

## THE EMERGENCY MANAGEMENT OF POISONING

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### Introduction

Drug overdose and poisoning is a common reason for presentation to emergency departments, accounting for 3-5% of attendances and causes over 2000 deaths a year in the UK. Drug overdose is the most frequent presentation of deliberate self-harm and this may complicate management. However most patients are young, otherwise medically well and managed appropriately the vast majority should recover fully.

This article aims to discuss the general principles behind the management of poisoning and then to review the specific treatment of the more common overdoses.

### General Principles

Many drugs in overdose (e.g. opiates, tricyclics, benzodiazepines) can cause significant depression of cerebral and cardio-respiratory function and emergency management should always start with a rapid **initial assessment** and **resuscitation** of the airway, breathing and circulation. Then, careful **history** and **examination** will in most cases give an indication as to the likely severity of the overdose and guide subsequent management. Treatment principles include strategies to reduce absorption, increase elimination, general supportive measures and where available, the use of specific antidotes to reduce toxicity. It is strongly recommended that, in cases where doubt exists regarding the degree of risk, or appropriate management, the Poisons Information Service be contacted. In the UK, they can be reached by dialing 0870 600 6266, 24 hours a day, or information may be obtained via their website [www.spib.axl.co.uk](http://www.spib.axl.co.uk)

**History.** A detailed and reliable account of the drug or drugs taken should be sought; This should include the drug name, amount, preparation type, time of ingestion and the co-ingestion use of other substances such as alcohol or recreational drugs which might influence the patients clinical state or drug clearance. The presence of vomiting of tablets soon after overdose should be noted but does not preclude significant toxicity.

The medical, social, psychiatric and therapeutic drug history will help to identify high-risk patients and guide subsequent management.

The patient may well be uncooperative or unable to give these details and so a collateral and confirmatory history should be acquired from available sources (e.g. drug packets, ambulance crew, witnesses, suicide note, patient records, etc).

**Examination.** The **airway, breathing and circulation** should be reassessed and treated accordingly: Basic airway manoeuvres, simple adjuncts and/or cuffed **endotracheal intubation** may be required if the airway is compromised. The patient's level of consciousness may give an indication as to the toxicity of the overdose, risk to airway and guides the level of supportive care likely to be needed. It can be expressed on the 'AVPU' scale or

as a formal GCS (although not designed for this purpose, it does give a reproducible score which is sensitive to subsequent changes.) A GCS equal or less than 8 (or responding to Pain only) increases the risk of airway compromise and endotracheal intubation is indicated unless rapid recovery is anticipated.

Careful attention should be paid to **respiratory function** particularly with sedative drug toxicity. This should include respiratory rate and tidal volume and the measurement of oxygen saturations using pulse oximetry. A low respiratory rate with decreased oxygen saturations may indicate hypoventilation but note that a normal saturation does not exclude hypercarbia or indeed hypoxia in carbon monoxide poisoning. If in any doubt, arterial blood gases should be measured. Tachypnoea can be seen with metabolic acidosis (tricyclics, methanol), anxiety, and stimulant drug overdose and as an early feature of salicylate poisoning (respiratory alkalosis). Supplementary oxygen via facemask should be given to all patients initially.

Many drugs exhibit **cardiovascular toxicity** in overdose (e.g. tricyclics, b-blockers, digoxin, lithium). This may manifest as hypotension and or cardiac arrhythmias. Pulse, blood pressure and ECG should be recorded, intravenous access established and initial fluid resuscitation given.

General examination may give corroborating evidence of significant ingestions or clues in unknown overdoses. Many drugs (SSRIs, tricyclics, phenothiazines) have serotonergic or anticholinergic effects with pupil dilatation, extra pyramidal movements, whilst opioid type drugs will cause sedation and pin point pupils.

### Further Management

Temperature, blood glucose (low in b-blocker, ethanol poisoning) and weight should also be recorded. Weight is important in calculating whether the patient is likely to have received a toxic dose and guides treatment e.g. in paracetamol overdose.

The examination should reveal any associated injury (accidental or deliberate self harm) or the presence of other substances, e.g. alcohol. Make an appropriate psychiatric examination of the patients mental state.

**Investigations** should be undertaken and may include appropriately timed drug levels when these will aid management e.g. paracetamol or lithium. In all cases of suspected overdose, it is recommended that a paracetamol and salicylate level be taken in addition to baseline biochemistry and haematology, as both of these poisons are associated with a lack of early clinical signs, and have specific therapeutic measures available to treat.

### Treatment

Supportive treatment of the cardio-respiratory and neurological systems should be given by standard Intensive Care methods.

Fitting should be controlled initially with intravenous diazepam (0.1- 0.3 mg/kg) or lorazepam (4mg in an adult, 0.05mg/kg in a child).

Gastric elimination, either by lavage or forced emesis may be useful, especially if the poison has been ingested less than 4 hours previously. In salicylate and tricyclic poisoning, forced gastric emptying may be useful up to 12 hours post ingestion. In the patient with disturbed level of consciousness, aspiration is a serious risk, and therefore in these patients, endotracheal intubation should be considered before emptying is attempted.

Drug absorption can be reduced by the use of activated charcoal, given either orally or nasogastrically. It is particularly useful for poisoning with benzodiazepines, tricyclics, anticonvulsants and antihistamines.

Drug elimination may be hastened by forced diuresis increasing renal clearance (if renal function is normal) or, in some cases, by consideration of dialysis.

### SPECIFIC POISONS

**Alcohol** (Blood concentration of  $>4.5\text{g/L}$  ( $98\text{mmol/L}$ ) is potentially fatal).

**Clinical features** – with increasing blood concentrations, features are progressive from ataxia, dysarthria, and nystagmus, to hypothermia, hypotension, stupor and coma. In severe cases, especially children, convulsions, respiratory depression and acidosis may occur.

**Hazards** – aspiration of vomit, hypoglycaemia (especially in children).

**Treatment** – General supportive

- Alcohol is rapidly absorbed from the gut, and therefore gut decontamination is unlikely to be of benefit.
- Hypoglycaemia should be treated as quickly as possible with oral glucose if the patient is awake, or otherwise intravenous 5% or 10% dextrose.
- If facilities allow, haemodialysis should be considered if blood concentration is greater than  $5\text{g/L}$ , or arterial pH is  $<7.0$ .

**Paracetamol** (Ingestion of as little as  $150\text{mg/kg}$  is potentially fatal).

**Clinical features** – often none. Occasionally nausea and vomiting, which is suggestive of liver damage if it persists beyond 24 hours and associated with right sub-costal tenderness.

**Specific Hazards** – Hepatocellular necrosis and liver failure. Liver damage is maximal 3-4 days after ingestion, and may be associated with hypoglycaemia, haemorrhage, encephalopathy, and death.

**Treatment Guidelines** - (knowledge of time of ingestion is vital).

Treatment with N-acetylcysteine must be started within 8 hours if maximal benefit is to be gained. Patients who regularly consume excessive alcohol, who are on long term carbamazepine, phenytoin, phenobarbitone, rifampicin or St. John's Wort, or who are likely to be glutathione deplete (e.g. HIV infection, eating disorders) are at higher risk of toxicity, and treatment should be started if  $>75\text{mg/kg}$  have been ingested.

### Presentation within 4 hours

- Consider activated charcoal if more than  $150\text{mg/kg}$  has been taken within the previous hour.
- 4 hours after ingestion, take a venous blood sample for plasma paracetamol level, as well as baseline biochemistry and haematology (including INR).
- If the patient is at risk according to the nomogram, start N-acetylcysteine at a rate of  $150\text{mg/kg}$  over 24 hours.
- If the patient is not at risk, no treatment is necessary. If treatment was started within 8 hours of ingestion, the risk of liver or renal damage is minimal.

### Presentation within 4-8 hours

- Gut decontamination is unlikely to be helpful.
- Take blood for plasma paracetamol level, and baseline investigation (as above). Treat with N-acetylcysteine according to the nomogram, and treat in all cases where ingestion has been  $>150\text{mg/kg}$  ( $75\text{mg/kg}$  in the at risk group). If the plasma paracetamol result is likely to be delayed, initiate treatment with N-acetylcysteine at  $150\text{mg/kg}$  over 24 hours, and stop if necessary once the results become available.
- The patient should have their liver function tests (LFTs), INR, creatinine and bicarbonate checked 12 hourly until they return to normal. If they are abnormal, N-acetylcysteine should continue to be given at the above rate until they improve, or if they worsen, specialist advice should be sought.

### Presentation after 8 hours

- Give N-acetylcysteine immediately unless certain that the ingestion has been less than  $150\text{mg/kg}$  ( $75\text{mg/kg}$  in the high risk group). DO NOT wait for the result of the plasma paracetamol level. Patients presenting at this time are at high risk from liver damage, and whilst there is less evidence to support it, it is thought that the administration on N-acetylcysteine may still be beneficial.
- Take blood urgently for paracetamol level, ALT, creatinine, and INR.
- If the risk of liver damage is confirmed, continue administration of N-acetylcysteine, and keep the patient under observation for 3-4 days monitoring biochemistry and INR. Once they return to normal, the infusion may be discontinued. Liver and renal failure, if present, should be managed conventionally, with specialist advice being sought as necessary.
- Metabolic acidosis is a poor prognostic sign.

### Presentation after 24 hours

- Measure plasma creatinine, ALT and INR, and venous acid/base balance/bicarbonate.
- If any of these are abnormal, consider treatment with N-acetylcysteine, and seek expert advice.
- For staggered overdoses, the risk of serious damage is minimal if  $<150\text{mg/kg}$  has been ingested in 24 hours. For all patients who have consumed more than this, consider treatment with N-acetylcysteine.

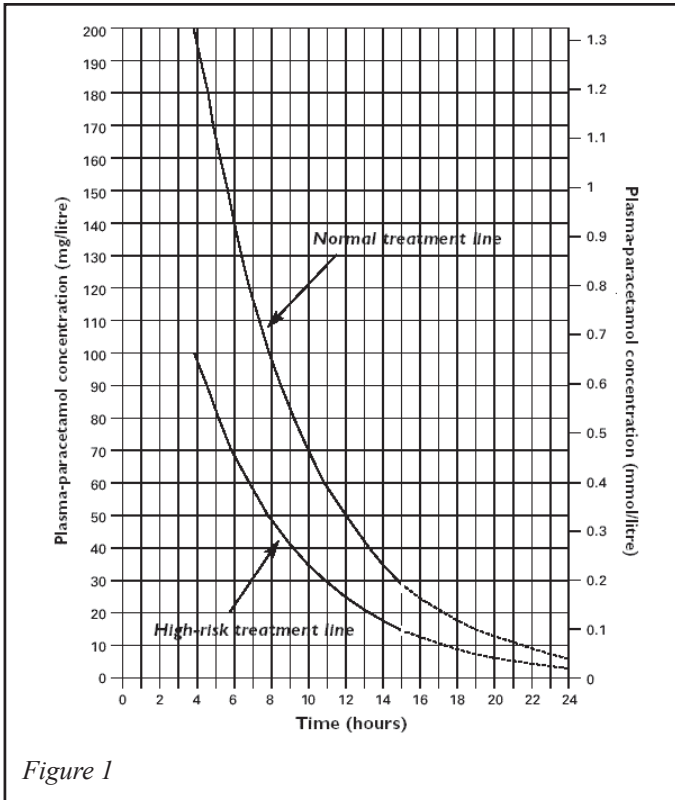


Figure 1

### Tricyclic antidepressants (TCAs)

**Clinical features.** Toxicity is due to anticholinergic effects at autonomic nerve endings, and a quinidine-like effect on the myocardium. Peripheral signs include tachycardia, dry skin, dry mouth and dilated pupils. Central signs include ataxia, nystagmus, fitting, drowsiness and coma. There may also be increased tone and hyperreflexia. ECG features include lengthening of the PR and QRS intervals. Rarely, skin blisters are seen, which should be treated as burns.

**Specific Hazards.** Convulsions, coma and metabolic acidosis which exacerbates myocardial problems.

#### Treatment guidelines

- Activated charcoal (50g) by mouth or nasogastric tube is indicated if the patient presents within 3-4 hours of ingestion.
- Patients who are asymptomatic with normal ECGs at 6 hours are unlikely to develop late problems.
- Arrhythmias should be treated in the first instance by correction of hypoxia and acid/base disturbance.
- Sodium bicarbonate alters the binding of TCAs to the myocardium, and therefore (50mmol) should be given intravenously to an adult with ECG changes or arrhythmias, even in the absence of acidosis.
- Convulsions should be treated with diazepam or lorazepam, NOT phenytoin, as the latter, in common with TCAs, block sodium channels, and hence potentiates cardio-toxicity.
- Consider Glucagon 1mg IV every 3 minutes to treat refractory hypotension and myocardial depression.
- Prolonged resuscitation may be successful after cardiac arrest.

**Salicylates** - (Ingested dose of 500mg/kg is potentially fatal)

**Clinical Features** – vomiting, dehydration, tinnitus, sweating, vasodilation, hyperventilation. Less commonly haematemesis, renal failure, hyperpyrexia. Presence of CNS signs, e.g. confusion, coma, convulsions are commoner in children, but are an indicator of severe poisoning in all.

**Specific Hazards** - in adults, a mixed respiratory alkalosis and metabolic acidosis is usual. In children less than 4 years, a metabolic acidosis is seen, which increases salicylate transfer across the blood-brain barrier.

**Assessment of severity of poisoning** - Plasma concentrations of >350mg/L indicate salicylate intoxication. Most deaths in adults are associated with a level of >700mg/L. Risk factors for death include age (<10 years and >70 years), acidosis, CNS features, late presentation, and pulmonary oedema.

#### Treatment guidelines

- Give activated charcoal if >250mg/kg has been ingested within 1 hour.
- If >120mg/kg has been ingested, do a plasma salicylate level at least 2-4 hours after ingestion. A repeat sample (2 hours later) may be needed in patients with suspected severe poisoning, as there may be continued absorption.
- Arterial blood gas analysis is helpful. If a metabolic acidosis is present, and the serum potassium is normal, give intravenous sodium bicarbonate, as below, to cause an alkaline diuresis. If the potassium is low, correct this **before** giving the bicarbonate.
  - Salicylate concentration in adults >500mg/L (3.6mmol/L) - give 1.5L of 1.26% sodium bicarbonate (or 225mL 8.4%) over 2 hours
- Salicylate concentration in children (<5years) >350mg/L (2.5mmol/L) – give 1mL/kg 8.4% bicarbonate diluted in 0.5L 5% dextrose at 2-3 mL/kg/hr.
- Aim to achieve a urinary pH of 7.5-8.5, repeating treatment if necessary to achieve a falling plasma salicylate level.
- The previously used forced alkaline diuresis should not be used as it carries a significant risk of pulmonary oedema.
- In severe poisoning with evidence of cardiac or renal failure, haemodialysis is the treatment of choice.

**Ethylene glycol** (antifreeze, coolant, brake fluid)

**Fatal dose** is 100mL for a 70kg adult - inhalation and skin absorption are not serious.

**Clinical features.** Ethylene glycol is rapidly absorbed from the gut, and toxic features such as dysarthria, ataxia, nausea and vomiting start within 30 minutes of ingestion. Fits, coma and metabolic acidosis follow. Between 12 and 24hr after ingestion, cardiac failure, hypertension and respiratory distress occur, with progression to renal failure and hypocalcaemia.

#### Treatment guidelines

- Consider gastric lavage if the patient presents early. Forced vomiting is contraindicated.

- Measure acid/base status, and calcium. Correct metabolic acidosis with IV sodium bicarbonate. Large amounts may be needed, hence watch for hypernatraemia. Correct hypocalcaemia with IV calcium gluconate.

- Ethanol (alcohol) is the most widely used antidote, as it competes with ethylene glycol for alcohol dehydrogenase, which is responsible for the conversion of the ethylene glycol to its toxic metabolites. If the patient is conscious, give 2mL/kg of 40% alcohol (gin, vodka or whisky) orally.

- If the patient is unconscious, or acidotic, give an IV loading dose of 10% ethanol (7.5mL/kg in water), followed by an infusion as below.

- Non-drinker/child – 66mg/kg/hour of ethanol (i.e. 1.65mL/kg/hr of 5% ethanol)
- Average adult – 110mg/kg/hr (i.e. 2.76mL/kg/hr of 5% ethanol)
- Chronic drinker - 150mg/kg/hr (i.e. 3.9mL/kg/hr of 5% ethanol)

- In severe poisoning with evidence of cardiac or renal failure, haemodialysis is the treatment of choice.

### Carbon Monoxide (CO)

**Clinical features** are related in the main to tissue hypoxia as a result of impaired oxygen carrying capacity of haemoglobin. Therefore headache, nausea, irritability, agitation and tachypnoea, progressing to impaired consciousness and respiratory failure. A metabolic acidosis and cerebral oedema may develop in severe cases, and progression to multi-organ failure may ensue. Late complications, occurring weeks later in survivors of the acute exposure, may include psychiatric and Parkinson-like movement disorders. Pulse oximetry is unreliable in carbon monoxide poisoning, as it overestimates oxygen saturation.

Chronic carbon monoxide poisoning is less easy to diagnose, and usually occurs in more than one member of a household, associated with the use of gas heaters in under ventilated areas. The main symptoms are headache and flu-like symptoms.

### Treatment guidelines

- Remove from exposure

- Give high dose oxygen in an attempt to displace CO from the haemoglobin, and hence improve oxygen delivery to the tissues

- Metabolic acidosis should be treated by improving oxygen delivery to the tissues. Sodium bicarbonate hinders this, and therefore should not be used.

- Consider mannitol 1g/kg if cerebral oedema develops.

- Measurement of carboxyhaemoglobin levels may give an indicator of severity of exposure (>20% indicates significant exposure), but correlation with clinical outcome is poor.

- In patients with coma, be alert to the possibility of longer term neurological damage.

- Hyperbaric oxygen is used in some specialist centres.

**Organophosphates** – see Update in Anaesthesia 19 (in press)

Supportive measures are vitally important. Avoid self contamination – wear protective clothing.

**Clinical features.** Organophosphates are readily absorbed through skin and the lungs. They bind irreversibly to acetylcholinesterase, hence lengthening the half-life of acetylcholine. Recovery only occurs with the synthesis of new acetylcholinesterase. Nicotinic effects (such as muscle weakness), and muscarinic effects (sweating, bronchospasm), predominate.

### Treatment guidelines

- Prevent further absorption by removing source, including soiled clothing

- Give high dose oxygen

- Consider gastric lavage

- Give atropine (2mg for adults, 0.02mg/kg for children) IV every 10-30 minutes until there is improvement.

- IV diazepam (5-10mg for an adult, 0.02mg/kg for a child) to control twitching

- In severe poisoning, consider use of pralidoxime (a cholinesterase reactivator) in the first 24 hours.

- Intubation and ventilation is frequently required.