



# Medical Bulletin No. 5

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## Cyanide poisoning - first aid and medical treatment

### Properties

Cyanide is a rapidly acting and extremely toxic chemical that exists in various forms. Depending on temperature, it can be a colourless gas or liquid (e.g. hydrogen cyanide – HCN, cyanogen) or a solid (e.g. sodium or potassium cyanide). Cyanide is described as having a bitter almond odour at concentrations greater than 1 ppm, but not everyone can detect this.

### Routes of absorption

The primary route of occupational exposure is through inhalation, which results in rapid absorption into the systemic circulation. A less common route in the occupational setting is through ingestion. Cyanide can also be absorbed through the eyes or intact skin.

### Mechanism of action

Cyanide inhibits cytochrome oxidase at the cellular level, preventing cells from using oxygen. This impairs the function of vital organs.

### Cyanide poisoning

The onset of symptoms following cyanide exposure depends on:

- the form of cyanide;
- the mode of entry into the body; and
- the dose.

#### Acute

**Mild poisoning** - This may manifest as anxiety, headache, nausea and vomiting, mucous membrane irritation, metallic taste, shortness of breath and dizziness.

**Progression of poisoning** - Signs of deterioration include increasing shortness of breath, falling blood pressure, cardiac arrhythmia, periods

of cyanosis and a deteriorating level of consciousness.

#### Moderate and severe poisoning -

Exposure to cyanide gas produces the most rapid onset of symptoms. High concentrations of inhaled cyanide result in rapid loss of consciousness with seizures, difficulty breathing and cardiac arrest, with death occurring within a few minutes. Survivors may suffer brain injury due to either a direct toxic effect or anoxia (lack of oxygen).

**Eyes** - Direct contact with cyanide in caustic solutions is irritating to the eyes. Cyanide can also be absorbed into the body through the eyes.

**Skin** - Cyanide in caustic solution is corrosive to the skin and can also be fairly rapidly absorbed through the skin.

#### Chronic

Chronic exposure may result in symptoms of headache, eye irritation, fatigue, chest symptoms and nose bleeds. This is uncommon as cyanide is broken down to thiocyanate in the body and excreted.

### Rescue and first aid

**The first priority is to remove the casualty from further exposure – ideally move to a source of fresh air.**

The trained rescuer should have donned appropriate respiratory and dermal personal protective equipment (PPE), especially gloves, goggles and an appropriate respirator if hydrogen cyanide or liquid cyanide is involved.

**Airway** - Clear and insert oral airway if casualty is unconscious and not breathing. If breathing, place in coma position.

**Breathing** - Mouth-to-mouth resuscitation should be avoided due to the risk of contamination to the rescuer.

If not breathing, use a resuscitation bag and mask. Provide 100% oxygen by mask with a non-return valve if available.

**Circulation** - Check for pulse. Commence external cardiac massage if absent.

### Oxygen

**Oxygen (100%) is considered the most useful treatment for early cyanide poisoning and should be administered to anyone exposed to cyanide, whether conscious or unconscious, breathing or not breathing.**

Each site needs to undertake a **risk assessment** to determine the appropriate quantity and location of oxygen that should be available on site, taking into consideration the numbers of potentially exposed personnel and the duration to reach a tertiary care facility.

### Decontamination

Remove any contaminated clothing and ensure these items are placed in a sealed collection bag. Wash down the casualty with copious amounts of fresh water.

**Treatment should not be delayed by decontamination procedures and should be started immediately.**

### Transfer

Arrange urgent transfer to the nearest hospital or, if remote, nearest doctor. The casualty should be accompanied by someone trained in cardiopulmonary resuscitation (CPR) and able to continue resuscitation. The cyanide antidote kit should accompany the person.

## Ingestion

There is little evidence to support the benefit of emesis (vomiting), gastric lavage or charcoal administration, especially when more than 2 hours have lapsed since ingestion. This form of treatment should only be used on the advice of an emergency physician or toxicologist.

## Eye contamination

This should be managed with copious irrigation using water or normal saline for at least 5 minutes.

## Cyanide antidotes and kits

The use of antidotes is **not as immediately critical** as the administration of effective first aid, oxygen and life support measures.

### Mild poisoning

Administration of 100% oxygen may be all that is needed.

If the casualty rapidly improves after removal from cyanide exposure then no further immediate management beyond supplemental oxygen is required.

### Progression of poisoning

If there is evidence of deterioration, despite 100% oxygen administration, and there is a convincing history of exposure, administration of an antidote may be indicated, particularly if there is loss of consciousness or cardiovascular instability.

The preferred antidote is hydroxycobalamin administered intravenously. Oxygen should continue to be administered.

### Moderate and severe poisoning

Continue administration of 100% oxygen.

Advanced life support may be required if the casualty is in shock or having seizures, with due caution to the protection of the care giver.

Preferably insert two intravenous lines.

Monitor heart and blood pressure, and pulse oximetry if available.

Monitor level of consciousness using the Glasgow Coma Scale (GCS).

Take 10 ml blood in a sodium heparin or sodium fluoride tube for analysis of blood cyanide levels to confirm the diagnosis. The sample should be chilled but not frozen and transferred to a laboratory capable of undertaking

cyanide measurements. **Treatment should not be delayed while awaiting test results.** Note that as most cyanide is in the red blood cells, the levels in the blood may not accurately reflect the true level of free cyanide and symptoms should therefore guide treatment.

### Intravenous administration of an antidote

- **Hydroxycobalamin** is available through the Therapeutic Goods Administration (TGA) Special Access Scheme. It reacts with cyanide to form cyanocobalamin, which is excreted by the kidneys.  
*Dose:* Administer 5-15 g hydroxycobalamin intravenously (Cyanokit® contains two 2.5 g bottles) over 30 minutes or faster if the casualty's condition is deteriorating.
- **Sodium thiosulphate** is no longer a preferred antidote as it is a slower acting agent. However, it is considered by some authorities to be useful as an adjunct to hydroxycobalamin.
- **Kelocyanor (dicobalt edetate)** is no longer a preferred antidote as there is the potential for a severe adverse reaction if administered when cyanide poisoning has not occurred. It should only be used where there is unequivocal evidence of cyanide poisoning and hydroxycobalamin is not available. Even then, there may be a toxic reaction such as anaphylaxis, cardiac arrhythmia or convulsions. Co-administration of glucose may ameliorate this to some extent.

### Antidote storage

The selected cyanide antidote should be stored in a sealed tagged container in an accessible area with the cyanide protocol enclosed. The contents of the container and the expiry date should be regularly checked. Intravenous fluids and cannulae and blood sample tubes should be available. The kit should be transported with the casualty to the hospital or doctor.

## Monitoring in hospital

- **Arterial blood gases (ABGs).** Severe metabolic acidosis requires correction.
- **Fluid and electrolyte balance.**
- **Neurological, respiratory and cardiovascular status.** Watch for the development of pulmonary oedema and aspiration pneumonia in

comatose patients. Seizures will require treatment with intravenous or rectal benzodiazepines.

- Further antidote administration may be required, particularly if there is a persisting metabolic acidosis. Oxygen therapy will be determined by the response to the antidote.
- Close monitoring should continue for a minimum 24-48 hour period following exposure if an antidote has been required as delayed effects may occur.
- Following skin exposure, a period of 6 hours of monitoring is required to ensure there are no delayed effects.
- Re-assessment of eye splashes is required within 24 hours, and ophthalmologic assessment is recommended.

## Cyanide management plan

Each site should develop a medical management plan, including location and contact details of the nearest medical facility capable of treating a victim of cyanide poisoning.

## References

Agency for Toxic Substances and Disease Registry (ATSDR), US Department of Health and Human Services, Toxicological profiles for and ToxFQs Cyanide: viewed 27 July 2007 <[www.atsdr.cdc.gov](http://www.atsdr.cdc.gov)>

Braitberg G & Vanderpyl M, 2000, Treatment of cyanide poisoning in Australasia. *Emergency Medicine* 12, 232-240.

Cummings T, 2004, The treatment of cyanide poisoning. *Occupational Medicine* 54, 82-85.

*Micromedex®* Healthcare series -Cyanide.

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