EMERGENCY DRUG GUIDELINES

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National Drug & Therapeutics Committee Initiative

Evidence Based Drug Therapy

MINISTRY OF Health

Shaping Fiji's Health

Emergency Drug Guidelines

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Disclaimer

The authors do not warrant the accuracy of the information contained in this 2nd Edition of the *Emergency Drug Guidelines* and do no take responsibility for any death, loss, damage or injury caused by using the information in these guidelines.

While every effort has been made to ensure that these guidelines are correct and in accordance with current evidence-based and clinical practices, the dynamic nature of medicine information requires that users exercise in all cases independent professional judgment and understand the individual clinical scenario when referring, prescribing or providing information from the *Emergency Drug Guidelines, 2nd Edition*.

Preface

The publication of the Second Edition of the *Emergency Drug Guidelines* represents the culmination of the efforts of the National Drugs and Therapeutics Committee (NDTC) to publish clinical drug guidelines for common diseases seen in Fiji. These guidelines are targeted for health care professionals working at hospitals and at the primary health care settings. It sets the gold standard for the use of drugs in the treatment of emergency medical conditions in Fiji.

The guidelines have taken into account the drugs available in the Fiji Essential Medicines Formulary (EMF), 2006 Edition, in recommending treatment approaches. All recommended therapies are either evidence-based or universally accepted standards.

It is hoped that these guidelines will be used by all health care workers in their daily care of patients suffering from emergency medical conditions.

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The First Edition of these guidelines was drafted on behalf of the Ministry of Health (MOH) by Nick Adams, MBBS (Melb), FACEM, Principal Medical Officer, Accidents and Emergency Department, Colonial War Memorial Hospital in 1999.

The Ministry of Health initially approached Dr Adams to prepare these guidelines as part of an overall effort to develop treatment guidelines in critical areas. Dr Adams prepared these guidelines during his employment as a specialist emergency physician at CWM Hospital. The Ministry of Health gratefully acknowledges the personal enthusiasm and initiative of Dr Adams in producing these guidelines.

Dr Adams was assisted by Elizabeth Pemberton, MBBS, FANZCA, Long-Term Advisor in Anaesthesia, Pacific Postgraduate Medical Centre, Fiji School of Medicine, in the preparation of the draft guidelines.

The guidelines have been reviewed by a subcommittee of the National Drugs and Therapeutics Committee.

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1 Emergency Drugs

This section is intended as a brief guide to some of the drugs mentioned in this book. It is by no means exhaustive and does not cover all contraindications or dosage alterations in special situations. Information about these areas should be obtained elsewhere. The dosages below are guides only. Drug therapy should always be adjusted to the individual patient situation.

1.1 Local Anaesthetics

Local anaesthetic agents are used to provide anaesthesia through local wound infiltration, nerve blocks or regional techniques. Side effects from systemic absorption include seizures and cardiac arrhythmias. Avoid accidental intravenous administration by aspirating for blood prior to injection.

Lignocaine is the agent of choice for local wound infiltration. The 1% solution is suitable for local infiltration of most wounds. A concentration of 2% should be used for digital nerve blocks and any other area where a smaller volume of anaesthetic is desirable.

Lignocaine with adrenaline should not be used on the extremities, i.e. nose, fingers, toes, ears or penis. The addition of adrenaline helps control bleeding and also extends the duration of anaesthesia.

1.2 Sedatives and Induction Agents

These drugs are used to depress the conscious state either for sedation or general anaesthesia. They should be used with great care as unconscious patients are unable to protect their airway and because of the risk of causing hypoventilation and hypotension.

Ketamine has anaesthetic and analgesic properties and is less likely to produce hypotension than other sedative agents. It also has a mild bronchodilator action which makes it useful when anaesthetising patients with asthma. Adverse effects include increased salivation, laryngospasm, raised intracranial pressure and unpleasant hallucinations after recovery of consciousness. Ketamine should not be used in patients at risk of raised intracranial pressure (e.g. head injuries, meningitis) or in patients with ischaemic heart disease. It should not be given unless personnel and facilities are available to protect the patient's airway.

Ketamine should be given as an intravenous bolus. The usual dose is 2 mg per kg although some patients may require larger amounts. The onset of action is within 60 seconds and the duration is about 20 minutes.

Thiopentone is a barbiturate with a short action because of rapid distribution. Its main adverse effects relate to cardiorespiratory depression. It should be used with great care in patients who are hypotensive and should not be given unless personnel and facilities are available to protect the patient's

airway. It is a potent anticonvulsant and is the drug of choice for anaesthetising patients with status epilepticus.

Thiopentone should be given as an intravenous bolus. The usual dose is 3 to 5 mg per kg. The lower dose should be used in the elderly. The onset of action is about 30 seconds and its effects last for 5 to 10 minutes.

Midazolam is a short-acting benzodiazepine. It has powerful amnestic properties and produces less cardiorespiratory depression than thiopentone. It is a fairly safe and useful anaesthetic induction agent in the critically ill and is also used to sedate children and agitated patients.

Midazolam can be given intramuscularly or as an intravenous bolus. In children, intranasal midazolam is a useful premedication prior to suturing. The onset of action of intravenous midazolam is 1 to 2 minutes and the effects of a single dose last from 60 to 90 minutes. Intranasal midazolam has its maximal effect within 10 minutes and lasts up to 2 hours.

In ADULTS: The intravenous dose is 2.5 to 15 mg. The dose should be titrated to its effect. Smaller doses are usually required for the elderly, whereas alcoholics may require higher doses. The intramuscular dose is 5 to 10 mg.

In CHILDREN: The intravenous dose is 0.15 to 0.3 mg per kg up to 0.5 mg per kg. The intranasal dose is 0.2 to 0.4 mg per kg (to a maximum of 5 mg), slowly dropped into alternate nostrils

over 15 seconds.

1.3 Anticholinergics

Anticholinergic drugs block the effects of acetylcholine at muscarinic receptors. The most commonly used anticholinergic agent is atropine. This drug is used for the treatment of bradycardia due to increased vagal tone, to block the cholinergic effects of drugs such as suxamethonium in children, and to reverse some of the adverse effects of anticholinesterase (organophosphate) poisoning. Ipratropium is used in the treatment of asthma and benztropine is used in the treatment of oculogyric crisis.

Atropine should be used with care in patients with ischaemic heart disease as it may cause a marked sinus tachycardia. The usual adult dose is 0.6 mg intravenously as a bolus, repeated in 5 minutes if necessary. A dose of 3 mg will produce complete blockade of muscarinic cholinergic receptors in an adult.

Much larger doses are used in anticholinesterase poisoning. Atropine may be given via the endotracheal tube in an emergency; use twice the normal intravenous dose and dilute in 10 ml of 0.9% saline. The paediatric dose is 20 micrograms per kg (to a maximum of 0.5 mg). The onset of action is within 5 minutes and the duration of action is 2 to 4 hours.

Benztropine is used in the treatment of oculogyric crisis precipitated by prochlorperazine or similar drugs. Overdose of

benztropine can cause central anticholinergic syndrome (confusion, hallucinations). The usual dose in adults is 1 to 2 mg orally or intramuscularly. Children should be given 20 micrograms per kg. Its duration of action is shorter than most of the drugs that cause oculogyric crisis so a repeat oral dose should be given 4 hours after the initial dose.

1.4 Opioid Analgesics

Opioid agents are mainly used for their analgesic and sedative actions. The main side effects of these drugs are respiratory depression, hypotension, nausea, vomiting, and constipation.

NOTE: The use of parenteral opioid drugs is not recommended in patients with chronic or recurrent painful conditions such as migraine or back pain due to the risk of addiction.

Morphine is usually used in the treatment of acute myocardial infarction and pulmonary oedema. As an analgesic, it may produce less dysphoria than pethidine. The usual dose in adults is 2.5 mg intravenous bolus repeated every few minutes as required to a maximum of 15 mg. The usual dose in children is 0.05 mg per kg given intravenously every 5 minutes to a maximum of 0.2 mg per kg. The duration of action is about 3 hours.

Pethidine is mainly used as an analgesic. This is a highly addictive drug even after a few doses. The best method of administration is a dose of 25 to 50 mg intravenously every 3 to 4 hours. Alternatively, a dose of 25 to 100 mg (maximum 150

mg) may be given intramuscularly. The duration of action is 2 to 3 hours with intramuscular dose and shorter with intravenous administration.

Fentanyl is a short acting narcotic used to sedate patients prior to painful procedures or intubation (often in combination with midazolam). The usual dose of fentanyl is 1 microgram per kg. The duration of action is 30 to 40 minutes.

1.5 Antiemetics

Anti-emetic drugs are used for the temporary relief of nausea and vomiting.

Metoclopramide (brand name: Maxolon) should not be given to children less than 16 years of age due to the high incidence of acute dystonic reactions. It should also not be given to patients with bowel obstruction. Metoclopramide is useful in the treatment of migraine and may also help the passage of calculi in renal colic. The usual dose is 10 mg by intravenous bolus or intramuscular injection or orally. Males weighing more than 70 kg may require 15 or 20 mg. Females with low body weight or the elderly should be given 5 mg initially.

Prochlorperazine (brand name: Stemetil) is also useful for the treatment of vertigo as well as nausea and vomiting. It should not be given to children less than 16 years of age. The oral dose is 5 to 10 mg 8-hourly. The intramuscular or intravenous dose is 12.5 mg every 8 hours.

Promethazine (brand name: Phenergan) is a weaker antiemetic than prochlorperazine and is more sedating. It can be given intravenously, intramuscularly or orally. The usual dose is 0.5 mg per kg.

1.6 Corticosteroids

Although very useful in the treatment of asthma, anaphylaxis and many other conditions, the beneficial effects of these drugs are delayed for several hours at least. They should be used with care in patients with diabetes or peptic ulcer disease. All agents have similar anti-inflammatory effects but differ in their mineralocorticoid potency. Their mineralocorticoid (or aldosterone-like) effects may be undesirable and include sodium retention, oedema, and hypokalaemia.

Equivalent anti-inflammatory doses are:

100 mg hydrocortisone = 25 mg prednisolone = 4 mg dexamethasone

Hydrocortisone has marked mineralocorticoid effects. It should be given intravenously over 5 minutes. The usual dose is 50 to 100 mg intravenously 6-hourly.

Dexamethasone has virtually no mineralocorticoid effects. It can be given intramuscularly or intravenously as well as orally. The usual dose is 0.1 mg per kg every 8 hours.

Prednisolone has moderate mineralocorticoid effects. It is

given orally. The usual dose is 1 mg per kg daily to a maximum of 80 mg.

1.7 Antiepileptics

The first line drug in the treatment of epilepsy is diazepam. Phenytoin is useful for the treatment of idiopathic epilepsy but is less effective for seizures due to other causes. Barbiturates such as phenobarbitone are powerful anti-epileptics but also cause cardiorespiratory depression and marked depression of conscious state often necessitating intubation and ventilation.

Diazepam is a safe and effective agent for the termination of seizures. It may be given intravenously or rectally. The oral route is too slow in an emergency, whereas the intramuscular route is painful and unpredictable. The onset of action when given intravenously is 1 to 2 minutes, whereas the rectal route may take 5 to 10 minutes to have its full effect. The usual intravenous dose is 0.1 mg per kg repeated every 5 minutes if required. The usual rectal dose is 0.5 mg per kg.

Phenytoin must be given by slow intravenous injection. The infusion rate should not exceed 50 mg per minute in adults or 1 mg per kg per minute in children. The drug should be diluted in 0.9% saline only (not 5% dextrose) so that the concentration is no greater than 5 mg per ml. Rapid infusion of concentrated solutions may cause hypotension. The usual loading dose is 15 mg per kg intravenously.

1.8 Antiarrhythmics

1.8.1 Lignocaine

Lignocaine shortens the action potential duration. It is the drug of first choice in the treatment of ventricular tachycardia although phenytoin is used in the treatment of ventricular tachycardia due to digoxin toxicity.

Lignocaine 2% should be given intravenously over one minute in a dose of 1 mg per kg. A further 0.5 mg per kg may be given after 5 minutes if necessary. Lignocaine has a very short half-life so the intravenous bolus should be followed by an infusion at a rate of 40 micrograms per kg per minute. Adverse effects include confusion, coma, seizures and heart block but are not often encountered. Elderly patients may require lower infusion rates.

1.8.2 Propranolol

Propranolol is occasionally used to delay conduction through the atrioventricular (AV) node in the treatment of supraventricular tachycardia or atrial fibrillation. It also may be of benefit in the treatment of ventricular tachycardia due to theophylline overdose. Propranolol should not be used in patients with decompensated left ventricular failure, asthma, or bradyarrhythmias. The dose should be titrated according to effect. Give 10 micrograms per kg intravenously every 2 minutes to a maximum of 100 micrograms per kg.

1.8.3 Amiodarone

Amiodarone prolongs the action potential duration. It is used in the treatment of both ventricular and atrial arrhythmias. At least some of its therapeutic effects are often delayed for up to 24 hours. Amiodarone is not a negative inotrope and is well tolerated by patients with cardiac failure. Intravenous administration is occasionally associated with hypotension due to vasodilation. The usual loading dose of amiodarone is 5 mg per kg given intravenously over 30 minutes.

1.8.4 Verapamil

Verapamil is a calcium channel antagonist and depresses sinus node automaticity and AV node conduction. It is therefore used to treat supraventricular tachyarrhythmia. It is a powerful negative inotrope and should be used with great care in patients with impaired left ventricular function.

Verapamil should not be given to children less than 2 years of age. It should not be given to patients with left ventricular failure, bradycardia, or hypotension. The effectiveness of vagal manoeuvres is increased following the administration of verapamil. The usual dose in adults is 1 mg intravenous boluses every minute to a maximum of 10 mg.

1.8.5 Digoxin

Digoxin is used to control the ventricular rate in atrial fibrillation. It is contraindicated in atrial fibrillation associated

with Wolff-Parkinson-White syndrome. The main advantage digoxin has over other drugs available to control conduction through the AV node, is the fact that it is not a negative inotrope. Most patients with atrial fibrillation have significant underlying cardiac disease and often tolerate poorly the myocardial depressant effects of verapamil and propranolol, making digoxin the safest choice. The effects of digoxin are increased in the presence of hypokalaemia, hypothyroidism, hypomagnesaemia, and hypercalcaemia. Digoxin should not be given to patients with bradycardia. The maximum therapeutic effects of digoxin are delayed by 6 to 24 hours after administration. The usual initial dose is 10 micrograms per kg given intravenously over 20 to 30 minutes and the total digitalizing dose should be given within 24 hours.

1.8.6 Adenosine

Adenosine is a very short acting agent used in the treatment of supraventricular tachycardia. It is best given in incremental doses according to response (usually 6 mg initially and if no response, give 12 mg and if necessary followed by 18 mg). Adenosine should be given as a rapid intravenous bolus followed by a 20 ml 0.9% saline flush. It should be given with great care to asthmatics as it may occasionally induce severe bronchospasm in these patients. Adenosine is antagonised by theophylline and is unlikely to be effective in patients who are taking this drug.

1.9 Antihypertensives

Several different drugs are available for the management of hypertensive emergencies.

Hydrallazine is a direct acting arteriodilator. It should not be used in patients with ischaemic heart disease who are not being treated with a beta-blocker. Side effects include nausea, tachycardia, and headache. Peak effects are not seen for 10 to 20 minutes after intravenous injection and it has a duration of action of 4 to 8 hours. The usual dose in adults is 10 mg intravenously every 20 minutes to a maximum of 50 mg.

Nifedipine is a direct-acting arterial vasodilator. When given by sublingual route, it has unpredictable effects and can precipitate myocardial infarction or stroke by excessive lowering of blood pressure. Hence, it should not given by this route.

1.10 Inotropic Agents

Inotropic agents are used in the treatment of cardiogenic and distributive shock. All should be infused via a large vein.

Adrenaline is an alpha- and beta-adrenergic agonist. It causes an increase in cardiac output and heart rate plus vasoconstriction. It is given by infusion into a large vein at a rate of 1 to 70 micrograms per minute titrated to effect.

Dopamine has similar effects to adrenaline but produces more tachycardia at higher doses. It may preferentially enhance renal blood flow at rates less than 5 micrograms per kg per minute.

Dobutamine has positive chronotropic and inotropic effects which are balanced by a mild degree of vasodilation so that myocardial oxygen demand is generally not increased. Dobutamine is generally considered the inotrope of choice in patients with myocardial ischaemia. The usual dose range is 2 to 20 micrograms per kg per minute titrated to effect.

1.11 Diuretics

Frusemide is a potent loop diuretic used in the treatment of fluid overload. Its main side effects are hypokalaemia and fluid depletion. Damage to the inner ear may occur with too rapid intravenous injection. Frusemide is ineffective in the acute treatment of hypertension and should not be used except as an adjunct to other more powerful drugs.

Intravenous frusemide has an onset of action within 5 minutes, a peak effect at about 30 minutes, and a duration of action of 2 hours. Dosage varies according to renal function; most patients without renal impairment will have a significant diuresis after 40 mg given intravenously. Doses in excess of 250 mg may be required to diurese patients with severe renal failure.

Frusemide should not be given intravenously at a rate faster than 40 mg per minute. The absorption of intramuscular frusemide is unpredictable and this route of administration

should not be used.

1.12 Muscle Relaxants

Suxamethonium is a depolarising muscle relaxant. It is given as an intravenous bolus and has its maximal effect within 60 seconds. The duration of paralysis is usually about 5 minutes. Very rarely, some patients with an atypical plasma cholinesterase enzyme will be paralysed for much longer. The usual dose is 1 to 1.5 mg per kg in adults and 2 mg per kg in children. Suxamethonium is contraindicated in the presence of hyperkalaemia, lower motor neurone diseases, and between 3 days and 2 years after major burns. In the absence of these contraindications, suxamethonium is the drug of first choice for muscle relaxation in rapid sequence intubation.

Vecuronium is a non-depolarising muscle relaxant. Given as an intravenous bolus it has its onset in about 3 minutes and lasts 20 to 30 minutes. The usual dose is 0.1 mg per kg.

1.13 Neuroleptics

Haloperidol is the safest neuroleptic to use for sedation. It may be given intramuscularly or intravenously. The usual intravenous dose in adults is 2.5 mg repeated every 5 minutes to a maximum of to 10 mg.

Chlorpromazine is more likely to cause hypotension than haloperidol.

Diazepam can be used as a sedative for short defined periods of treatment to avoid addiction.

1.14 Anti-asthma Drugs

Salbutamol is a beta-2 adrenergic agonist. It is best given in the inhaled form (either via an inhaler or a nebulizer). Intravenous salbutamol may occasionally be required for very severe asthma where marked airway obstruction may prevent the inhaled form of the drug from reaching the distal airways. The main side effects of salbutamol are sinus tachycardia, tremor, and anxiety. It can also cause hypokalaemia.

Nebulized salbutamol may be given as often as necessary, even continuously. The upper dose limit is defined in each patient by the adverse effects of tachyardia and tremor. The usual dose is 5 mg in adults and older children, and 2.5 mg in children less than 5 years old. The dose should be diluted up to 2 ml using 0.9% saline but may be given without dilution.

Intravenous salbutamol is given in a dose of 5 micrograms per kg (up to a maximum of 250 micrograms) over 1 to 2 minutes and repeated once 15 minutes later if necessary.

Ipratropium is used in the treatment of asthma and chronic obstructive pulmonary disease (COPD). It has a synergistic effect with salbutamol. Adverse systemic effects are very rare but nebulized ipratropium can inadvertently enters the eye and causes a fixed, dilated pupil. The usual dose in adults is 0.5 mg

via a nebulizer every 4 to 6 hours. Children 5 years of age or under should be given 0.25 mg per dose.

Corticosteroids are discussed in *Section 1.6*.

Aminophylline is a xanthine derivative that has been used for many years in the treatment of asthma. However, it is a weak bronchodilator and has no additional benefit over optimal doses of salbutamol. It also has a very narrow therapeutic margin and therefore has little place in the management of acute asthma. Adverse effects include ventricular tachycardia, seizures, and hypokalaemia. Its use should be restricted to severe asthma.

1.15 Intravenous Fluids

Normal (0.9%) saline contains 154 mmol per liter of sodium chloride. It is essentially isotonic and iso-osmolar, and is distributed to the extracellular fluid space. It is the fluid of first choice in the treatment of hypovolaemia. Normal saline contains too much saline to be used as the sole maintenance fluid, although it may be alternated with 5% dextrose.

Dextrose 5% contains 50 g per liter of dextrose. It is distributed to the total body water space and is thus not suitable for emergency rehydration. Although it can be used as the sole maintenance fluid in the short term, prolonged administration of 5% dextrose alone may cause hyponatraemia, especially in children.

Dextrose 3% with 0.3 saline contains 51 mmol per liter of sodium chloride and 30 g per liter of dextrose. Its primary use is as a maintenance fluid (with potassium) in children. It may be suitable for rehydration of patients with mild or moderate dehydration.

Hartmann's solution contains a mixture of ions similar to that of the extracellular fluid. It may be substituted for 0.9% saline except in the presence of hyperkalaemia or alkalosis. It contains 140 mmol per liter of sodium, 109 mmol per liter of chloride, 29 mmol per liter of bicarbonate, 5 mmol per liter of potassium, and 2 mmol per liter of calcium.

Plasma volume expanding solution (e.g. Haemaccel, Gelofusin): Colloids can be used for patients with hypovolaemic shock in association with crystalloid solutions.

1.16 Tetanus Prophylaxis

Regular immunization with tetanus toxoid is the best way to prevent death due to tetanus. Children should receive doses of tetanus toxoid at 6, 10 and 14 weeks of age then booster doses at 6 years. Thereafter, booster doses of tetanus toxoid should be given every 10 years.

Patients presenting with a skin wound should be treated as described below. A non-immune patient is one who has never received a full course of tetanus toxoid injections. Tetanus

prone wounds include puncture wounds, contaminated or infected wounds and crush wounds.

1.16.1 Non-immune patient with tetanus prone wound

- *Give tetanus toxoid 0.5 ml intramuscularly and complete course (with repeat tetanus toxoid injections at 6 weeks and 6 months),*

PLUS

- *Give tetanus immune globulin 250 units intramuscularly at a different site than that of the tetanus toxoid injection.*

1.16.2 Non-immune patient with clean wound

- *Give tetanus toxoid 0.5 ml intramuscularly and complete course (with repeat tetanus toxoid injections at 6 weeks and 6 months).*

1.16.3 Immune patient with tetanus prone wound

If more than 5 years since last tetanus toxoid booster THEN

- *Give tetanus toxoid 0.5 ml intramuscularly.*

1.16.4 Immune patient with clean wound

If more than 10 years since last tetanus toxoid booster THEN

❖ *Give tetanus toxoid 0.5 ml intramuscularly.*

1.17 Drugs Used in Cardiac Arrest

Adrenaline is a powerful endogenous catecholamine. The pharmacologic doses used in cardiac arrests far exceed the amounts usually produced by the adrenal glands. Adrenaline has both alpha- and beta-adrenergic agonist effects. It stimulates myocardial contraction, increases the heart rate, and raises the blood pressure. Its most dangerous adverse effect is induction of ventricular arrhythmias, an effect which is far more likely when the myocardium is sensitized to catecholamines. This occurs with myocardial ischaemia (which adrenaline can also induce by increasing myocardial work), and with overdoses of drugs such as amphetamines and cocaine. In the setting of a cardiac arrest, the induction of ventricular arrhythmias is obviously not a problem and a large intravenous bolus doses should be given. However, in situations other than cardiac arrest, such as anaphylaxis or asthma, adrenaline should be used with great care to avoid worsening the patient's condition. In these circumstances, adrenaline is best given intravenously in small carefully titrated doses. *Also see Section 1.10.*

The absorption of adrenaline given by the subcutaneous or intramuscular routes is unpredictable especially in shock states but administration by these routes can be life-saving in patients in shock states due to anaphylaxis. In ventricular fibrillation or asystole, adrenaline should be given in doses of 1 mg by

intravenous bolus. Administration should be by a central line if already present or by a large peripheral vein and followed by a 20 ml 0.9% saline flush to ensure it rapidly reaches the central circulation. If there is no intravenous access then adrenaline can be given via the endotracheal tube. When given by this route it should be diluted in 10 ml of 0.9% saline and the dose should be 5 times the intravenous dose. There is no role for intracardiac injection of adrenaline (or any other drug).

Lignocaine is recommended for the treatment of ventricular fibrillation and ventricular tachycardia. Its effectiveness has not been proven but it is unlikely to be harmful. The usual dose is 1 mg per kg intravenously given over 1 minute. Lignocaine has a short therapeutic half-life so a successful bolus dose should be followed by a lignocaine infusion. Lignocaine may be given via the endotracheal tube if intravenous access is unavailable. Twice the intravenous dose is used and it should be diluted in 10 ml of 0.9% saline. *Also see Section 1.8.1.*

Atropine is used in the treatment of asystole and severe bradycardia. It acts to block the effects of the vagus nerve on the heart. A dose of 3 mg in an adult produces complete atropinization, blocking all the cholinergic receptors. The main adverse effect of atropine is to produce a sinus tachycardia which may be harmful in the presence of ischaemic heart disease. The usual total dose of atropine used in cardiac arrest is 40 micrograms per kg which may be given as a single bolus or in several divided doses a few minutes apart. *Also see Section 1.3.*

Sodium bicarbonate is used to treat the metabolic acidosis associated with cardiac arrest. Its effectiveness has not been proven and it has many potential adverse effects. Most authorities recommend that it be given in prolonged cardiac arrests (i.e. those greater than 10 minutes in duration). It should be given earlier in the presence of acute renal failure, hyperkalaemia, or tricyclic antidepressant overdose. The usual dose is 1 mmol per kg intravenously over 1 to 2 minutes.

2 Cardiovascular Emergencies

2.1 Cardiac Arrest

2.1.1 Basic cardiac life support (BCLS)

Prompt and effective cardiopulmonary resuscitation (CPR) has been shown to increase survival after cardiac arrest. It should begin as early as possible after the onset of cardiac arrest and continued with as little interruption as possible until the patient either recovers spontaneous circulation or a decision is made to cease the resuscitation efforts.

a. Call for help

Proper CPR requires at least two people. At least one other person is required to obtain the drugs and equipment needed for advanced cardiac life support.

b. Check for response

Assess the patient's conscious state quickly by shaking the patient and yelling his or her name. Loss of consciousness always accompanies cardiac arrest. Unconscious patients are unable to protect their own airway.

c. Airway

Look in the mouth for a foreign body or vomitus. Listen for breath sounds. Noisy breath sounds are a sign of a partly obstructed airway. The absence of breath sounds may indicate complete airway obstruction.

Act to protect and maintain the airway. Perform appropriate procedures including suctioning, head tilt, chin lift, jaw thrust, and insertion of an oral airway. The correct size oral airway can be estimated by holding it against the side of the patient's face – it should reach from the corner of the mouth to the ear lobe.

d. Breathing

Look for movement of the chest wall and listen to the lungs for breath sounds on both sides of the chest. Asymmetry of breath sounds may be a sign of a pneumothorax.

Act by ventilating the patient with a bag and mask. Be sure to use an appropriate size face mask that fits the patient's face. Mouth to mouth ventilation should be performed if a bag and mask are unavailable.

e. Circulation

Feel for the carotid or femoral pulse and listen for heart sounds. (The brachial pulse is often the easier to feel in neonates, rather than the carotid or femoral). If there is no palpable pulse, act

by starting external cardiac massage. Cardiac massage should be performed on the lower 1/2 of the sternum, depressing it about 5 cm in adults and older children. In young children and babies, it should be depressed about 1/4 of the distance between the front and the back of the chest. The rate should be 80 per minute in adults and 100 per minute in children and babies. The ratio of ventilations to compressions depends on the number of persons doing CPR and is as follows:

- If one person, 2:30 in children and ??? in adults
- If two persons, 2:15 in children and ??? in adults

Start advanced cardiac life support as soon as possible.

2.1.2 Advanced cardiac life support (ACLS)

Cardiac arrest most commonly occurs due to life-threatening arrhythmias. The first step in ACLS is to determine what the cardiac rhythm is by attaching a cardiac monitor. Cardiac arrest rhythms can be divided into three basic types:

- "Shockable" rhythm
    - Pulseless ventricular tachycardia (VT)
    - Ventricular fibrillation (VF)
- "Non-shockable" rhythm
    - Asystole or severe bradycardia
    - Pulseless ventricular activity.

a. Pulseless ventricular tachycardia or ventricular fibrillation (VF)

Ventricular tachycardia without an adequate cardiac output should be treated as for ventricular fibrillation. The most important feature of the treatment of these arrhythmias is prompt **defibrillation**. Defibrillation is the only treatment that has been definitely shown to increase survival after cardiac arrest – it should be performed as early as possible.

The primary drug in the treatment of VF is adrenaline – all other drugs are of secondary importance.

- Provide basic cardiac life support as described above.
- Defibrillate with 360 joules **(first shock)** once only.
- Immediately continue CPR for 2 minutes continuously.
- During CPR, establish intravenous access (if not yet available) and secure airway and ventilate with 100% oxygen.
- Check heart rhythm after 2 minutes of CPR.

If no response:

- Defibrillate again **(second shock)** with 360 joules and resume CPR immediately and continue for 2 minutes.
- Check heart rhythm.

If still no response:

- *Give adrenaline 1 mg bolus intravenously (1 ml of 1:1,000 or 10 ml of 1:10,000)* and defibrillate **(third shock)** with 360 joules, followed by CPR for 2 minutes.
- Check heart rhythm.

NOTE: Adrenaline dose should be followed by a 20 ml normal saline flush. Adrenaline may also be given down the endotracheal tube – the dose is 5 times the intravenous dose and it should be diluted in 10 ml of normal saline.

If still no response:

- *Give amiodarone 300 mg slow bolus intravenously (if available),*

  OR

  Lignocaine 2%, 100 mg bolus intravenously, and defibrillate **(fourth shock)** with 360 joules, followed by CPR for 2 minutes.

- Check heart rhythm.

If still no response:

- *Give adrenaline 1 mg bolus intravenously (1 ml of 1:1,000 or 10 ml of 1:10,000)* and defibrillate **(fifth shock)** with 360 joules, followed by CPR for 2 minutes.

- Continue defibrillation and CPR for 2 minutes, giving adrenaline every alternate cycle.

Sodium bicarbonate is generally not indicated unless cause of arrest is secondary to hyperkalaemia or tricyclic overdose.

NOTES:

- If there is no spontaneous circulation 20 minutes after cardiac arrest then the chance of recovery is essentially zero and resuscitation should usually be ceased.

- If sinus rhythm is restored, check for pulse and blood pressure. The patient may require an adrenaline infusion to maintain blood pressure. Lignocaine or amiodarone infusion should be continued (refer to Annex).

In children:

- ❖ Defibrillate at 2 joules per kg then 4 joules per kg.
- ❖ Give *adrenaline 10 micrograms per kg (0.1 ml per kg of 1: 10, 000 up to 1 ml).*

Ventricular tachyarrhythmias in special circumstances

Other drugs may be indicated in some special circumstances:

Digoxin Toxicity (see *Section 5.2.14*) – Ventricular

tachycardia in the presence of digoxin toxicity may respond to phenytoin and magnesium sulphate. If defibrillation is necessary then 25 joules may be all that is required. Higher defibrillation energies may induce ventricular fibrillation.

Theophylline Toxicity (see *Section 5.2.16*) – Administration of intravenous propranolol may be helpful for ventricular tachyarrhythmias.

b. Asystole or severe bradycardia

Asystole has a very poor survival rate compared to VF. It is wise to make sure that the rhythm is indeed asystole by inspecting more than one lead on the ECG monitor. Very occasionally, VF may look like asystole in one of the ECG leads.

- Provide basic cardiac life support as described above.
- Obtain intravenous access.
- Secure airway and continue to ventilate with maximum oxygen available.
- Give *adrenaline 1 mg intravenous bolus (1ml of 1:1, 000 or 10 ml of 1:10 ,000).*
- Continue external cardiac massage.

If no response:

- Give *atropine 3 mg intravenous bolus.*
- Continue external cardiac massage.

If no response:

- Give *adrenaline 5 mg intravenous bolus.*
- Continue external cardiac massage.
- Further doses of *adrenaline 1 mg intravenously* may be given at 3- to 5-minute intervals until return of spontaneous circulation or cessation of resuscitation efforts.

NOTES:

In children

❖ Give *adrenaline 10 micrograms per kg (0.1 ml per kg of 1: 10,000 up to 1 ml) and repeat as necessary every 5 minutes.*

❖ Give *atropine 50 micrograms per kg.*

If there is no spontaneous circulation 20 minutes after cardiac arrest then the chance of recovery is essentially zero and resuscitation should usually be ceased.

c. Pulseless ventricular activity (formerly called electromechanical dissociation (EMD)

This term refers to patients who have a cardiac rhythm other than VF, VT, or asystole but without a detectable cardiac output. Most cases are due to severe and irreversible cardiac muscle dysfunction but occasionally pulseless ventricular activity may be due to a treatable cause.

Treatment is as for ventricular asystole with the addition of the need to exclude potentially reversible causes ("4Hs and 4Ts") such as:

- hypoxia
- hypovolemia, severe
- hypothermia or hyperthermia
- hypokalemia or hyperkalemia and metabolic acidosis
- cardiac tamponade
- tension pneumothorax
- toxins, poisons, drugs
- thrombosis – pulmonary or coronary.

Tension pneumothorax

Insert a wide-bore intravenous cannula in the second intercostal space in the midclavicular line on the side of the pneumothorax.

Hypovolaemia

❖ Administer *Haemaccel 10 m per kg intravenous bolus stat.*

Severe hyperkalaemia or acidosis

❖ Give *0.1 ml per kg of 10% calcium chloride (to a maximum dose of 10 ml) intravenous bolus and repeat in 5 minute, if necessary,*

PLUS

❖ Give *8.4% sodium bicarbonate 1 mmol per kg intravenous bolus.*

Calcium channel blocker overdose or hypocalcaemia

❖ Give *0.1 ml per kg of 10% calcium chloride (to a maximum of 10 ml) intravenous bolus and repeat in 5 minutes, if necessary.*

Beta-adrenergic antagonist overdose *(see Section 5.2.7)*

❖ Give *glucagon 5 mg intravenous bolus.*

NOTE: This is not available in the EDL (Essential Drug List).

- Obtain intravenous access.
- Secure airway and continue to ventilate with maximum oxygen available.
- Give *adrenaline 1 mg intravenous bolus.*
- Continue external cardiac massage.
- Give *adrenaline 5 mg intravenous bolus.*
- Continue external cardiac massage.

2.1.3 Intubation

Endotracheal intubation should be attempted as soon as possible during cardiopulmonary resuscitation to ensure adequate ventilation.

2.2 Cardiogenic Shock

Cardiogenic shock is defined as a state where the cardiac output is inadequate to maintain tissue perfusion. It is usually characterised by hypotension, compensatory peripheral vasoconstriction, and signs of congestive cardiac failure. It is very important to distinguish cardiogenic shock from hypovolaemic shock and distributive shock (due to anaphylaxis or sepsis).

Cardiogenic shock has many different causes, the usual being acute myocardial infarction. Treatment of the underlying cause, whenever possible, is essential. Administration of inotropic agents should be viewed only as a temporary measure while the underlying cause is reversed. Close monitoring in an intensive care unit is highly desirable. The prognosis of cardiogenic shock is dismal and most patients will not recover despite the following therapy.

2.2.1 Maintain airway and breathing

The usual maneuvers to maintain an adequate airway and adequate ventilation, up to and including endotracheal

intubation should be used. All patients should at least receive high flow oxygen via face mask.

- Give *oxygen to maintain arterial oxygen saturation greater than 95%.*

2.2.2 Optimise intravascular volume

Insertion of a central venous line allows accurate measurement of central venous pressures (CVP) and also makes administration of inotropic agents safer. If CVP line is not available, examination of neck veins must be used. Correct anaemia with administration of blood or otherwise use boluses of normal saline to achieve an optimal CVP (5 to 10 cm water). Note that patients with right ventricular infarction usually require a much higher central venous filling pressure (e.g. 20 cm water) than other patients.

- Give *0.9% saline boluses of 100 ml intravenously to obtain an optimal central venous filling pressure.*

2.2.3 Inotropic agents

The initial agent of choice in cardiogenic shock is dobutamine, if available. Dopamine is a suitable alternative.

In ADULTS:

- Give *dobutamine 2 micrograms per kg per minute by intravenous infusion and increase rate by 1 to 2*

micrograms per kg per minute every 5 minutes to a maximum of 20 micrograms per kg per minute;

OR

- Give *dopamine 2 micrograms per kg per minute by intravenous infusion and increase to 20 micrograms per kg per minute, if necessary.*

In CHILDREN:

- Give *dobutamine 2 micrograms per kg per minute by intravenous infusion and increase rate by 1 to 2 micrograms per kg per minute every 5 minutes according to response to a maximum of 20 micrograms per kg per minute;*

OR

- Give *dopamine 2 micrograms per kg per minute by intravenous infusion and increase rate by 1 microgram per kg per minute every 5 minutes according to response to a maximum of 20 micrograms per kg per minute.*

NOTE: Ideally, inotropic agents should be infused via a central venous line. Otherwise, a large peripheral vein (such as the femoral vein or the cubital veins) should be used. In some situations, a combination of dopamine and dobutamine can be more effective than either agent alone.

2.3 Unstable Angina

This coronary syndrome is characterized by anginal pain which is severe, of recent onset, or which has recently become abruptly worse. Angina occurring at rest or following recent myocardial infarction is also classified as unstable angina.

There is evidence that the reason for unstable angina is a sudden change in a previously stable plaque within an atheromatous coronary artery. Rupture of the endothelium over and around the plaque leads to vasoconstriction, platelet adhesion, and an inflammatory response. If the vessel becomes completely occluded, a myocardial infarct will result. However, commonly, occlusion is not complete and the area around the plaque settles down over a period of a few weeks.

All patients diagnosed to be suffering from unstable angina should be referred for admission preferably to the Coronary Care Unit (CCU).

The most important distinction to make is between unstable angina and an acute myocardial infarction. The factors favouring an acute myocardial infarction include pain of more than 15 to 20 minutes duration; pain not responsive to nitrates or requiring narcotics; and systemic features such as pallor, sweating, vomiting, and hypotension. If any or all of these are present, refer immediately to hospital. An electrocardiogram (ECG) is critically important in making the diagnosis.
The aim of treatment in unstable angina is to relieve the pain and to modify the environment around the “active” plaque to

reduce the likelihood of coronary artery occlusion and subsequent myocardial infarction. However, it should be borne in mind that chest pain might be secondary to other serious conditions like acute myocardial infarction, pericarditis, aortic dissection, and pulmonary embolism.

For initial treatment:

- Oxygen therapy.
- *Aspirin 150 to 300 mg orally stat,*

  AND
- *Morphine 2.5 to 5 mg intravenously as needed,*

  AND
- *Atenolol 50 to 100 mg orally daily,*

  OR
- *Propranolol 40 to 80 mg orally two to three times daily.*

If pain still persists, in addition, heparin should be given as follows:

- *Heparin 5,000 units intravenous bolus dose followed by 1,000 units per hour by intravenous infusion.*

The infusion rate should be adjusted to keep the PTTK (partial thromboplastin time with kaolin) between 60 and 85 seconds.

The PTTK should be measured 6-hourly until stable, then daily thereafter.

Heparin will normally be required for at least 3 days and possibly longer depending on clinical response.

If pain persists and if the patient's hemodynamic status allows, ADD:

- *Nifedipine SR 20 to 40 mg orally twice daily,*

  AND, if required, ADD

- *Isosorbide dinitrate 10 to 40 mg orally three times daily.*

If symptoms persist despite all of the above treatment, cardiological intervention, if available, is required with a view to further investigation and revascularization.

2.4 Acute Myocardial Infarction

Complete occlusion of a coronary artery leads to the death of the cardiac muscle it supplies. Occlusion of a large, proximal vessel may cause myocardial ischaemia of such an extent that the patient dies rapidly of pump failure. Alternatively, a ventricular arrhythmia (tachycardia, fibrillation) may reduce cardiac output to such a drastic extent that, if the abnormal rhythm cannot be reversed, death is most likely.

Severity of pain by itself is a poor indicator of the extent of myocardial damage especially in a diabetic patient. Poor cerebral function, peripheral circulatory signs such as pallor, sweating, and hypotension combined with extensive ECG changes with or without arrhythmias point to a large infarct.

The aims of immediate management are to:

- relieve pain
- achieve coronary reperfusion and minimize infarct size
- prevent and treat heart failure and shock
- allay the patient's anxiety

All patients with suspected myocardial infarction should be admitted to hospital and preferably to a unit where cardiac monitoring can be performed.

2.4.1 Immediate management

- *Aspirin 300 mg* chewed or dissolved before swallowing.
- *Oxygen 4 to 6 liters per minute* by mask.
- *Morphine 2.5 to 5 mg intravenously with repeat doses as necessary for pain relief,*

  AND

- *Glyceryl trinitrate 600 micrograms sublingually with a repeat dose in 5 minutes if no response.*

It should not be given in hypotension and if right ventricular infarction is suspected.

Unless the patient is very anxious, routine use of a sedative drug (e.g. diazepam) is not recommended.

2.4.2 Thrombolytic therapy

The indications for thrombolytic therapy includes chest pain that has developed within the previous 12 hours with either ST segment elevation myocardial infarction (STEMI) or development of new left bundle branch block (LBBB).

Streptokinase

Administer streptokinase (STK) 1.5 million international units (IU) by intravenous infusion over 30 to 60 minutes. If blood pressure falls as a result of the infusion, reduce the rate or stop briefly and restart at half the previous rate.

Streptokinase induces antibody formation that makes it unsuitable for use in subsequent episodes of coronary occlusion. It may also produce allergic symptoms (i.e. bronchospasm, angio-oedema, urticaria, flushing, and musculoskeletal pain).

The contraindications to thrombolytic therapy are shown in Table 1.

Patients most likely to benefit from thrombolytic treatment are those presenting early with large anterior infarcts especially if complicated by heart failure.

Those presenting after 24 hours have less chance of benefit and increased risk of cardiac rupture.

For mild or moderate allergic reactions to streptokinase:

- *Promethazine 25 mg intravenously,*

  AND / OR

- *Hydrocortisone 100 mg intravenously.*

Severe allergic reactions should be treated as for anaphylaxis. Give

- *Adrenaline 1 in 1,000 solution, 0.5 to 1 ml (0.5 to 1 mg) intravenously over 5 minutes.*

If response is poor, increase dose to:

- *Adrenaline 1 in 1,000 solution 2 to 5 ml (2 to 5 mg) intravenously over 5 minute,*

  AND ADD

- *Promethazine 25 mg intravenously,*

  OR

- *Hydrocortisone 100 mg intravenously.*

NOTE: Refer to *Cardiovascular Guidelines* for details on the subsequent management of unstable angina and acute myocardial infarction.

2.5 Cardiac Arrhythmias

Cardiac arrhythmias range from trivial ectopic beats to the life-threatening ventricular fibrillation. Whether or not an arrhythmia requires intervention depends largely on its capacity to make a significant impact on cardiac output.

In a patient whose myocardial function is already impaired (e.g. by a large infarct) a change from normal sinus rhythm to atrial fibrillation with an increased ventricular rate of 140 beats per minute may be sufficient to cause heart failure. By contrast, a young person with a normal myocardium may sustain a supraventricular tachycardia at the same rate for days without any evidence of cardiac decompensation.

The urgency for intervention and the nature of that intervention are dictated equally by the situation in which the arrhythmia occurs and by the nature of the arrhythmia itself.

Most arrhythmias are benign and injudicious use of antiarrhythmic drugs can be harmful as many of them are proarrhythmic in their own right.

Table 1. Contraindications to thrombolytic therapy

Absolute contraindications	Relative contraindications
Active internal bleeding Recent surgery, biopsy or trauma Prior cardiopulmonary resuscitation Known bleeding disease (haemophilia, platelet disorders) Ischemic stroke within 6 months Neurosurgery within 6 months A previous intracranial bleed Severe uncontrolled hypertension (a blood pressure greater than 180/110 mm Hg during presentation) Aortic dissection Coma Oesophageal varices	Previous peptic ulcer disease Warfarin therapy Liver disease Previous streptokinase therapy within the last four years Previous hypersensitivity to streptokinase Heavy perivaginal bleeding Diabetic proliferative retinopathy Pregnancy

2.5.1 Tachyarrhythmias

a. Atrial tachyarrhythmias

i. Sinus tachycardia

This implies a persistent heart rate over 100 per minute in a resting patient.

It usually has an underlying cause such as anxiety, thyroid overactivity, or systemic illness. The first approach should be to identify and treat the underlying cause.

If no obvious underlying cause is apparent, treatment is generally not needed.

ii. Atrial premature complexes

Treatment is seldom required. If patient is symptomatic,

- *Atenolol 25 to 100 mg orally daily,*
  OR
- *Propranolol 40 to 80 mg orally two to three times daily.*

iii. Paroxysmal supraventricular tachycardia (PSVT)

This occurs intermittently and sometimes can be converted to sinus rhythm by carotid sinus massage, by the Valsalva manoeuvre, or by holding ice cold water in the mouth. If these are ineffective,

- *Verapamil 5 mg intravenously slowly, repeat if needed up to 15 mg;*

  OR

- *Adenosine 6 mg bolus intravenously over 5 to 10 seconds, if unsuccessful,*
  followed by 12 mg intravenously 2 minutes later,
  and if needed, 18 mg intravenously thereafter.

Adenosine can produce chest pain and large falls in blood pressure. However, the half-life of the drug is short and recovery will occur within one minute normally without intervention. If the symptoms persist, aminophylline intravenously can be used.

If above drugs are not available,

- *Digoxin 0.25 to 0.50 mg orally stat,*
  repeat same dose orally 6 hours later,
  followed by 0.25 mg orally 6 hours after the second dose,

followed by 0.25 mg orally 6 hours after the third dose, and
continue at 0.25 orally mg daily.

If rapid control is needed, digoxin may be given intravenously (see below under section on atrial fibrillation).

The maintenance digoxin dose should be adjusted depending on the patient's renal function and serum potassium level.

Verapamil must never be given to a patient with a wide-complex undiagnosed tachycardia – QRS > 0.12 seconds. If there is any possibility that the rhythm is a ventricular tachycardia, either use adenosine or treat as for ventricular tachycardia.

Once arrhythmia has been stabilized, prophylaxis against further attacks of PSVT, if frequent, must be initiated. Drugs that can be used for prophylaxis include digoxin, beta-blockers, calcium channel blockers, and amiodarone (in difficult cases).

iv. Atrial flutter and fibrillation

Atrial flutter usually presents with a 2:1 atrioventricular block and a regular rate of around 150 beats per minute. Atrial fibrillation presents with a similar rate which is however quite irregular. The aims of treatment are discussed below.

- ***Control ventricular rate***

This is only required if the ventricular rate is >100 per minute. The urgency to control the rate depends on the pre-existing ventricular rate.

❖ *Digitalization:*

Digoxin 0.25 to 0.50 mg orally stat,
repeat same dose orally 6 hours later,
followed by 0.25 mg orally 6 hours after the second dose,
followed by 0.25 mg orally 6 hours after the third dose, and
continue at 0.25 orally mg daily.

The intravenous route is rarely necessary because oral digititalization is just as effective. However, if rapid digitalization is needed, digoxin may be given intravenously. The total loading dosage is 0.5 to 1.5 mg. A loading dose of 0.5 mg in 20 ml of normal saline is given as an intravenous infusion for 20 minutes. The remaining dose is also given intravenously over 20 minutes at intervals of 4 to 6 hours depending on the response over a period of 24 hours. The total digitalizing dose will need to be reduced if the patient has had digoxin in the preceding 2 weeks.

OR

- *Verapamil 5 mg intravenously up to 15 mg with careful monitoring of pulse and blood pressure.*

For long-term control, the drugs that can be used are similar to that mentioned under the section on PSVT.

- ***Treatment of underlying cause***

Whenever possible, the underlying cause should be identified and treated (e.g. hypokalaemia, thyrotoxicosis).

- ***Reversal to sinus rhythm***

For atrial fibrillation of recent onset, consideration should be given to convert it to sinus rhythm by electrocardioversion. Medical therapy with amiodarone or sotalol might be effective. In chronic AF, recent evidence suggests that rate control is just as effective as rhythm control.

- ***Anticoagulant therapy***

Unless contraindicated and impractical (i.e. poor patient compliance, difficulty in monitoring), anticoagulant therapy should be considered in every patient with chronic AF to prevent thromboembolic event. If warfarin cannot be used for one reason or another, aspirin can be used as alternative but is not as

effective as warfarin. The risk of thromboembolism increases in patients with previous thromboembolism, mitral valve disease, heart failure, hypertension, and in older patients – especially women over the age of 75 years.

b. Ventricular arrhythmias

i. Premature ventricular ectopics including bigeminy

These are benign unless patients have underlying heart disease. If no obvious cause is found, the following measures are advisable:

- reduction of coffee and tea intake
- cessation of smoking
- reduction alcohol intake.

Drug treatment is not normally required but in symptomatic cases beta-blockade may be of value.

❖ *Atenolol 25 to 100 mg orally daily,*

OR

❖ *Propranolol 40 to 80 mg orally two to three times daily.*

ii. Ventricular tachycardia (VT)

- ***Non-sustained ventricular tachycardia***

In hospitals where ECG monitoring is possible, treat only prolonged episodes that cause cardiovascular haemodynamic instability.

- *Lignocaine 2%, 50 to 100 mg intravenously over 1 to 2 minute, followed by 4 mg per minute intravenous infusion for a maximum of one hour, then 1 to 2 mg per minute by intravenous infusion for 24 hours (see Appendix).*

If patient is unresponsive or if lignocaine is contraindicated use:

- *Amiodarone 5 mg per kg intravenously (preferably through a central venous line) over 1 to 2 hours, followed by 10 to 15 mg per kg infused over a 24- hour period (see Appendix).*

- ***Sustained ventricular tachycardia***

  - With haemodynamic stability

  Treatment is the same as for non-sustained ventricular tachycardia.

  - With haemodynamic instability ("pulseless VT") – Refer to *Section 2.1*.

iii. Ventricular fibrillation – Refer to *Section 2.1*.

iv. Ventricular asystole – Refer to *Section 2.1*.

v. Torsades de pointes

This is a rare, polymorphic ventricular tachycardia in which the QRS axis is constantly shifting (turning, "torsade"). Patients usually have a prolonged QTc (greater than 0.45 seconds) on the ECG. The rhythm is particularly prone to occur as a result of drug therapy including treatment with tricyclic antidepressants, phenothiazines, erythromycin, and ketoconazole. Any drug suspected of causing the arrhythmia should be stopped immediately.

Patients should be managed in hospital with ECG monitoring. No consensus exists about the most effective treatment. Lignocaine can be effective.

- *Lignocaine 2%, 75 to 100 mg intravenously over 1-2 minutes, followed by 4 mg per minute for a maximum of one hour. Maintenance infusion thereafter of 1 to 2 mg per minute by intravenous infusion (see Appendix).*

  Alternatively,

- *Magnesium sulphate 50%, 2 grams intravenously over 10 to 15 minutes, followed, if necessary, by 0.5 to 0.75 gram per hour by intravenous infusion for 12 to 24 hours.*

DO NOT use amiodarone to treat this arrhythmia as it may provoke it.

2.5.2 Bradyarrhythmias

a. Sinus bradycardia

Treat only if symptomatic. Exclude hypothyroidism, pituitary failure, and drugs (e.g. beta-blockers, digoxin, and verapamil).

If intervention is required:

- *Atropine 0.6 to 1.8 mg intravenously and repeat as needed.*

b. Atrioventricular block

Drugs (digoxin, beta-blockers, or verapamil) may be the cause and should be withheld if this appears to be the case.

i. First degree AV block

There is prolonged PR interval on ECG. This requires no treatment.

ii. Second degree AV block

There are two types.

- ***Wenckebach phenomenon (Mobitz type I)***

In this type of AV block, there is successive prolongation of the PR interval followed by a dropped beat and the whole cycle repeats.

- ***Mobitz type II***

There is a fixed ratio between the atrial and ventricular contractions in this type of arrhythmia, e.g. 2:1 or 3:1.

Generally, both types of AV block do not require treatment. Rarely, pacing may be required in Mobitz type II AV block.

iii. Third degree heart block

This may be an acute and potentially spontaneously reversible complication of, for example, an acute **anterior or inferior** myocardial infarction. In centers where cardiac pacing is possible, this is the treatment of choice.

If pacing is not available give

- *Isoprenaline 20 micrograms intravenously,*

repeat according to clinical response, and
follow with an infusion of 1 to 4 micrograms per minute, or
occasionally higher in patients who have been on beta-blockers (see Appendix).

There is anecdotal evidence for the efficacy of ephedrine, salbutamol, and theophylline in maintaining response if the block has responded to isoprenaline.

The treatment of choice for chronic heart block is permanent cardiac pacing.

iv. Sinoatrial block and sick sinus syndrome

These conditions require pacemaker therapy if persistent. However, this therapeutic option is currently not available in Fiji.

2.6 Acute Pulmonary Oedema

Acute pulmonary oedema is a medical emergency that requires prompt treatment. Oxygen, morphine, vasodilators, and diuretics should be used. If the patient becomes hypotensive (systolic blood pressure <90 mmHg and has signs of peripheral hypoperfusion) then treat as for cardiogenic shock.

2.6.1 Maintain airway and give oxygen

Give high flow oxygen via a face mask. Some patients with severe pulmonary oedema may require intubation and mechanical ventilation. The use of continuous positive airway pressure (CPAP) via mask is very useful if available.

2.6.2 Positioning

Sit the patient upright. This reduces the intrathoracic blood volume and improves ventilation of the lungs.

2.6.3 Diuretics

Intravenous frusemide has a beneficial vasodilatory action as well as being a powerful diuretic:

- Give *frusemide 40 mg intravenous bolus.*

NOTE: Patients with renal impairment or those who are already on frusemide therapy may require larger doses of frusemide (up to 250 mg). It is best to titrate repeat doses according to the patient's response. If the urine output is inadequate 30 minutes after the first dose then give a further dose of 80 mg intravenously. Doses greater than 40 mg should be given slowly over 5 to 10 minutes to avoid damage to the inner ear.

2.6.4 Morphine

Narcotics reduce anxiety and dyspnea and may also cause pulmonary vasodilation.

- Give *morphine 2.5 to 5 mg intravenously every 5 minutes to a maximum of 15 mg.*

NOTE: Use the lower dose of morphine in the elderly and those patients with a lower body weight.

2.6.5 Bronchodilators

Fluid in the airways often causes bronchospasm which worsens the effect of pulmonary oedema. If there is any wheeze or other evidence of bronchospasm then

- Give *salbutamol 5 mg via nebulizer (using oxygen) and repeat in 30 minutes if necessary.*

2.6.6 Vasodilators

Glyceryl trinitrate and isosorbide dinitrate cause vasodilation and may also improve myocardial blood supply.

- Give *glyceryl trinitrate tabs 600 micrograms sublingually and repeat every 15 minute, if necessary, ensuring that the blood pressure is maintained.*

NOTE: Glyceryl trinitrate should not be given if the patient is in cardiogenic shock without the concomitant administration of dopamine or dobutamine.

*2.*6.7 Inotropes

Failure to respond to the above treatment may require addition of dobutamine or dopamine as for cardiogenic shock. Most patients needing inotropes will also need intubation and mechanical ventilation. Persistent hypoxia (oxygen saturation less than 90%) despite treatment is an indication for intubation.

2.7 Hypertensive Emergency

This is seldom needed but may be required in hypertensive encephalopathy, acute hypertensive heart failure, dissecting aneurysm, and phaeochromocytoma. Patients with these conditions should be admitted to the hospital and monitored. The aim is to reduce blood pressure within 60 to 90 minutes.

While the blood pressure may respond to oral agents (as above), initial parenteral treatment may be needed.

- *Hydrallazine 5 mg bolus intravenously over 5 to 10 minutes and repeated every 20 minutes up to a maximum of 20 mg, followed by intravenous infusion of hydrallazine (see Appendix);*

  OR

- *Labetalol (100 mg per 20 ml); initial dose of 20 to 40 mg given intravenously over 1 to 2 minutes, and repeated at intervals of 5 to 10 minutes until 200 mg have been given. Alternatively, labetalol may be given as a continuous intravenous infusion at a rate of 2 mg per minute (see Appendix).*

After initial stabilization, the patient should be changed to oral treatment for maintenance.

The practice of opening a nifedipine 10 mg capsule and giving it sublingually is not supported as emergency treatment. It delivers an uncertain dose and most of the effect occurs as a result of absorption of the swallowed drug. **On occasions in older patients unexpected rapid falls in blood pressure have resulted in stroke or myocardial infarction.** In Fiji, nifedipine 10 mg capsule is restricted to obstetric and paediatric practice.

Please note that in some situations, urgent reduction with intravenous drugs over a short period of time is not recommended (e.g. severe, uncomplicated essential hypertension; severe hypertension postoperatively in a patient suffering from pain; severe asthma). In such situations, oral antihypertensive drugs can be used and blood pressure reduction can be achieved in 48 to 72 hours.

3 Respiratory Emergencies

3.1 Asthma

Asthma is a common respiratory disease in both adults and children. Severity is estimated by clinical assessment, and if available, by measurement of peak expiratory flow rate and by pulse oximetry. Patients with severe asthma should be considered for management in an intensive care unit and may occasionally require intubation and mechanical ventilation.

3.1.1 Treatment in adults

a. Oxygen

All patients with moderate or severe asthma should be given oxygen.

- Give oxygen by face mask, if required, to maintain oxygen saturation ≥ 92%.

b. Beta-adrenergic agonists

Use beta-adrenergic agonists to reverse bronchospasm. In very severe asthma where nebulized salbutamol might not reach the peripheral bronchi, intravenous salbutamol may also be

required.

- Give *salbutamol 5 mg by nebulizer with oxygen (≥ 8 liters per minute) and repeat every 30 minutes as necessary (may give continuously in severe asthma),*

  OR

- *Give salbutamol by puffer ideally using spacer (up to 50 puffs) if nebulizers are not available, if required;*

  PLUS if very severe

- Give *salbutamol 5 micrograms per kg intravenously (to a maximum of 250 micrograms) over one minute then commence an infusion at 5 micrograms per kg per hour.*

NOTE: Continuous nebulized salbutamol is probably as effective as intravenous salbutamol.

c. Anticholinergics

These agents have a synergistic effect with beta-adrenergic agonists. In severe asthma the addition of ipratropium may be beneficial.

- Give *ipratropium bromide 250 to 500 micrograms by nebulizer and repeat every 4 hours if necessary.*

d. Corticosteroids

Steroids reduce inflammation of the airways. Their effects are delayed for at least 4 hours but they are important to prevent relapse. Oral steroids are as effective as those given parenterally in most patients.

- Give *hydrocortisone 200 mg intravenously stat then 100 mg intravenously 6-hourly,*

  OR

- Give *prednisolone 40 mg orally daily.*

e. Other drugs

Aminophylline provides no additional benefit to optimal doses of beta-adrenergic agonists. It has a number of undesirable side effects including seizures, ventricular tachycardia, hypokalaemia, and vomiting. Routine use in asthma is not recommended. However, it may be of benefit in patients with severe asthma who require hospitalization. A loading dose is given to patients who are not taking oral theophylline.

- Give *aminophylline 5 mg per kg (to a maximum of 250 mg) intravenously over 5 minutes followed by an infusion at a dose of 0.6 to 0.9 mg per kg per minute.*

Adrenaline does not appear to have any advantage over salbutamol. It may be used as a last resort or when intravenous

access is not available:

- Give *1:1,000 adrenaline 0.5 to 1 mg intramuscularly or subcutaneously.*

NOTE: Adrenaline may be given down the endotracheal tube – the dose is 5 times the intravenous dose and it should be diluted in 10 ml of normal saline.

3.1.2 Treatment in children

a. Oxygen

- Give oxygen by face mask or by nasal prongs as needed.

b. Beta-adrenergic agonists

Use beta-adrenergic agonists to reverse bronchospasm. In very severe asthma intravenous salbutamol may be useful in addition to nebulized.

- Give *salbutamol 2.5 mg by nebulizer with 6 to 8 liters of oxygen per minute to children 5 years of age or under, or give 5 mg by nebulizer to children over 5 years and repeat every 30 minutes, if necessary, for at least three times, and if no response, give continuously;*

  PLUS, if very severe,

❖ Give *salbutamol 5 micrograms per kg intravenously (to a maximum of 250 micrograms) over one minute.*

NOTE: Intravenous salbutamol may be more effective than continuous nebulization in young children with severe asthma.

c. Anticholinergics

These agents have a synergistic effect with beta-adrenergic agonists.

❖ Give *ipratropium bromide 250 micrograms nebulizer every 20 minutes for three doses and then 2- to 4-hourly.*

d. Corticosteroids

Steroids reduce inflammation of the airways. Their effects are delayed for at least 4 hours but they are important to prevent relapse. Oral steroids are as effective as those given parenterally in most patients.

❖ Give *hydrocortisone 2 to 4 mg per kg intravenously to a maximum of 200 mg then 6- hourly,*

OR

❖ Give *prednisolone 1 to 2 mg per kg orally to a maximum of 60 mg daily.*

e. Other drugs

Aminophylline provides no additional benefit to optimal doses of beta-adrenergic agonists. It has a number of undesirable side effects including seizures, ventricular tachycardia, hypokalaemia, and vomiting. Routine use in asthma is not recommended. However, it may be of benefit in patients with severe asthma or whenever salbutamol or hydrocortisone is not available.

A loading dose is given to patients who are not taking oral theophylline.

- Give *aminophylline 5 mg per kg (to a maximum of 250 mg) intravenously over 5 minutes.*

Adrenaline does not appear to have any advantage over salbutamol. It may be used in severe asthma as a last resort or when intravenous access is not available.

- Give *1:1,000 adrenaline 0.1 ml per kg intramuscularly or subcutaneously to a maximum of 0.5 ml.*

3.2 Exacerbation of Chronic Obstructive Pulmonary Disease

Exacerbation of chronic obstructive pulmonary disease (COPD) is a common problem in emergency medicine. The response of COPD to treatment is generally slower than that of

asthma and most patients require admission.

3.2.1 Oxygen

It is essential that oxygen be given to maintain oxygen saturation greater than 92%. Although administration of oxygen can cause an elevation in arterial carbon dioxide levels in a few patients, this is far less of a problem than hypoxia itself. For mildly hypoxic patients, oxygen via an intranasal catheter will be sufficient while those with more severe hypoxia may require oxygen via a face mask. Use the lowest flow rate necessary to maintain an adequate arterial oxygen saturation. Where carbon dioxide retention is considered likely, monitor arterial blood gases (ABGs).

CAUTION: In patients with carbon dioxide retention, oxygen saturation should be maintained between 90 to 92%.

3.2.1 Bronchodilators

Salbutamol and ipratropium have a synergistic action.

- Give *salbutamol 5 mg via nebulizer every 2 to 4 hours as required,*

  PLUS

- Give *ipratropium bromide 250 to 500 micrograms via nebulizer every 4 hours.*

3.2.2 Corticosteroids

Oral and parenteral routes are equally effective except in the sickest patients.

- Give *hydrocortisone 200 mg intravenously stat then 100 mg intravenously 6-hourly,*
  OR

- Give *prednisolone 40 mg orally daily.*

3.2.3 Antibiotics

Antibiotics should be given when infection is the underlying cause of the exacerbation (as suggested by fever, and/or increased sputum volume and purulence).

NOTE: More serious infections may require intravenous antibiotics.

- Give *amoxycillin 500 mg orally 8-hourly,*

  OR, if penicillin sensitive,

- Give *erythromycin 500 mg orally 6-hourly.*

3.3 Croup

Croup is a viral infection of the upper airway which affects

children from the ages of 6 months to 3 years. It is characterized by fever, a harsh cough, a hoarse voice, and stridor. Children who have stridor while at rest or who have signs of respiratory distress (i.e. suprasternal retraction, tachypnea, restlessness) should be admitted. Pulse oximetry is useful – an oxygen saturation of 93% or less while breathing air is also an indication for admission. Most cases of croup however are mild and self-limited.

3.3.1 Mild croup

These patients will have stridor only with exertion or crying and no signs of respiratory distress. Avoid exposure to cold air. Give paracetamol for fever.

- Give *paracetamol 20 mg per kg orally 6-hourly as required.*

3.3.2 Moderate croup

These patients will have stridor at rest and some signs of respiratory distress but oxygen saturation should be greater than 90% on air.

- Give *oxygen to maintain an oxygen saturation greater than 93%;*

  PLUS

- Give *dexamethasone 0.6 mg per kg intramuscularly as a*

single dose.

3.3.3 Severe croup

These patients will have signs of marked respiratory distress plus hypoxia or cyanosis. Admission to an intensive care unit is desirable and intubation may be necessary.

- Give *oxygen to maintain an oxygen saturation greater than 92%;*

  PLUS

- Give *dexamethasone 0.6 mg per kg intramuscularly as a single dose;*

  PLUS

- Give *nebulized adrenaline, 0.5 ml per kg of 1: 1,000 solution in 3 ml of normal saline (maximum dose of 2.5 ml for ≤ 4 years old and 5 ml for > 4 years).*

NOTE: Patients who fail to respond to nebulized adrenaline may require endotracheal intubation. Nebulized adrenaline provides only temporary relief of airway obstruction lasting 1 to 2 hours. Patients should be closely observed after this period for recurrence of obstruction.

3.4 Epiglottitis

Epiglottitis is a medical emergency and failure to provide prompt treatment may be fatal. It is due to infection of the epiglottis with *Haemophilus influenzae* bacteria. Epiglottitis mainly affects children between the ages of 3 and 8 years but is occasionally seen in adults as well. It is characterized by fever, inspiratory and expiratory upper airway noises, a severe sore throat, dysphagia, and drooling. The patient usually looks very unwell.

There is a very high risk of acute airway obstruction. All patients should be referred immediately to an anaesthetist and admitted to an intensive care unit. Attempting to view the throat or otherwise upsetting the child may cause airway obstruction and should be avoided. Keep the patient sitting up.

- Give *ceftriaxone 100 mg per kg stat then 50 mg per kg intravenously daily,*

  OR

- Give *chloramphenicol 40 mg per kg stat then 25 mg per kg intravenously daily.*

3.5 Oxygen Therapy

Oxygen is essential for human metabolism and lack of oxygen is generally fatal within 5 to 6 minutes. Oxygen has almost no

adverse effects in the acute situation and should not be withheld if there is any suggestion of it being needed. Indications for oxygen therapy include:

- cardiac or respiratory arrest
- hypoxia of any cause
- cardiac failure
- myocardial infarction
- shock of any cause
- carbon monoxide poisoning.

Oxygen therapy should be monitored with pulse oximetry and ABGs estimation, if available. In general, aim to achieve an oxygen saturation of at least 92% (except in patients who are carbon dioxide retainers). Humidification of oxygen is not necessary.

3.5.1 Methods of oxygen delivery

a. Intranasal catheters

These provide a low concentration of oxygen of between 25% and 40%. They should be used with an oxygen flow rate of between 1 and 4 liters per minute (1 to 2 liters per minute in children). Higher flow rates cause drying of the nasal mucosa and are uncomfortable. They should only be used in patients with mild hypoxia or cardiac failure or myocardial ischaemia. They do not provide a high enough oxygen concentration for patients with significant hypoxia, carbon monoxide poisoning, shock, or cardiac arrest.

b. Plastic face masks

These provide oxygen concentrations of between 35% and 70%. The oxygen flow rate should be set between 4 and 15 liters per minute. Do not use face masks with an oxygen flow rate less than 4 liters per minute. This method of oxygen delivery is suitable for patients with moderate hypoxia or shock.

c. Tight fitting face masks (e.g. Laerdal, CPAP masks)

These devices can provide oxygen concentrations close to 100%, if available. They should be used in patients with severe hypoxia or with cardiac arrest.

3.5.2 Adverse effects of oxygen

Patients with COPD and elevated carbon dioxide levels may occasionally have a hypoxia-dependent respiratory drive. In these patients, the administration of oxygen causes hypoventilation and an increase in the carbon dioxide level. Although this may cause problems it is usually far less dangerous than hypoxia itself. In the emergency situation, it is important that hypoxia is corrected – problems with carbon dioxide retention can be handled later. Do not hesitate to give oxygen to hypoxic patients with COPD, but they should be observed for possible deterioration caused by worsening hypercapnea.

Administration of 100% oxygen sometimes causes pulmonary toxicity but this only occurs after 24 hours and therefore is not a problem in the emergency situation.

NOTE: If arterial blood gases or pulse oximetry measurement is available, then they should be undertaken before the commencement of oxygen to establish the baseline in significantly hypoxic patients or those at risk of carbon dioxide retention.

4 Neurologic Emergencies

4.1 Seizures

There are numerous causes of epileptic seizures. In adults, the majority occur in known epileptics with idiopathic epilepsy while in children febrile convulsions are a common cause. However, it is important to exclude less common, reversible, and serious causes of seizures such as hypoglycaemia, hyponatraemia, hypocalcaemia, eclampsia, drug overdose, meningitis, or intracranial lesions.

Most seizures are self-limiting and brief. Emergency drug treatment is only necessary if the seizures are prolonged (>5 minutes) or recurrent. Initial treatment is gentle restraint of the patient in the left lateral position and administration of high flow oxygen via face mask.

4.1.1 Treatment in adults

- Give *diazepam 5 mg intravenous bolus and repeat every 2 minutes as required to a maximum dose of 20 mg. This dose may be repeated 30 minutes later if necessary,*

  OR, if there is no intravenous access,

- Give *diazepam 0.5 mg per kg per rectum (use intravenous solution);*

  PLUS, if seizures persist or are recurrent,

- Give *phenytoin 15 mg per kg via intravenous infusion over 20 minutes.*

NOTE: If seizures persist despite diazepam and phenytoin, THEN diazepam or thiopentone infusions should be considered.

a. Diazepam infusion

- *Diazepam 100 mg in normal saline to make a total of 100 ml solution (strength: 1 mg per ml) and infuse at a rate of 2 mg per hour.*

Patient must be carefully monitored for respiratory depression.

b. Thiopentone infusion

The patient should be intubated before the thiopentone infusion is begun.

- For induction, give *thiopentone 5 mg per kg intravenous bolus,*

  THEN

- Commence *thiopentone infusion at a rate of 50 mg per hour.*

4.1.2 Treatment in children

- Give *diazepam 0.2 mg per kg intravenous bolus and repeat after 5 minutes to a maximum dose of 6 to 12 mg,*

  OR, if there is no intravenous access,

- Give *diazepam 0.5 mg per kg per rectum;*

  PLUS, if seizures persist,

- Give *phenytoin 15 to 20 mg per kg via intravenous infusion over 20 minutes,*

  OR

- Give p*henobarbitone 20 mg per kg intravenously or intramuscularly stat which may be repeated 10 mg per kg as required to a maximum dose of 40 mg per kg.*

If seizures persist and last for more than 60 minutes, give

- *Midazolam infusion 1 to 4 micrograms per kg per minute (3 mg per kg in 50 ml of dextrose saline or normal saline to run at 1 to 4 ml per hour).*

If seizures persist, consider thiopentone infusion:

❖ For induction, give *thiopentone 5 mg per kg intravenous bolus,*

THEN

❖ Commence *thiopentone infusion at a rate of 1 mg per kg per hour.*

4.2 Migraine

Migraines are recurrent, often unilateral, throbbing headaches associated with nausea, photophobia, and sometimes visual disturbance. The diagnosis is usually fairly obvious but it is important to consider other causes of headache (e.g. meningitis, subarachnoid haemorrhage) if there are atypical features.

4.2.1 Treatment in adults

Patients should rest in a quiet dark room after treatment.

❖ Give *metoclopramide 10 mg orally or intramuscularly,*

OR

❖ Give *prochlorperazine 5 mg orally or 12.5 mg intramuscularly;*

THEN 15 minutes later,

❖ Give *aspirin 900 mg orally, repeat in 4 hours, if required;*

PLUS

❖ Give *paracetamol* 1.5 gram orally, *repeat in 4 hours, if required.*

NOTE: Other drugs that can be used in the treatment of acute migraine include ergotamine preparations and sumatriptan but they are not available in the Fiji EDL.

4.2.2 Treatment in children

Paracetamol alone is usually sufficient along with rest in a quiet dark room.

❖ Give *paracetamol 20 mg per kg orally or rectally.*

4.3 Oculogyric Crisis

Oculogyric crisis is an acute focal dystonic reaction to neuroleptic agents and anti-emetic drugs such as metoclopramide. It most commonly affects young women. It is characterised by involuntary deviation of the eyes upward often with torticollis (spasm of the neck muscles).

❖ Give *benztropine 2 mg orally or intramuscularly.*

NOTE: A further dose of benztropine should be given 4 hours

later to prevent recurrence.

4.4 Tetanus

Tetanus is a severe life-threatening disease caused by the toxin producing bacterium *Clostridium tetani*. It usually follows local wound contamination in an improperly immunized individual. Clinical features include muscle rigidity (esp. trismus), painful muscle spasms, fever, labile hypertension, and abnormalities of cardiac rhythm. Patients should be managed in an intensive care unit if possible.

4.4.1 Airway and breathing

Give high flow oxygen via face mask. Cardiorespiratory status should be closely monitored. Patients with respiratory muscle involvement will need early intubation, muscle paralysis and ventilation.

4.4.2 Tetanus immune globulin and immunization

Tetanus immunoglobulin neutralizes circulating toxin. Large doses are required.

- Give *tetanus immune globulin 4,000 units intravenously over 30 minutes.*

Commence active immunization with tetanus toxoid.

- Give *tetanus toxoid 0.5 ml intramuscularly*.

4.4.3 Wound debridement

Aggressive wound debridement is essential.

4.4.4 Antibiotics

Penicillin or metronidazole is effective against *C. tetani*:

- Give *benzylpenicillin 100,000 units per kg (maximum dose of 4 megaunits) intravenously 4-hourly,*

  OR, if penicillin sensitive,

- Give *metronidazole 7.5 mg per kg (maximum dose 500 mg) intravenously 8-hourly.*

4.4.5 Muscle spasms

Morphine and diazepam are used to control muscle spasms. Very large doses may be required. A quiet environment should be maintained.

4.5 Acute Bacterial Meningitis in Adults

In adults, *Streptococcus pneumoniae* is the most likely organism. *Haemophilus influenzae* and *Neisseria meningitidis* are less common. Cerebrospinal fluid (CSF) microscopy and culture are vital in directing antibiotic therapy. Therefore, a lumbar puncture and blood culture should be performed as

soon as possible. Caution is required with lumbar puncture if the patient is in coma, has signs of increased intracranial pressure, or has focal neurological signs. A computed tomography (CT) scan of the head is preferred before lumbar puncture if available.

Bacterial meningitis is a medical emergency and antibiotic therapy should not be delayed if there is difficulty in obtaining a CSF sample. In such cases, empirical therapy should be started immediately.

In rural areas or where there is a delay in transferring patient to a major hospital, if meningitis is suspected, antibiotics should be started immediately, either with:

- *Penicillin G 4 megaunits intravenously or intramuscularly 6-hourly,*

  OR

- *Ceftriaxone 2 grams intravenously as a single dose (if available).*

Penicillin, chloramphenicol, and ceftriaxone have proven to be effective in the treatment of meningitis. Chloramphenicol in oral doses achieves good CSF penetration.

Dexamethasone has been found to be useful in children. Recent literature suggests that it has a role in the management of bacterial meningitis in adults and is to be given just before

the first antibiotic dose.

- *Dexamethasone 10 mg intravenously just before the first dose of antibiotic followed by 10 mg intravenously 6-hourly for 4 days.*

4.5.1 Empirical therapy

- *Penicillin G 1.8 gram (3 megaunits) intravenously 4-hourly for 10 days,*

  PLUS

- *Chloramphenicol 750 mg to 1 gram intravenously 6-hourly for 10 days.*

In patients hypersensitive to penicillin:

- *Chloramphenicol alone,*

  OR

- *Ceftriaxone 4 grams intravenously daily in one or two divided doses.*

Change to appropriate regimen once the organism and susceptibility result are available. If no organism is identified, continue empirical therapy for a total of 10 days.

4.5.2 Specific therapy

a. Streptococcus pneumoniae and Neisseria meningitidis meningitis

- *Penicillin G 1.8 gram (3 megaunits) intravenously 4-hourly.*

In penicillin hypersensitive patients:

- *Ceftriaxone 4 grams intravenously daily in two divided doses.*

Pneumococcal meningitis is to be treated for 10 to 14 days. Some very ill patients may require treatment for 21 days. Meningitis due to *Neisseria meningitidis* usually requires treatment for 7 days only.

NOTE: At the end of penicillin therapy, *rifampicin 10 mg per kg per dose (up to 600 mg) orally 12-hourly for 4 doses* should be given to eradicate nasopharyngeal carriage in cases of meningococcal meningitis. This treatment should also be given to all close contacts.

b. Gram negative bacterial meningitis

Consultation is advisable. Generally, for gram-negative meningitis not due to *H. influenzae*, a combination of ceftriaxone and gentamicin is useful and the treatment is for 21 days.

5 Poisoning and Overdoses

Poisoning may occur with both chemicals (e.g. insecticides) or with therapeutic drugs, many of which can be toxic in overdose. Poisoning and overdose may or may not be life-threatening, depending on the type and amount of substance ingested. Treatment is most often supportive only and care should be taken that any intervention does not worsen the situation. Below are the steps to be taken in most cases of poisoning.

5.1 General Principles

5.1.1 Resuscitation (see *Section 2.1*)

- Rapidly assess the airway, breathing, and circulation.
- Maintain the airway, if necessary.
- Administer oxygen.
- Obtain intravenous access.
- Give intravenous fluids if the patient is hypotensive.

NOTE: Oxygen should be avoided unless absolutely necessary in patients with paraquat poisoning as it may increase toxicity.

5.1.2 Gastric decontamination

The best method of preventing absorption of ingested poisons is with the use of activated charcoal.

- Give *activated charcoal 1 gram per kg (to a maximum of 50 grams) orally or via nasogastric tube.*

Patients who are unable to protect their airway (i.e. excessive drowsiness) should be intubated BEFORE insertion of a nasogastric tube and administration of activated charcoal.

In CHILDREN:

- Give *activated charcoal 15 to 30 grams if under 12 years old and 50 to 60 grams if over 12 years of age.*

NOTE: Ipecac syrup has no role in the treatment of poisoning. Gastric lavage should be performed only in exceptional circumstances such as recent ingestion of large doses of paracetamol. Gastric lavage is contraindicated in ingestion of hydrocarbons, caustics, and corrosives.

Administration of activated charcoal is the easiest, safest, and most effective method of decontamination of the gut in almost all situations. In paraquat poisoning, Fuller's earth (if available) should be substituted for activated charcoal. Activated charcoal does not effectively absorb hydrocarbons, anticholinesterase insecticides, heavy metals, or acids and alkalis, but it is unlikely to cause harm in these situations and

may still be given, especially if there is doubt about exactly what the patient has ingested.

5.1.3 Supportive care

Continued observation and the provision of oxygen, intravenous fluids and airway support as required. Knowledge of the pharmacologic effects of the substance ingested allows anticipation of possible problems.

5.1.4 Specific antidotes

Antidotes to a number of drugs exist and their use is described in the sections below.

5.1.5 Psychiatric evaluation

Self-administered overdoses are more often expressions of distress due to emotional crises than true suicide attempts. All patients should be assessed for suicidal intent and treated appropriately. Appropriate counseling should be given prior to discharge.

5.2 Treatment of Specific Poisons

5.2.1 Opiates (e.g. codeine, heroin, pethidine, morphine, methadone)

These drugs cause depression of conscious state and

hypoventilation. Particular attention should be paid to the maintenance of the airway and adequate ventilation. The specific antidote naloxone is highly effective.

- Give *naloxone 0.4 mg intravenously or intramuscularly and repeat in 5 minutes if necessary to a maximum of 2 mg.*

NOTE:

- Failure to respond to a dose of 2 mg of naloxone is an indication that the depression of conscious state is not due to opiate ingestion alone – other possible causes should be considered.
- Naloxone has a short half-life and further intramuscular doses may be required after 1 to 2 hours.
- Naloxone may induce pulmonary oedema.

5.2.2 Paracetamol

Overdose of this drug is common and can be fatal. Initial symptoms are mild with nausea, vomiting, and sometimes abdominal pain. Hepatic failure and death may follow in days to weeks. The minimum toxic dose is 150 mg per kg and almost all patients who ingest more than 350 mg per kg will develop hepatic failure. Acetylcysteine is the specific antidote and if given within 8 hours may largely prevent hepatic damage. It may still be useful when given from 8 to 24 hours after the ingestion.

If urgent serum paracetamol levels are available, then an assessment of the risk of hepatic damage is done using the Rumack-Matthew nomogram which relates serum paracetamol levels to time since ingestion. If a paracetamol level is available within 8 hours of ingestion then withhold acetylcysteine until a toxic level is confirmed. If a paracetamol level will not be available within 8 hours of ingestion, then acetylcysteine should be commenced immediately. **If there is any doubt about the time of ingestion or if paracetamol levels are not available, then acetylcysteine should be given to all patients in whom it is reasonably certain that they have ingested an overdose of paracetamol.**

- Give *acetylcysteine 150 mg per kg intravenously over 15 minutes,*

  THEN
- Give *acetylcysteine 50 mg per kg intravenously over 4 hours.*

  THEN
- Give *acetylcysteine 100 mg per intravenously over 16 hours.*

NOTE: Acetylcysteine may cause severe bronchospasm in some individuals. If this occurs the infusion should be ceased and salbutamol administered. Hydroxycobalmin has been used as an alternative antidote.

5.2.3 Anticholinesterases (e.g. insecticides)

These substances cause severe cholinergic effects including vomiting, diarrhoea, bradycardia, hypotension, hypersalivation, bronchospasm, urinary incontinence, muscle weakness, constricted pupils, and pulmonary oedema. Poisoning may occur with skin exposure or inhalation, as well as with oral ingestion. The specific antidote is atropine and very large doses may be required. Atropine will not reverse muscle weakness so intubation and mechanical support of ventilation may be required. **Pralidoxime**, which is an acetylcholinesterase reactivator, may also be useful, particularly if administered in conjunction with atropine.

a. Treatment in adults

- Give *atropine 3 mg intravenously every 5 to 15 minutes until atropinization is achieved (dry mouth, tachycardia, pupillary dilatation). There is no maximum dose; however, 20 or 30 mg may be required;*

  PLUS

- *Pralidoxime 1gram intravenously over 30 minutes and repeat every 12 hours if symptoms persist.*

b. Treatment in children

- Give *atropine 1.2 mg intravenously every 5 minutes until the patient develops sinus tachycardia (heart rate of up to*

120 beats per minute). There is no maximum dose.

PLUS

- *Pralidoxime 20 mg per kg intravenously over 30 minutes and repeat every 12 hours if symptoms persist.*

NOTE: Further doses of atropine may be needed for 24 to 48 hours after exposure.

5.2.4 Aliphatic hydrocarbons (e.g. kerosene, petroleum)

Hydrocarbons cause irritation of the gastrointestinal tract, with common symptoms being abdominal pain, vomiting, and diarrhoea. Their most dangerous toxic effects occur when they are aspirated into the lungs causing a chemical pneumonitis. This may occur either during the primary ingestion or when the patient subsequently vomits. **Hydrocarbons are not absorbed by activated charcoal so this should not be given.** Patients who have any signs or symptoms of aspiration pneumonitis (e.g. fever, cough, dyspnea, wheeze) should be given oxygen, admitted for observation, and administration of intravenous antibiotics should be considered. Patients with severe vomiting and diarrhoea may need intravenous hydration. There is no specific antidote for these chemicals.

5.2.5 Alkali ingestion (e.g. bleach, drain cleaner)

Gastric decontamination is not indicated in alkali ingestion and

vomiting should be avoided. There is no specific antidote; the treatment is supportive only.

Ingestion of an alkaline substance causes damage to the oropharynx and oesophagus. Household bleach (5% sodium hypochlorite) is not a very strongly alkaline substance and is unlikely to cause serious injury. These patients need only symptomatic treatment with intravenous fluids and admission for observation. Stronger alkalis such as drain cleaner may cause severe chemical burns the complications of which include airway obstruction and oesophageal or gastric perforation. These patients should be admitted for rehydration and consideration of upper gastrointestinal endoscopy to determine the extent of the damage.

5.2.6 Oral anticoagulants (e.g. warfarin, rat poison)

Overdose of these substances causes prolongation of the prothrombin time and increased risk of bleeding. Patients who have active bleeding or who are at high risk of developing bleeding (e.g. post-operative) should be actively treated. Vitamin K reverses the effect of oral anticoagulants over 12 to 24 hours whereas fresh frozen plasma provides immediate replacement of coagulation factors. In patients not at immediate risk, ceasing warfarin temporarily until the prothrombin time is in the therapeutic range is all that is required. The potency of rat poisons vary – some may require large doses of vitamin K over several weeks.

a. Treatment in adults

- Give *vitamin K 5 to10 mg intravenously slowly stat;*

  PLUS, if necessary,

- Give *fresh frozen plasma 2 units intravenously and repeat as necessary to a maximum of 8 units using repeated measurements of the prothrombin time as a guide to therapy.*

Refer to consultant physician for subsequent management.

b. Treatment in children

- Give *vitamin K, 0.3 mg per kg (maximum 10 mg) intramuscularly daily;*

  PLUS, if necessary,

- Give *fresh frozen plasma 20 ml per kg (maximum 2 units) intravenously and repeat as necessary using repeated measurements of the prothrombin time as a guide to therapy*

5.2.7 Beta-adrenergic antagonists (e.g. propranolol, atenolol)

Beta-blocker overdose causes bradycardia, AV node block and hypotension, sometimes complicated by bronchospasm,

congestive cardiac failure, and confusion. Hypoglycaemia may also occur in children. These overdoses may be fatal and patients with significant toxic effects may need a central venous line, ECG monitoring, and monitoring in an intensive care unit (if available).

a. Treatment in adults

- Give *adrenaline infusion 10 micrograms per minute and increase by 5 micrograms per minute every 2 minutes until the systolic blood pressure is >90 mmHg, to a maximum of 100 micrograms per minute.*

b. Treatment in children

- Give *adrenaline infusion 0.5 micrograms per kg per minute and increase by 5 micrograms per minute every 2 minutes until the systolic blood pressure is >90 mmHg, to a maximum of 100 micrograms per minute;*

  OR

- Give *isoprenaline infusion 0.5 to 10 micrograms per kg per minute.*

5.2.8 Iron

Overdose of iron initially causes vomiting, diarrhoea, abdominal pain, and sometimes haematemesis. After a variable

quiescent period during which these gastrointestinal symptoms resolve, the patient may develop shock and hypoglycaemia plus cardiac, hepatic, and renal failure. The specific antidote is desferrioxamine but supportive care including intravenous fluid and glucose (if necessary) is important as well. Iron is not well absorbed by activated charcoal.

The following patients should receive desferrioxamine:

- all symptomatic patients
- all patients who have iron tablets visible on a plain abdominal X-ray
- all patients in whom the serum iron level (if available) is greater than 350 micrograms per dl (90 micromoles per liter).

❖ Give *desferrioxamine 15 mg per kg per hour by intravenous infusion continued until the patient is asymptomatic (usually 12 to 24 hours).*

5.2.9 Benzodiazepines (e.g. diazepam)

These substances are very safe in overdose generally causing only drowsiness. Supportive care and observation is usually all that is necessary.

5.2.10 Nonsteroidal anti-inflammatory dugs (e.g. indomethacin, ibuprofen, aspirin)

Overdose of these drugs causes nausea, vomiting, abdominal

pain, and drowsiness. Treatment is supportive only.

5.2.11 Phenytoin

In overdose, phenytoin causes cerebellar dysfunction (nystagmus, ataxia, dysarthria, nausea, and vomiting) plus confusion, coma and paradoxically, seizures. Treatment is essentially supportive. Diazepam should be used to control seizures.

5.2.12 Aspirin

This commonly used drug can be highly toxic in overdose. The clinical features include gastrointestinal (nausea, vomiting, haematemesis), neurologic (confusion, coma, seizures), and metabolic (fever, tachypnea, and hypokalaemia) manifestations. Metabolic acidosis and hypoglycaemia may occur in children. Cardiac failure and acute respiratory distress syndrome are uncommon complications. The potentially toxic dose is greater than 150 mg per kg. Patients with manifestations of aspirin overdose should be admitted and treated as follows:

- Give *0.9% saline (or 0.3% saline with 3% dextrose in children) intravenously at a rate necessary to maintain a urine output greater than 2 ml per kg per hour;*

  PLUS

- Give *sodium bicarbonate 1 mmol per kg intravenously*

every 4 hours to maintain a urine pH greater than 7.5 if facilities are available;

PLUS

- Give *potassium chloride 0.25 mmol per kg intravenously over at least one hour, every 4 hours to maintain serum potassium levels > 4 mmol per liter.*

NOTE: Frequent measurement of urine output, urine pH, and serum potassium should be performed (e.g. every 2 to 4 hours). Larger or smaller doses of sodium bicarbonate and potassium chloride than those listed above may be required.

5.2.13 Carbon monoxide (e.g. car exhaust)

This odourless and colourless gas competes with oxygen for the binding sites on the haemoglobin molecule. Toxic effects include headache, nausea, confusion, coma, seizures, and cardiac arrhythmias. Treatment for symptomatic patients is with 100% oxygen for at least 12 hours.

5.2.14 Digoxin

Poisoning with this drug may be acute (usually intentional self-poisoning) or chronic (gradual accumulation in a patient taking digoxin for therapeutic reasons). Patients with significant toxicity always complain of nausea and vomiting. Other clinical features include headache, diarrhoea, visual disorders, confusion, and coma. Acute poisoning causes marked

hyperkalaemia whereas chronic toxicity cases are often hypokalaemic. Digoxin toxicity has been known to cause just about every type of cardiac arrhythmia from complete heart block to ventricular tachycardia. In addition to the usual supportive care, complications should be treated as follows:

a. Ventricular tachycardia

- Give *phenytoin 15 mg per kg intravenously, infused no faster than 50 mg per minute;*

  PLUS

- Give *magnesium sulphate 50 mg per kg intravenously (maximum dose 5 grams) over 5 minutes.*

THEN, if arrhythmia persists,

- Give *lignocaine 1 mg per kg intravenous bolus.*

NOTE: Use cardioversion only as a last resort as it may induce intractable ventricular fibrillation. If it is absolutely necessary then use low energies (e.g. 25 joules in an adult).

b. Bradyarrhythmias

- Give *atropine 10 micrograms per kg intravenous bolus and repeat in 5 minutes, if necessary.*

c. Hyperkalaemia (serum potassium >6 mmol per liter)

i. Treatment in adults

- Give *short-acting insulin 10 units intravenous bolus,*

  PLUS, at the same time,

- Give *50 ml of 50% glucose intravenously over 5 minutes.*

ii. Treatment in children

- Give *short-acting insulin 0.1 unit per kg intravenous bolus,*

  PLUS, at the same time,

- Give *50% glucose 2 ml per kg intravenously over 5 minutes.*

NOTE: Serum glucose should be monitored hourly over the next 4 hours. Calcium should not be given to patients with digoxin toxicity. The above treatment for hyperkalaemia may be repeated in 2 hours if necessary. Refer to *Section 7.1* for subsequent management.

5.2.15 Barbiturates (e.g. phenobarbitone)

In overdose, barbiturates can cause severe central nervous system depression with coma, hypoventilation, and hypotension. Patients with significant ingestions will need intensive supportive care. There is no specific antidote.

5.2.16 Theophylline

Theophylline poisoning may occur because of deliberate ingestion of an overdose or due to gradual accumulation of the drug in those taking it for therapeutic reasons. Toxicity affects several organ systems:

- cardiovascular – supraventricular and ventricular tachycardia, atrial fibrillation
- gastrointestinal – nausea, vomiting, and diarrhoea
- neurologic – agitation, confusion, seizures
- metabolic – hypokalaemia, hyperglycaemia.

Seizures may be resistant to treatment with benzodiazepines; intubation and sedation with barbiturates may be required. Hypokalaemia should be treated with intravenous potassium replacement (see *Section 7.2*), while tachyarrhythmias may respond to beta-adrenergic antagonists.

For supraventricular or ventricular tachycardia:

- Give *propranolol 0.5 mg intravenous bolus and repeat every 2 minutes up to a maximum of 10 mg.*

Note: Propranolol is contraindicated in patients with asthma.

5.2.17 Chloroquine

This drug is highly toxic in overdose causing hypotension and cardiac arrhythmias. Treatment involves adrenaline and very large doses of diazepam. Most patients will require intubation and management in an intensive care unit (if available).

- Give *adrenaline 0.25 microgram per kg per minute via intravenous infusion and increase rate by 5 micrograms per minute until systolic blood pressure is greater than 90 mmHg;*

  PLUS

- Give *diazepam 2 mg per kg intravenously over 30 minutes.*

5.2.18 Verapamil

The minimum toxic dose of verapamil in an adult is about one gram. Its main effects are upon the heart where it causes hypotension, bradycardia, and heart block. The specific antidote is calcium. In addition, bradycardia may require treatment with atropine (see *Section 1.3*) and hypotension may require inotropes (see *Section 1.10*).

- Give *5 ml of 10% calcium chloride (equals about 1 gram of elemental calcium) intravenously over 5 minutes.*

Further doses may be required according to response.

5.2.19 Tricyclic antidepressants (e.g. amitriptyline, doxepin, imipramine)

These agents are very dangerous in overdose. The most important toxic effects are on the cardiovascular system (hypotension and ventricular tachycardia) and the central nervous system (coma and seizures). Toxicity is greatly enhanced in the presence of acidosis. Respiratory acidosis due to depressed conscious state may occur and should be promptly treated with intubation and ventilation. Seizures and hypotension may cause metabolic acidosis and also should be promptly treated. All patients should be observed, preferably with cardiac monitoring for at least 24 hours. Patients who exhibit no signs of toxicity at that time (including sinus tachycardia or QRS widening > 0.12 seconds) can be discharged safely.

a. Seizures

- Give *diazepam 0.1 mg per kg intravenous bolus and repeat in 5 minutes, if necessary.*

NOTE: Phenytoin is not effective in this situation. If seizures persist despite 2 doses of diazepam then the patient requires intubation and sedation with barbiturates.

b. Hypotension

- If venous venous pressure is not increased, give *0.9% saline boluses of 100 ml intravenously until a systolic blood pressure is* $\geq$ *90 mm Hg.*

NOTE: If hypotension persists despite the above measures then inotropes may be necessary (see *Section 1.10*).

c. Ventricular tachycardia

- Give *lignocaine 1 mg per kg intravenous bolus.*

NOTE: If ventricular arrhythmias persist or the patient becomes unstable then treat with synchronized cardioversion (see *Section 2.5.1*).

5.2.20 Phenothiazines (e.g. chlorpromazine, haloperidol, promethazine, fluphenazine, thioridazine, trifluoperazine)

Drugs in this class cause sedation, hypotension and occasionally torsade de pointes (see *Section 2.5.1*) in overdose. Anticholinergic symptoms such as dry mouth, sinus tachycardia, and urinary retention may occur especially with chlorpromazine and thioridazine. Complications of therapeutic doses include oculogyric crisis (see *Section 4.3*). Treatment is mainly supportive.

5.2.21 Lithium

Acute lithium overdose mainly affects the gastrointestinal system (nausea, vomiting, and diarrhoea) and the central nervous system (tremor, hyperreflexia, ataxia, confusion, seizures, and coma). Treatment is supportive and includes hydration with adequate amounts of 0.9% saline intravenously to maintain a good diuresis and enhance lithium excretion.

5.2.22 Ciguatera poisoning

This syndrome is caused by ingestion of certain reef fish (especially red bass or *damu*). It is characterised by nausea, vomiting, and dysthesias (especially abnormal temperature perception when placing the hands in water). Other symptoms include headache, myalgia, diarrhoea, tremor, itching, and sweating. On examination, patients often have a mild sinus bradycardia. Severity varies greatly. Treat dehydration as described in *Section 7.5*.

NOTE: Patients may present with ECG changes that may mimic ischaemic heart disease. For bradycardia and vomiting:

- Give *atropine 10 micrograms per kg intravenously or intramuscularly to a maximum of 1.2 mg.*

If symptoms have been present for less than 24 hours then mannitol is often useful. Patients must be adequately rehydrated with 0.9% saline prior to administration of mannitol.

- ❖ Give *20% mannitol 1gram per kg (200 ml) intravenously over 30 minutes.*
- ❖ Consider *promethazine 25mg intramuscularly or 20 mg orally* for symptomatic treatment.

5.2.23 Paraquat poisoning (e.g. Gramaxone)

Paraquat poisoning is extremely serious and even a few milliliters of concentrated paraquat can be fatal. Rapid treatment is essential within 4 hours and certainly no longer than 12 hours. However, treatment must not be withheld because a longer period has elapsed. All cases should be admitted for close clinical and biochemical monitoring.

Steps:

- Give stomach washout.
- Give *120 grams Fuller's earth* (2 × 60 gram containers) mixed with 800 ml of water orally or by gastric tube (within 4 hours of ingestion, if possible). If Fuller's earth is not available, activated charcoal may be used.
- Following this, give as a purgative 200 ml (for an adult) of *20% mannitol orally or via a nasogastric tube*.
- Repeat administration of Fuller's earth and mannitol until the stools are seen to contain Fuller's earth. This may take between 4 to 6 hours after the administration of the purgative.
- Close clinical and biochemical monitoring is necessary.
- Delay the use of oxygen (at least 48 hours) as it enhances the toxicity of paraquat.

- General supportive measures may include:
    - Use of antibiotics for aspiration pneumonia
    - Care of mouth and throat ulcers.

5.3 Poisons Information

You may contact:

New Zealand National Poisons Centre
Office 9am-5pm weekdays: Tel 643 479 7248
24 hour emergency: Tel 643 474 7000
Fax: 643 477 0509
E-mail: poisons@otago.ac.nz

Address: **National Poisons Centre**
Department of Preventive and Social Medicine
University of Otago
PO Box 913
Dunedin
NEW ZEALAND

6 Endocrine Emergencies

6.1 Diabetic Ketoacidosis

Diabetic ketoacidosis (DKA) is a life-threatening complication occurring mostly in patients suffering from type 1 diabetes mellitus. DKA usually occurs in the setting of an intercurrent infective illness, or of missed insulin doses, and is characterised by hyperglycaemia, ketosis, and acidosis. DKA can be the first presentation of an undiagnosed type 1 diabetes mellitus.

6.2.1 Management

Management should be undertaken urgently in the nearest health care facility.

a. Airway and breathing

All patients should be given oxygen via a face mask. In patients who are drowsy and are vomiting, insertion of a nasogastric tube is recommended to limit regurgitation and aspiration.

b. Intravenous fluids

Moderate to severe dehydration is always present in DKA. Initially fluid resuscitation should be with large volumes of normal saline. When the blood glucose falls to $\leq$12 mmol per liter, then the fluid should be changed to 5% dextrose or dextrose saline.

In adults, administer an intravenous infusion of normal saline as follows:

One liter for 30 minutes,
One liter for one hour,
One liter for 2 hours,
One liter for 4 hours.

Further infusion should be administered according to clinical assessment of the patient. In children, a paediatrician should be consulted and appropriate fluid management should be administered.

c. Insulin

- *Intravenous bolus dose of 10 units short-acting insulin* THEN *followed by short-acting insulin intravenously 4 units per hour either by direct intravenous administration or by using an infusion pump.*

If infusion pumps are not available, use the microset intravenous giving set used in paediatrics to achieve the required infusion rate.

If venous access cannot be established, give:

- *Short-acting insulin intramuscularly 8 units per hour.*

  Blood sugar should be measured every hour and insulin doses adjusted[1]. Insulin doses can be halved when the blood glucose reaches ≤12 mmol per liter. Thereafter, insulin can be changed to multiple-dose ("QID") insulin regimen subcutaneously followed by twice-daily dosing.

d. Electrolytes

i. Potassium

Insulin drives glucose and potassium into the cells and their respective serum concentrations fall. If serum potassium is not elevated, a safe and cautious approach is to initiate supplementary intravenous potassium at a rate of no more than 10 to 20 mmol per hour once insulin and fluids have been started, and when **renal function and urinary output** have been assessed as satisfactory.

[1] For adjustment of doses of insulin infusion, refer to the Appendix.

Measure serum potassium along with serum sodium every 4 to 6 hours.

ii. Bicarbonate

Sodium bicarbonate should not be given routinely. It is only considered when the blood pH is less than 7.0. In such cases, *infuse 50 mmol of sodium bicarbonate over one hour*.

e. Treatment of underlying cause

Treat the underlying cause especially infection.

f. Other measures

An indwelling catheter should be inserted to monitor urine output. Other measures that may be required are: oxygen therapy and insertion of nasogastric tube if paralytic ileus develops.

On recovery, every patient with DKA should be re-educated about avoidance of the complication and the recognition of early warning signs and symptoms.

6.2.2 Special considerations in children (but always contact a paediatrician)

Rehydration is critical. The degree of dehydration should be assessed as follows:

Mild (3% or less) – just clinically detectable.
Moderate (around 6%) – easily, reduced skin turgor, poor capillary return.
Severe (10%) – poor perfusion, rapid pulse, reduced blood pressure.

Normal saline is the recommended intravenous fluid for rehydration.

Deficits should be replaced gradually (over 24 to 48 hours) and **not with rapid infusion** as is appropriate for adults. Tables to guide the rate of fluid replacement according to body weight and degree of dehydration are available at pediatric units of respective divisional hospitals.

6.2 Hyperosmolar, Hyperglycaemic State

This is a relatively uncommon event usually occurring as a dramatic presenting feature or as a complication of type 2 diabetes mellitus.

It presents with a history of thirst, polyuria, and progressive impairment of consciousness commonly in a patient who is 60 years or older. It differs from DKA in that patients in

hyperosmolar, hyperglycaemic state do not develop ketoacidosis.

Investigations reveal very high blood glucose (usually higher than 30 mmol per liter) the serum sodium is often elevated, and the calculated serum osmolality >320 mOsm per liter[2].

The treatment is similar to that in DKA (see *Section 6.1* above).

Intravenous isotonic saline, low dose intravenous insulin (4 to 6 units per hour by infusion), and careful attention to serum potassium concentrations are the central strategies. Careful monitoring is required as in DKA.

On recovery, the patient may not need long-term insulin therapy. After an initial period of stabilisation with insulin, most patients with type 2 diabetes mellitus who present in a hyperosmolor, hyperglycaemic state can be controlled with oral hypoglycaemic drugs combined with diet.

6.3 Adrenal Insufficiency

Adrenal insufficiency is most often due to sudden cessation of long-term corticosteroid treatment (≥10 mg prednisolone or prednisone daily generally for more than 2 weeks). Other

[2] Serum osmolality = 2 (Na + K) + urea (mmol per liter) + blood sugar (mmol per liter).

causes include Addison's disease, adrenal tumours, and meningococcal septicaemia. Clinical features are non-specific and include anorexia, nausea, vomiting, lethargy, and postural hypotension. Blood chemistry usually reveals **hyperkalaemia, hyponatraemia,** and an elevated urea level. Hypoglycaemia commonly occurs.

6.3.1 Treatment in adults

a. Intravenous fluids

Use normal saline to correct hyponatraemia and dehydration.

- Give *0.9% saline 1,000 ml intravenously over 1 hour,*

  THEN

- Give *0.9% saline 1,000 ml intravenously over 2 hours,*

  THEN

- Give *0.9% saline 1,000 ml intravenously over 4 hours and repeat as necessary.*

b. Corticosteroids

- Give *hydrocortisone 200 mg intravenous bolus then give 100 mg intravenously 6- hourly.*

6.3.2 Treatment in children

a. Intravenous fluids

Use normal saline to correct hyponatraemia and dehydration.

- Give *0.9% saline 20 ml per kg intravenously over 1 hour,*

  THEN

- Give *0.9% saline intravenously at the rate necessary to correct the estimated fluid deficit plus maintenance requirements over the next 24 hours.*

b. Corticosteroids

- Give *hydrocortisone 3 mg per kg intravenous bolus then 1 mg per kg 6- hourly.*

If the patient is usually taking steroids, and the usual dose is known, give 4 times the dose the patient is usually taking.

NOTE: See *Section 7.5* for calculation of paediatric fluid deficits. Treat hypoglycaemia as described in *Section 6.4* below.

6.4 Hypoglycaemia

Patients should be treated urgently.

If the patient is conscious and able to swallow, give a sugary food or drink, followed by foods that are absorbed longer, e.g. crackers.

If the patient is unable to swallow or unconscious at home, give sugar paste or honey into the mouth, and transfer immediately to the nearest health care facility for intravenous glucose therapy. At the health care facility, if the patient is unconscious or unable to swallow:

- *Give 30 to 50 ml dextrose 50% intravenously followed by continuous intravenous infusion of 5% dextrose for up to 24 hours.*

Hypoglycaemia in the elderly, particularly as a consequence of accumulation of sulphonylurea in the plasma, may be difficult to reverse and may re-occur for several days after stopping the drug.

NOTE: Oral hypoglycaemics have long half-lives particularly in renal failure (e.g. 12 hours for glibenclamide), so relapse of hypoglycaemia may occur if these drugs have been taken in overdose. Admission for observation may be needed. Although the sympathetic signs of hypoglycaemia resolve within minutes of the administration of glucose, the neuroglycopenic features may take up to 30 minutes to resolve completely. Glucagon will not reverse hypoglycaemia if the hepatic glycogen stores are exhausted (e.g. starvation, alcoholism).

6.5 Thyroid Storm

Thyroid storm is diagnosed by the presence of prominent signs of hyperthyroidism plus fever and central nervous system dysfunction (confusion, coma, seizures). It is a rare medical emergency requiring prompt intensive treatment.

6.5.1 Airway and breathing

Give high flow oxygen via a face mask. Unconscious patients may need intubation.

6.5.2 Intravenous fluids

Obtain intravenous access. Dehydrated or shocked patients should be resuscitated with 0.9% saline.

6.5.3 Beta-adrenergic antagonists

These drugs antagonise the peripheral effects of thyroid hormone. Cardiac monitoring is desirable.

- Give *propranolol 0.5 mg intravenous bolus every 2 minutes to a maximum of 10 mg using control of tachycardia (pulse <100 beats per minute) as an endpoint.*

6.5.4 Antithyroid drugs

- Give *carbimazole 100 mg via nasogastric tube then 20 mg*

8- hourly thereafter.

6.6 Myxedema Coma (Hypothyroid Crisis)

Hypothyroid crisis occurs in patients with long standing hypothyroidism who are exposed to an extra physiological stress that causes decompensation. The stress is usually an intercurrent illness such as pneumonia or stroke. Treatment should be directed at the underlying cause of the decompensation as well as by hypothyroidism itself. This condition has a very high mortality. Clinically these patients have signs and symptoms of longstanding hypothyroidism plus hypotension, hypothermia, confusion, coma, and seizures. Biochemical abnormalities include hyponatraemia and hypoglycaemia.

6.6.1 Airway and breathing

Oxygen should be supplied via a face mask. Intubation and ventilation will be required for comatose patients.

6.6.2 Intravenous fluids

Despite their oedematous appearance, most patients have intravascular fluid depletion. This should be corrected by careful administration of 0.9% saline intravenously. Monitoring of central venous pressure and urine output is desirable.

6.6.3 Corticosteroids

Most patients have a co-existing adrenal insufficiency.

- Give *hydrocortisone 200 mg intravenously stat then 100 mg intravenously 6-hourly thereafter.*

Corticosteroids should be given before the administration of thyroid hormone.

6.6.4 Thyroid hormone

Replacement of thyroid hormone is the definitive treatment for hypothyroidism but it should be done slowly over several days.

- Give *thyroxine 10 micrograms per kg via nasogastric tube as a single dose then 100 micrograms per day.*

NOTE: The dose should be reduced in patients suffering from ischemic heart disease.

6.7 Phaeochromocytoma

Phaeochromocytoma is a catecholamine-producing tumour usually located in the adrenal glands. These tumours cause paroxysmal swings in the blood pressure along with sweating, palpitations, and headache. Definitive treatment is surgical excision of the tumour but in the emergency situation control of the blood pressure is important.

- Give *labetalol 0.2 mg per kg intravenously and repeat every 10 minutes.*

7 Fluid and Electrolyte Emergencies

7.1 Hyperkalaemia

The organ principally affected by hyperkalaemia is the heart and this can lead to heart block, bradycardia, ventricular fibrillation, and asystole. In all cases the cause of the hyperkalaemia should be established and corrected if possible. The treatments below are mostly temporary measures to lower the serum potassium level. A 12-lead ECG and monitoring is desirable, as ECG changes, if present, indicate that emergency treatment is needed. In general, the higher the potassium level, the more urgent it should be lowered.

7.1.1 Mild hyperkalaemia (serum potassium <6.0 mmol per liter)

This is best treated with diuresis and administration of an ion-exchange resin. Give fluids and frusemide as required to promote urine flow. This may not initially be possible in patients with acute oliguric renal failure. If indicated:

- Give *polystyrene sulphonate resins (Resonium A) 1 gram per kg (to a maximum of 30 grams) orally or rectally diluted in 50 to 100 ml of water.*

7.1.2 Moderate to severe hyperkalaemia (serum potassium >6.0 mmol per liter)

Treat as for mild hyperkalaemia. In addition, consider giving insulin-dextrose and/or sodium bicarbonate.

a. Treatment in adults

- Give *short-acting insulin 10 units intravenous bolus,*

  PLUS

- Give *50 ml of 50% dextrose or glucose intravenously over 5 minutes.*

For persistent hyperkalemia, consider giving*:*

- *Sodium bicarbonate 8.4%, 100 mmol, intravenously over 5 minutes.*

For intractable hyperkalaemia attributable to acute renal failure, consider peritoneal dialysis.

b. Treatment in children

- Give *neutral or short-acting insulin 0.1 units per kg intravenous bolus;*

  PLUS, at the same time,

- Give *50% dextrose or glucose 2 ml per kg intravenously over 5 minutes;*

  PLUS

- Give *sodium bicarbonate 1 mmol per kg intravenously over 5 minutes.*

NOTE: Serum glucose should be monitored hourly over the next 4 hours. The above treatment for hyperkalaemia may be repeated in 2 hours if necessary.

If hyperkalemia is accompanied with cardiac arrhythmias, give:

- *10% calcium chloride, 0.2 ml per kg (to a maximum of 10 ml) intravenously over 5 minutes.*

Calcium should not be given to patients with digoxin toxicity.

7.2 Hypokalaemia

Hypokalaemia can cause muscle weakness and cardiac arrhythmias. Patients with pre-existing cardiac disease (especially ischaemic heart disease and those on digoxin therapy) may be at increased risk of cardiac arrhythmias caused by hypokalaemia.

For mild deficiencies, oral potassium replacement is sufficient. One 600-mg tablet of potassium chloride contains about 8

mmol of potassium. As a general guide, if the serum potassium is >3.0 mmol per liter and the patient is asymptomatic, give oral potassium chloride. If the serum potassium is 2.5 to 3.0 mmol per liter, oral potassium chloride may be sufficient. But if hypokalaemia is acute in onset and/or the patient has significant heart disease, intravenous potassium chloride should be considered. If the serum potassium is <2.5 mmol per liter, intravenous potassium chloride is usually administered.

Intravenous potassium is irritant to veins and may cause cardiac arrhythmias if administered too quickly. The concentration should be no greater than 40 mmol per liter and it should be given not faster than 0.25 mmol per kg per hour (not more than 20 mmol per hr). If intravenous potassium chloride is to be administered, it should be given as follows:

- *Give potassium chloride 0.25 mmol per kg at least one hour and repeat as necessary. Dilute in 0.9% saline or 5% dextrose so that the concentration of potassium does not exceed 40 mmol per liter.*

7.3 Hypercalcaemia

Hypercalcaemia can cause nausea, vomiting, lethargy, confusion, coma, and cardiac arrhythmias (usually heart block). There are a variety of causes most commonly primary hyperparathyroidism and malignancy. Initial treatment is with intravenous rehydration and frusemide. The aim should be to produce a daily urine volume of about 6 liters in an adult.

Close monitoring of fluid status is important especially in elderly patients to avoid over or underhydration.

Treatment of hypercalcaemia should be based on the ionized calcium rather than the total calcium level. The normal total serum calcium level is 2.1 to 2.6 mmol per liter but the ionized fraction will vary with blood pH and serum albumin levels. Calcium levels should be corrected to account for changes in albumin level. The corrected calcium = patient's serum calcium value + [(40 – serum albumin) x 0.02].

- Give *0.9% saline 15 ml per kg intravenously every 4 hours,*

  PLUS

- Give *frusemide 0.5 mg per kg intravenously every 4 hours.*

NOTE: Adjustment of the frusemide dose may be necessary to avoid dehydration or fluid overload.

7.4 Hypocalcaemia

Hypocalcaemia may cause confusion, seizures, neuromuscular irritability, cardiac failure, heart block, and ventricular fibrillation. Symptoms generally do not appear until the serum calcium is less than 2.0 mmol per liter. For acute treatment:

- Give *10% calcium chloride 0.1 ml per kg (to a maximum*

of 5 ml) intravenously over 5 minutes and repeat in 30 minutes if necessary;

PLUS, if symptoms fail to resolve,

❖ Give *magnesium sulphate 0.1 mmol per kg intravenously over 5 minutes.*

7.5 Fluid resuscitation

The basic principles of fluid resuscitation are:

- Accurate assessment of fluid deficits.
- Replacement with a fluid that approximates the composition of the fluid that was lost.
- Continuous reassessment of hydration status.

7.5.1 Assessing fluid deficits

Estimation of a fluid deficit is mainly via clinical assessment. Measurement of the blood urea may also be useful but elevation is usually delayed and only occurs with moderate to severe dehydration. Signs of dehydration include reduced tissue turgor, dry skin and mucous membranes, tachycardia, postural hypotension, low JVP, mild fever, and reduced urine output. Hypotension and acidosis are late signs and signal the development of hypovolaemic shock.

7.5.2 Selection of replacement fluid

The basic principle is to replace the deficit with a similar fluid. In most cases, the fluid lost is similar to the extracellular fluid, containing mainly sodium and chloride. Potassium losses vary. Sometimes fluid with a low sodium content is lost causing a hypernatraemic dehydration. On other occasions sodium, rich fluids are lost causing a hyponatraemic dehydration.

No matter what fluid has been lost, the initial treatment for severe dehydration is administration of normal saline. After initial resuscitation, subsequent fluid therapy should be based on measured levels of plasma sodium and potassium.

7.5.3 Reassessment

Ongoing reassessment is necessary, particularly of urine output. The best sign of adequate hydration is a urine output exceeding 0.5 ml per kg per hour.

7.5.4 Hypovolaemic shock

- Give *0.9% saline 10 ml per kg intravenous bolus and repeat if necessary.*

Consider the use of *plasma expanding solution such as Haemaccel or Gelofusine.*

7.5.5 Maintenance requirements each 24 hours

These maintenance requirements are averages only. The actual fluid requirements will vary from patient to patient and with factors such as the presence or absence of fever, and ongoing losses.

a. Adults

Water - 40 ml per kg
Sodium - 2 mmol per kg
Potassium - 2 mmol per kg

b. Children

Water - 100 ml per kg for the first 10 kg of body body weight then, 50 ml per kg for the next 10 kg of body weight then, 20 ml per kg thereafter
Sodium - 2 to 3 mmol per kg
Potassium - 2 mmol per kg

8 Miscellaneous Emergencies

8.1 Anaphylaxis

Allergic reactions may be triggered by a variety of factors including drugs (e.g. penicillin), foods (e.g. shellfish), insect stings, and chemicals. There is a wide spectrum of severity ranging from a harmless skin rash (urticaria), to potentially fatal airway obstruction (laryngeal oedema), and full-blown anaphylaxis (hypotension, bronchospasm). Anaphylaxis is much more common in adults than children.

The mainstays of treatment are oxygen, adrenaline, and intravenous fluid. Steroids may prevent relapse and antihistamines provide some relief of urticarial itch but these drugs do nothing for the life-threatening features of acute severe anaphylaxis.

8.1.1 Treatment in adults

a. Airway and breathing

Administer high flow oxygen via face mask. Administer a bronchodilator.

❖ Give *salbutamol 5 mg via nebulizer, repeat if required.*

b. Adrenaline

If severe (hypotension or severe bronchospasm or stridor or hypoxia):

❖ Give *adrenaline 0.5 mg (0.5 ml of 1:1,000 dilution) intramuscularly and repeat in 5 minutes if required.*

c. Intravenous fluids

❖ Give *0.9% saline 250 ml intravenous bolus and repeat, if necessary.*

NOTE: Large volumes of intravenous fluid may be necessary to maintain an adequate blood pressure in severe anaphylaxis.

d. Corticosteroids

❖ Give *hydrocortisone succinate 200 mg intravenously, THEN 100 mg 6- hourly,*

OR

❖ Give *prednisolone 50 mg orally daily.*

NOTE: All patients with significant anaphylaxis should be observed for 24 hours as relapse may occur.

e. Anti-histamines

❖ Give *promethazine 25 mg intramuscularly followed by either 25 mg intramuscularly or 20 mg orally three times daily.*

f. Other issues

- Proper documentation of all cases.
- Patient and relatives should be educated to avoid subsequent episodes.
- Patient may be provided with a medic alert bracelet.
- Some patients may require adrenaline syringes for home use.

8.1.2 Treatment in children

a. Airway and breathing

Administer high flow oxygen via a face mask. Bronchodilators reduce bronchospasm.

❖ Give *salbutamol 2.5 mg via nebulizer in children 5 years of age or under; for children older than 5 years, give salbutamol 5 mg via nebulizer; repeat if required.*

b. Adrenaline

❖ Give *adrenaline 10 micrograms per kg mg intravenously*

over 1 minute and repeat in 5 minutes if required.

NOTE: If intravenous access is not available then adrenaline may be given via the intramuscular route.

❖ Give *adrenaline 10 micrograms per kg intramuscularly.*

c. Intravenous fluids

❖ Give *0.9% saline 10 ml per kg bolus intravenously and repeat as necessary.*

d. Corticosteroids

❖ Give *hydrocortisone succinate 4 mg per kg intravenously,*

OR

❖ Give *prednisolone 1 mg per kg orally.*

NOTE: All patients with significant anaphylaxis should be observed for 24 hours as relapse may occur.

e. Anti-histamines

❖ *Consider the use of promethazine.*

f. Other issues

- Proper documentation of all cases.
- Patient and relatives should be educated to avoid subsequent episodes.
- Patient may be provided with a medic alert bracelet.
- Some patients may require adrenaline syringes for home use.

8.2 Pre-eclampsia

8.2.1 Treatment of severe pre-eclampsia

a. Airway and breathing

Give high flow oxygen via a face mask and obtain intravenous access.

b. Hypertension

Mild elevations in blood pressure often respond to magnesium sulphate. If the blood pressure remains high, then it should be gently lowered over several hours to a level of 140/90 mmHg.

❖ Give *hydrallazine 5 mg intravenously and repeat every 20 minutes to a maximum of 40 mg.*

c. Seizures

i. Seizure prevention

Magnesium sulphate reduces the blood pressure and helps prevent seizures.

- Give *magnesium sulphate 4 grams intravenously over 10 minutes then commence an infusion at a rate of 2 grams per hour.*

NOTE: It is important to monitor magnesium levels during treatment. Clinically, hypermagnaesaemia causes loss of deep tendon reflexes and a reduction in the respiratory rate. If the patient becomes hyporeflexic or the respiratory rate falls below 8 per minute, then the infusion should be ceased temporarily. If biochemical estimation of the serum magnesium level is available, then this should be measured frequently, aiming for a level of between 2 and 4 mmol per liter. Magnesium is superior to phenytoin, which was previously used for seizure prophylaxis.

ii. Seizure management

If seizures occur despite administration of magnesium sulphate then conventional anticonvulsants should be used.

- Give *diazepam 5 mg intravenous bolus and repeat every 5 minutes to a maximum of 20 mg;*

  PLUS, if seizures persist,

- Give *phenytoin 15 mg per kg intravenously over 20 minutes.*

NOTE: If seizures persist despite adequate levels of magnesium sulphate and phenytoin then the patient will require intubation and ventilation and the administration of a thiopentone infusion.

d. Fluid balance

Insertion of a urinary catheter to monitor urine output is essential. A central venous catheter may also be useful. Careful administration of crystalloid solutions is necessary to maintain urine output while avoiding pulmonary and cerebral oedema associated with over-hydration.

8.3 Septic Shock

Septic shock is a serious complication of bacterial septicaemia. Hypotension in this condition is a result of a combination of abnormal vasodilation, hypovolaemia, and impaired cardiac function. **It has a very high mortality and requires intensive treatment, preferably in an intensive care unit.** The most

important aspect of management of septic shock is of course treatment of the infection with antibiotics. Other supportive therapy may include treatment of gastrointestinal haemorrhage, renal failure, and disseminated intravascular coagulation (DIC).

8.3.1 Maintain airway and breathing

The usual manoeuvres to maintain an adequate airway and adequate ventilation, up to and including endotracheal intubation should be used. All patients should at least receive high flow oxygen via face mask.

- ❖ Give oxygen to maintain an arterial oxygen saturation greater than 95%.

8.3.2 Optimise intravascular volume

Vigorous administration of intravenous fluid is generally required. Insertion of a central venous line is useful as it allows accurate measurement of central venous filling pressures and also makes administration of inotropic agents safer. Where central venous pressure monitoring is unavailable, the JVP provides an alternative indicator of volume status to guide fluid resuscitation. Correct anaemia with administration of blood or otherwise use boluses of normal saline to achieve an optimal central venous pressure.

- ❖ Give *0.9% saline boluses of 100 ml intravenously to obtain an optimal central venous filling pressure.*

8.3.3 Inotropic agents

Inotropic agents should only be used if significant hypotension persists despite adequate fluid replacement.

a. Treatment in adults

- Give *dopamine 2 micrograms per kg per minute by intravenous infusion and increase rate by 1 to 2 micrograms per kg per minute every 5 minutes to a maximum of 20 micrograms per kg per minute.*

b. Treatment in children

- Give *dopamine 2 micrograms per kg per minute by intravenous infusion and increase rate by 1 microgram per kg minute every 5 minutes to a maximum of 20 micrograms per kg per minute.*

NOTE: Ideally, inotropic agents should be infused via a central venous line. Otherwise a large peripheral vein (such as the femoral vein or the cubital veins) should be used.

8.4 Acute Psychosis

The acutely confused and agitated patient can present a diagnostic and management problem. Often a combination of temporary sedation and gentle physical restraint is necessary to allow the patient to be examined and assessed. However, it is

essential that the underlying cause of the confusion is found and treated. Sedation is not a treatment in itself.

Important and treatable causes of confusion include hypoxia, hypercapnia, drug overdoses, head injuries, infections, hyponatraemia, and many other medical problems. Sedated patients should be closely observed.

- Give *haloperidol 2.5 to 5 mg intramuscularly or intravenously and repeat in 10 minutes, if necessary;*

  OR

- Give *diazepam 5 to 10mg intravenously and repeat 30 minutes later, if required;*

  OR

- Give *midazolam 2.5 to 5 mg intramuscularly or intravenously and repeat in 5 minutes, if necessary.*

NOTE: Use the lower doses in the elderly or those with body weights less than 50 kg.

Appendix

1. Amiodarone Infusion

Formulation: 50 mg per ml ampoule

Preparation: Loading dose – Mix calculated loading dose of amiodarone (5 mg per kg) in 250 ml of dextrose 5%. Infuse for 1 to 2 hours (125 to 250 ml per hour).

Maintenance dose – Mix calculated maintenance dose of amiodarone (10 to 15 mg per kg) in 500 ml of dextrose 5%. Infuse for 24 hours (20 ml per hour).

Note: Amiodarone is incompatible with normal saline solution.

2. Lignocaine 1% Infusion

Formulation: 1% solution (10 mg per ml) vial

Preparation: Discard 400 ml from 1 liter of dextrose 5% and add 4 grams (400 ml or 40 vials of lignocaine 1%; concentration of 4 mg of lignocaine 1% per ml).

Infusion:

Time	Rate (ml per hour)	Dose (mg per hour)
First hour	60	4
Second hour	45	3
After second hour for 24 hours	30	2

3. Lignocaine 2% Infusion

Formulation: 2% solution (20 mg per ml) vial

Preparation: Discard 200 ml from 1 liter of dextrose 5% and add 2 grams (200 ml or 20 vials) of lignocaine 2%; concentration of 4 mg of lignocaine per ml).

Infusion:

Time	Rate (ml per hour)	Dose (mg per hour)
First hour	60	4
Second hour	45	3
After second hour for 24 hours	30	2

4. Hydrallazine Infusion

Formulation: 20 mg per ampoule

Preparation: Reconstitute 20 mg ampoule by adding 2 ml of sterile water (concentration: 10 mg of hydrallazine per ml). Add hydrallazine solution above to 98 ml of normal saline in a metered chamber (concentration: 1 mg of hyrallazine per ml).

Infusion: Infuse initially at 0.2 to 0.3 mg per minute (12 to 18 ml per hour).

Maintenance dose: 0.05 to 0.15 mg per minute (3 to 9 ml per hour).

5. Labetalol Infusion

Formulation: 100 mg per 20 ml (5 mg per ml)

Preparation: Add 100 mg (20 ml) of labetalol in 80 ml of dextrose 5% in a metered chamber (concentration: 1 mg of labetalol per ml).

Infusion: Recommended dose – 0.5 to 2.0 mg per minute.

Infusion rate – 30 ml per hour (0.5 mg per

minute) initially then titrate at diastolic blood pressure of 110 mm Hg is achieved to a maximum dose of 120 ml per hour (2 mg per minute).

6. Dobutamine Infusion

Formulation: 1 vial contains 250 mg of dobutamine in powder form

Preparation: Add 10 mg of sterile water to the 250 mg vial of dobutamine. Add the dobutamine solution to 90 ml of normal saline or dextrose 5% in a metered chamber (concentration: 2.5 mg of dobutamine per ml or 2,500 micrograms of dobutamine per ml).

Infusion: 2.5 to 10 micrograms per kg per minute. For example: In a 60 to 70 kg patient, the rate of the dobutamine infusion will be 4 to 20 ml per hour.

7. Dopamine Infusion

Formulation: 1 vial contains 200 mg per 5 ml of dopamine

Preparation: Add 200 mg of dopamine in 95 ml of normal saline or dextrose 5% in a metered chamber. After reconstitution, the concentration of

dopamine in the chamber will be 200 micrograms per ml (1 ml = 60 microdrops or 33 micrograms per microdrop).

Infusion: To achieve enhanced renal perfusion – 2 to 5 micrograms per kg per minute (120-300 micrograms per minute). For antihypotensive effect – 5 to 50 micrograms per kg per minute (300 to 3,000 micrograms per minute). For example, the infusion rate in a 60 kg patient will be 4 to 10 microdrops per minute (4 to 20 ml per hour) for renal perfusion dose and 10 to 100 ml per hour for antihypotensive effect.

8. Streptokinase Infusion

Formulation: 1 vial contains 1.5 million units (megaunits) of streptokinase

Preparation: Add 2 ml of normal saline to the vial containing 1.5 megaunits of streptokinase. Mix the streptokinase solution to 98 ml of normal saline in a metered chamber.

Infusion: 100 ml per hour

9. Isoprenaline Infusion

Formulation: 2 mg per ampoule (1 mg per ml)

Preparation: Add 2 mg (1 ampoule) of isoprenaline to 99 ml of normal saline or dextrose 5% in a metered chamber (concentration: 0.02 mg of isoprenaline per ml or 20 micrograms of isoprenaline per ml).

Infusion: Initially at 3 ml per hour (1 microgram per minute) then titrate accordingly based on response of heart rate, blood pressure, urine output, central venous pressure, and peripheral circulation up to a maximum of 60 ml per hour (20 micrograms per minute).

10. Magnesium sulphate

Formulation: 50%, 2 ml (1 gram) ampoule; 10 ml (5 grams) ampoule

Preparation: Loading dose – Magnesium sulphate 50%, 4 grams (8 ml) diluted in 100 ml of dextrose 5%.

Maintenance dose – Magnesium sulphate 50% (25 ml) in 100 ml dextrose 5%.

Infusion: Loading dose – Use infusion pump and run at 300 ml per hour and set total volume at 108 ml.

Maintenance dose – Infuse at 1 gram per hour. Set infusion pump to run at 10 ml per hour and set total volume at 125 ml.