATIONS

1. Mask intolerance (25%)
2. Skin damage.
3. Gastric distension and aspiration. (Routine gastric decompression is not indicated however.)
4. Patient may still become obtunded and lose airway.
5. Sinus pain, nasal congestion.
6. Raised intraocular pressure.
7. Raised intracranial pressure.
8. Hypotension if hypovolaemic.

## **VENTILATOR SET UP**

1. Use face mask and harness and connect to ventilator hose.
2. NIV can be delivered in CPAP and PCV modes on the ventilator. In NIV mode mask leakages will be detected and compensated and included in measured values for Vt and MV.
3. Switch on NIV by pressing Settings key, then scroll to page 2/2. On NIV line, change to ON and confirm.
4. Biphasic Positive Airway Pressure (BIPAP) can be delivered using NIV in the PCV mode. This is like giving CPAP at two alternating pressures.
5. Pressure support (a gas flow triggered by inspiratory effort to a set pressure) can be provided using the ASB (Assisted Spontaneous Breathing) function in either BIPAP or CPAP.

## TIPS TO AID PATIENT COMPLIANCE.

6. If patient able, allow the patient to hold the mask initially until used to it then apply harness.
7. Start with lower pressures and titrate up, the pressure should make the work of breathing easier rather than result in the patient fighting it. Provide an antiemetic.

## **BIPAP**

### **For hypoventilatory respiratory failure (e.g. acute exacerbation COPD)**

- Set PCV
- Turn NIV on
- I:E ratio 1:2
- PEEP = 4cm H<sub>2</sub>O
- P<sub>insp</sub> = 10cm H<sub>2</sub>O
- Titrate FiO<sub>2</sub> to SaO<sub>2</sub> >90%
- Adjust Trigger to maximise synchronisation with the patients breathing.
- Repeat ABG at 30 minutes
  - If PCO<sub>2</sub> decreased by 10-20% then PEEP = 4cm H<sub>2</sub>O, P<sub>insp</sub> = 16 cm H<sub>2</sub>O
  - If PCO<sub>2</sub> decreased by <10% then PEEP = 6cm H<sub>2</sub>O, P<sub>insp</sub> = 20 cm H<sub>2</sub>O
  - If PCO<sub>2</sub> rising or clinically no improvement consider intubation.

**For acute pulmonary oedema**

- Set PCV
- Turn NIV on
- I:E ratio 1:2
- PEEP = 8cm H<sub>2</sub>O
- P<sub>insp</sub> = 10 cm H<sub>2</sub>O
- Commence Fi O<sub>2</sub> 100%
- Adjust Trigger to maximise synchronisation with patients breathing.
- Repeat ABG at 30 minutes
  - If no improvement clinically and with ABG consider intubation.
  - Titrate PEEP to 10cm H<sub>2</sub>O and P<sub>insp</sub> to 15cm H<sub>2</sub>O

**If no improvement after 1 hour consider intubation pre-flight.**

**CPAP****For acute pulmonary oedema**

- Set CPAP
- Turn NIV on
- I:E ratio 1:2
- PEEP = 10 cm H<sub>2</sub>O
- PS = 0
- Commence FiO<sub>2</sub> 100%
- Repeat ABG at 30 min and assess patient clinically.
  - If no improvement consider intubation
  - Titrate PEEP to effect (may need 15-20cm H<sub>2</sub>O)

**For hypoventilatory respiratory failure**

- Set CPAP
- Turn NIV on
- I:E ratio 1:2
- PEEP = 4 cm H<sub>2</sub>O
- PS = 15 cm H<sub>2</sub>O
- Titrate FiO<sub>2</sub> to SaO<sub>2</sub> >90%
- Adjust trigger to maximise synchronisation with patient breathing.
- Repeat ABG at 30 min.
  - If no improvement consider intubation
  - Titrate pressure support (ASB) to effect

**If no improvement after 1 hour consider intubation pre-flight.**

**Reference:**

Bersten; A D and Soni; N Oh's Intensive Care Manual 5<sup>th</sup> Ed.

Drager Medical. Oxylog 3000 Instructions for Use.

Beed, M; Sherman, R et al. Emergencies in Critical Care. Oxford Handbook Series.

Dunn, R et al. The Emergency Medicine Manual 4<sup>th</sup> Ed.

Prepared by Dr Margareta Roeck (2008)

## SECTION FIFTEEN – OCCUPATIONAL & ADMINISTRATIVE

### 15.1 OCCUPATIONAL EXPOSURE TO BLOOD AND BODY FLUIDS

#### *Theory*

1. HIV, Hepatitis B and C may be transmitted by significant exposure to blood or other body fluids.
2. Prevention is the mainstay of protection, so standard infection control practices must be adhered to.
3. Risk of transmission is dependent on the type of injury sustained. A thorough risk assessment of each exposure must be performed by an RFDS medical officer.
4. Those exposed to a source positive for a blood-borne virus must be referred to an infectious diseases expert or clinical immunologist.

#### **RISKS**

1. Risk of Hepatitis B infection carries the highest risk after exposure to a positive source (10-40%). Hepatitis B vaccine is advised for all at risk staff (Nurses, Doctors, Pilots and Engineers); this vaccine has a 90% rate of protection after 3 doses.
2. Risk of Hepatitis C transmission after needle-stick injury from positive source is 1.8%. Transmission from mucous membrane exposure is rare.
3. Risk of HIV transmission after percutaneous exposure from positive source is 0.3% and 0.09% from mucous membrane exposure.
4. High risk injuries are:
  - Deep injury from device visibly contaminated with blood.
  - Injury associated with hollow bore needle.
  - Source patient has late stage HIV or high viral load
  - Source patient with Hep B who is HBeAg +ve, HBV DNA detectable, high viral load.
  - Source patient with Hep C who is HCV RNA PCR detectable

#### **PROCEDURE FOLLOWING INJURY OR EXPOSURE**

1. First aid. If skin is exposed the area should be washed well immediately with soap and water. If water is not available, use 60-90% alcohol hand cleanser (such as located in red intravenous roll in the aircraft.)
2. If the injury is to mucous membranes (eyes, mouth etc.) flush with copious water or normal saline.
3. Report to RFDS doctor immediately. Notify the doctor directly if on the flight, or by satellite telephone or radio, irrespective of your location. RFDS doctor should follow these guidelines:
  - Perform a risk assessment (based on history of incident, knowledge of patient)
  - Arrange baseline blood tests from source and recipient.
  - Counsel recipient (regarding risk, required follow-up, precautions.)
  - Seek advice or arrange referral to infectious diseases or immunology expert (the Immunology registrar at RPH is on call all hours via switch board.)
  - Complete a Clinical Incident Report (Notify Medical Director or Assistant Medical Director immediately).
  - Seek consent of recipient to forward follow-up results to office of Medical Director.
  - Worker's Compensation Report Complete notification for a work-related injury.

**Risk Assessment**

Non parenteral exposure (low risk)	<ul style="list-style-type: none"> <li>Intact skin</li> </ul>
Doubtful exposure (low risk)	<ul style="list-style-type: none"> <li>Superficial (not bleeding) intradermal injury with device thought NOT to be contaminated with bodily fluid.</li> <li>Contamination of prior wound with substance other than blood.</li> <li>Mucous membrane contact with substance other than blood.</li> </ul>
Possible exposure (low to moderate risk)	<ul style="list-style-type: none"> <li>Superficial (not bleeding) intradermal injury from device thought to be contaminated with blood.</li> <li>Prior wound contamination with blood.</li> <li>Mucous membrane contact with blood.</li> </ul>
Definite exposure (moderate risk)	<ul style="list-style-type: none"> <li>Penetrating injury with needle contaminated with blood or bodily fluid.</li> <li>Injection of &lt;1ml of blood or bodily fluid.</li> <li>Laceration caused by visibly contaminated instrument.</li> <li>In lab setting inoculation with HIV, HCV, HBV +ve tissues.</li> </ul>
Massive exposure (high risk)	<ul style="list-style-type: none"> <li>Blood transfusion.</li> <li>Injection of &gt;1ml blood or bodily fluid.</li> <li>Parenteral exposure to lab specimens containing high titre of virus.</li> </ul>

**MEDICAL MANAGEMENT**

Source negative for blood Borne virus	Source status unknown, or high risk, but negative	Source Hep B positive	Source Hep C positive	Source HIV positive
Offer repeat blood at 3 months	<p><b>If high risk injury treat as for positive source.</b></p> <p>Note: It is impossible to test a sharp.</p>	<ul style="list-style-type: none"> <li>If immune. No further action.</li> <li>Non-immune - see post-exposure prophylaxis.</li> <li>Rpt bloods at 3 and 6 months.</li> <li>Provide behavioural counselling.</li> </ul>	<ul style="list-style-type: none"> <li>No treatment is available.</li> <li>Refer to clinical microbiologist or hepatologist with Hep C expertise.</li> <li>Repeat bloods, HCV RNA PCR @ 4, 8, 12 wks.</li> <li>HCV ab @ 3 and 6 months.</li> <li>Arrange counselling / support.</li> <li>Provide behavioural counselling.</li> </ul>	<ul style="list-style-type: none"> <li>Immediate referral to immunologist (24 hr call) for advice on PEP. Truvada ® available from regional and private hospitals.</li> <li>PEP is best started with in 24hrs.</li> <li>Expect immunologist to advise on risk of infection, signs and symptoms, effectiveness of PEP, side effects of PEP, advice on pregnancy, breast feeding and comorbidities.</li> <li>Repeat testing at 6wks, 3 and 6 months.</li> <li>Ensure ongoing counselling.</li> <li>Provide behavioural counselling.</li> </ul>

PEP = Post-exposure prophylaxis

## HEP B PEP (FOR THE NON-IMMUNE)

### UNVACCINATED.

- If source HBsAg +ve, give HBIG and initiate Hep B vaccination within 24 hrs.
- If source is unknown, initiate Hep B vaccination within 24 hrs.
- 

### Previously vaccinated.

- If adequate immunity, no treatment.
- Non-responder (had 3 doses and re-immunised with 3 doses but still no response) should have 2 doses of HBIG (1st within 24 hrs, second in 1 month).
- Response to previous immunisation unknown, test anti Hep B Ab's, if inadequate give 1 dose HBIG and vaccine booster. If adequate no further action.

## RISK COUNSELLING

The nature of the injury and the status of the source must be ascertained in order to give accurate advice. Consider transmissibility information given at start of this guideline.

Non parenteral exposure (low risk)	Intact skin
Doubtful exposure (low risk)	<ul style="list-style-type: none"> <li>• Superficial (not bleeding) intradermal injury with device thought NOT to be contaminated with bodily fluid.</li> <li>• Contamination of prior wound with substance other than blood.</li> <li>• Mucous membrane contact with substance other than blood.</li> </ul>
Possible exposure (low to moderate risk)	<ul style="list-style-type: none"> <li>• Superficial (not bleeding) intradermal injury from device thought to be contaminated with blood.</li> <li>• Prior wound contamination with blood.</li> <li>• Mucous membrane contact with blood.</li> </ul>
Definite exposure (moderate risk)	<ul style="list-style-type: none"> <li>• Penetrating injury with needle contaminated with blood or bodily fluid.</li> <li>• Injection of &lt;1ml of blood or bodily fluid.</li> <li>• Laceration caused by visibly contaminated instrument.</li> <li>• In lab setting inoculation with HIV, HCV, HBV +ve tissues.</li> </ul>
Massive exposure (high risk)	<ul style="list-style-type: none"> <li>• Blood transfusion.</li> <li>• Injection of &gt;1ml blood or bodily fluid.</li> <li>• Parenteral exposure to lab specimens containing high titre of virus.</li> </ul>

## BEHAVIOURAL COUNSELLING

### HEP C EXPOSURE.

- May not donate blood, plasma, tissues or semen. Do not need to modify sexual practices,
- avoid pregnancy or refrain from breast feeding. Continue standard precautions with work practices.

**HEP B EXPOSURE IN NON-IMMUNE.**

- If high risk injury may not donate blood, plasma, tissues or semen. Should avoid pregnancy until outcome known. Continuation of breastfeeding and sexual activity will depend on immune
- status of baby or partner. Work practices may need to be modified according to the nature of the work (see DoH Policy for Health Care Workers with BBV Infections)

**HIV EXPOSURE.**

- For 12 months may not donate tissues, blood, plasma, breast milk or semen.
- Sexual abstinence or protected sex (condoms) for a minimum of 3 months.
- Avoid pregnancy till 6 month surveillance complete.
- Cease breast feeding.
- Do not share needles, razors, toothbrushes.
- Cover open wounds with waterproof dressings.

**REFERENCE:**

DoH Operational Directive Number: OD 0091/07, dated 20 December 2007.

“Management of occupational Exposure to Blood and Body Fluids in the Health Care Setting.”

Australian Immunisation Handbook (2007) 9<sup>th</sup> Ed.

Compiled by Dr Angela O'Connell 2008

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