CYANIDE
Cyanide Toxicity

**Ingestion**

**Lethal Doses**

- 60-90 mg Hydrogen Cyanide (HCN)
- 200 mg Potassium Cyanide (KCN)
# Cyanide Toxicity

**Inhalation**

<table>
<thead>
<tr>
<th>Concentration (mg.m(^{-3}))</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>immediately lethal</td>
</tr>
<tr>
<td>200</td>
<td>lethal after 10 minutes</td>
</tr>
<tr>
<td>150</td>
<td>lethal after 30 minutes</td>
</tr>
<tr>
<td>120-150</td>
<td>lethal after 30-60 minutes</td>
</tr>
<tr>
<td>50-60</td>
<td>20 minutes to 1 hour without effect</td>
</tr>
<tr>
<td>20-40</td>
<td>light symptoms after several hours</td>
</tr>
</tbody>
</table>
Cyanide Metabolism

$\text{CN}^- \xrightarrow{\text{Rhodanese}} \text{Thiocyanate} \rightarrow \text{SCN}^- + \text{SO}_3^-$

$\text{S}_2\text{O}_3^- \rightarrow \text{Urine}$
CYANIDE PLANTS

Almonds

250 mg CN/ 100g plant tissue

Cassava

104 mg CN/ 100 g plant tissue

Wild Cherries

140-370 mg CN/ 100 g plant material
CYANIDE
PLANTS
AMYGDALIN
CYANIDE
"DRUGS"

Laetrile
THE POLITICAL SUCCESS OF A SCIENTIFIC FAILURE

Controversial results of an experimental therapy

Amygdalin
Toxicity Studies in Rats Predict Chronic Cyanide Poisoning in Humans

Laetrile - A cancer cure? Prove it, the medical establishment demands

Why the Outlaw Cancer Drug is Finally Catching On
The Vitamin Fraud in Cancer Quackery

Laetrile - The Laetrile Nightmare
Trapped between fear of death, law and politics

Laetrile Toxicity Studies in Dogs
Laetrile at Sloan-Kettering: A Question of Amilnit

O
HO
HO
HO
HO
HO

Amygdalin
CYANIDE
INDUSTRY
ELECTROPLATING
HARDENING METALS
GOLD EXTRACTION
LABORATORIES
Cyanide
Fire
Cyanide/Carbon Monoxide
Cyanide/Carbon Monoxide
CYANIDE
RODENTICIDE/FUMIGANT

ZYCLON B
CYANIDE
CHEMICAL WEAPON
CYANIDE

SUICIDE
CYANIDE
TOXIC MECHANISM

Heme group of mitochondrial cytochrome
CYANIDE TOXIC MECHANISM

“HISTIOOTOXIC ANOXIA”
CYANIDE
TOXIC MECHANISM

VASOSPASM
Mild Toxicity
  Nausea
  Dizziness
  Drowsiness
Moderate Toxicity
  Loss of consciousness for a short period
  Convulsion
  Vomiting
  Cyanosis
Severe Toxicity
  Deep coma
  Dilated non-reactive pupils
  Deteriorating cardio-respiratory function
History
  Occupation, access to cyanide

Smell
  Bitter almonds

ECG
  Sinus tachycardia/bradycardia
  Ischaemic changes

Pulse oximetry
  Normal
ABG
Metabolic acidosis, normal oxygen

Anion gap (Na⁺ – [Cl⁻ + HCO₃⁻])
Elevated

Serum lactate
Elevated

Blood cyanide level
Elevated – difficult to rapidly determine
CYANIDE MANAGEMENT

HAZARD ASSESSMENT

ABC’s

TOXICO KINETICS

ABSORPTION

DISTRIBUTION

METABOLISM

ELIMINATION

TOXICO DYNAMICS

SUPPORTIVE CARE
CYANIDE MANAGEMENT

HAZARD ASSESSMENT

Cyanide is hazardous by:

- Ingestion
- Respiratory exposure
- Dermal exposure
CYANIDE MANAGEMENT

ABC’s

Avoid:
mouth to mouth, or
mouth to nose artificial ventilation
CYANIDE MANAGEMENT

DECONTAMINATION (absorption)

- Nasogastric aspiration
- Activated charcoal
- Gastric lavage
- Emesis
CYANIDE MANAGEMENT

ANTIDOTES (distribution/metabolism)

Enhanced cyanide metabolism

Cyanide ion binding
Enhancement of body’s natural mechanisms for dealing with cyanide:

i. oxygen

ii. Sodium thiosulphate
Enhanced cyanide metabolism

\[ \text{CN}^- \rightarrow \text{SCN}^- + \text{SO}_3^- \]

Rhodanese

Urine
CYANIDE ANTI-DOTES

Cyanide ion binding

Cobalt containing drugs

Methaemoglobin forming drugs
Cobalt containing drugs:

Cyanide ions will bind to cobalt which can be supplied in the form of either;

i. Hydroxocobalamin, or
ii. Dicobalt edetate.
Methaemoglobin forming drugs:

Cyanide will also bind to methaemoglobin formed after administration of:

i. Amyl nitrite;
ii. Sodium nitrite, or;
iii. 4-dimethylaminophenol (4-DMAP)
CYANIDE
ANTIDOTES

Cyanide ion binding

\[ \text{HbO}_2 + \text{NO}_2^- \rightarrow \text{MetHb} \]
CYANIDE
TOXIC MECHANISM

Heme group of mitochondrial cytochrome
CYANIDE
TOXIC MECHANISM
CYANIDE
ANTIDOTES

Cyanide ion binding

\[ \text{HbO}_2 \rightarrow \text{MetHb} \rightarrow \text{CNMetHb} \]
Cyanide ion binding

\[
\begin{align*}
\text{HbO}_2 & \rightarrow \text{MetHb} \\
\text{MetHb} & \rightarrow \text{CNMetHb} \\
\text{CNMetHb} & \rightarrow \text{HCN} \\
\text{HCN} & \rightarrow \text{CN}^- \\
\text{CN}^- & \rightarrow \text{S}_2\text{O}_3^- \\
\text{S}_2\text{O}_3^- & \rightarrow \text{SCN}^- + \text{SO}_3^- \\
\text{SCN}^- + \text{SO}_3^- & \rightarrow \text{Urine}
\end{align*}
\]
If the patient is unconscious:

Commence forced artificial ventilation with 100% oxygen using a mask and bag with a “non-return” valve (to prevent inspiration of inhaled gases)

Amyl nitrite may be administered via the ambu bag 0.2 - 0.4 mL for adults and 0.1 mL for children

NOTE:
Amyl nitrite forms a flammable mixture when combined with oxygen. It must therefore not be used in situations where it may be ignited.
CYANIDE
MILD POISONING

In those circumstances where an individual exposed to hydrogen cyanide by inhalation is conscious five minutes after exposure has ceased, and complains only of nausea, dizziness, drowsiness or other mild symptoms:

- Oxygen
- Reassurance
- Bed rest
Those patients who have been observed to have lost consciousness for a short period, or are suffering convulsions, vomiting and/or cyanosis:
Oxygen 100%: but for no longer than 12-24 hours

Amyl nitrite: 0.2 - 0.4 mL for adults and 0.1 mL for children via “ambu bag” (if there is delay in administering sodium thiosulphate)
Then

**Sodium thiosulphate**: 50 mL of 25% solution (12.5g) IV over 10 minutes. In children the dose is 300 to 500 mg/kg
Oxygen 100%: but for no longer than 12-24 hours

Amyl nitrite: 0.2 - 0.4 mL for adults and 0.1 mL for children via “ambu bag” (if there is delay in administering IV antidote)
And either

**Hydroxocobalamin**: 5 g (70 mg/kg for children) by rapid IV infusion. This dose may be repeated once or twice, depending upon response, with IV infusions over 30 minutes to 2 hours

**Sodium nitrite**: 10 ml of 3% solution (300mg) IV for 5 - 20 minutes. May be repeated at half initial dose

**Dicobalt edetate**: 20 ml of 1.5% solution (300mg) IV over 1 minute followed immediately by 50 ml of hypertonic glucose solution. May be repeated twice
Then

**Sodium thiosulphate:** 50 mL of 25% solution (12.5g) IV over 10 minutes. In children the dose is 300 to 500 mg/kg
CYANIDE