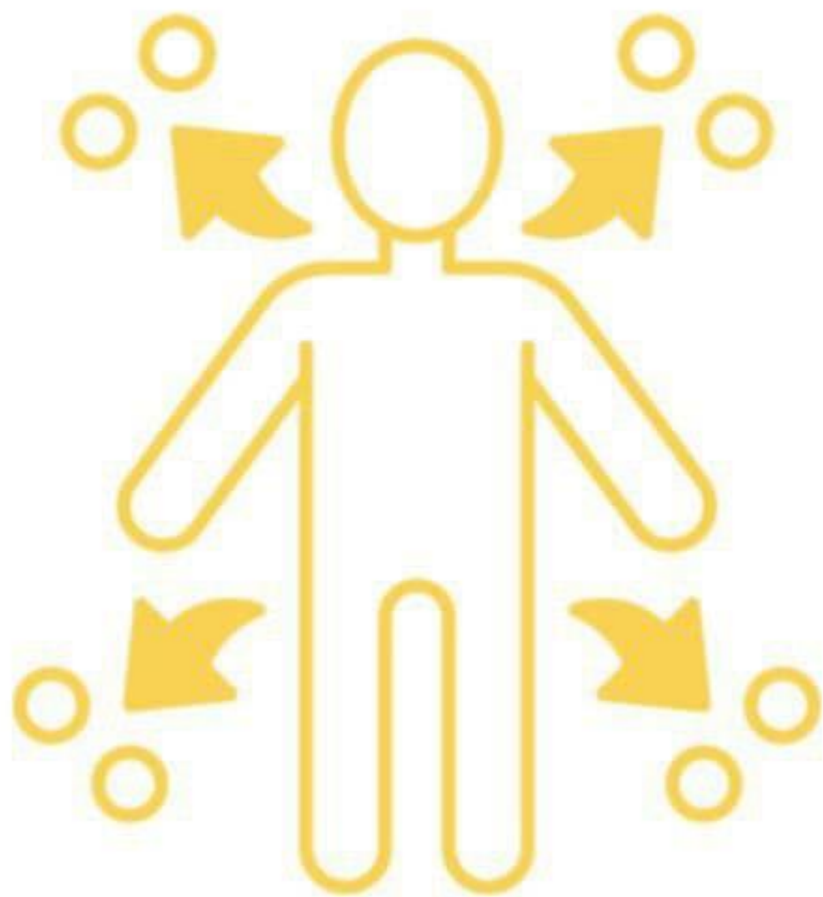


هاد والنائتریت  
حسیتهم زی بعض  
فالا حسن ادرسوهم  
ورا بعض

Industrial and household  
toxicology

**CYANIDE TOXICITY**



# MIRACLE Academy

سموم  
زميلتكم نهى حسن



لجان الرفعات

قال تعالى (يَرْفَعُ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ)

طبعاً هاد ما يربط مع

CHARCOL

# Sources

هاد السيانيدي يطلع من حرائق  
الخشب ويكون ببعض المواد  
المصنعة يعني من اسوأ أنواع  
التسمم وفي عليه كثير حالات  
انتحاريه

عنا الي يتسمم CO رح  
يتسمم كمان  
CYANIDE

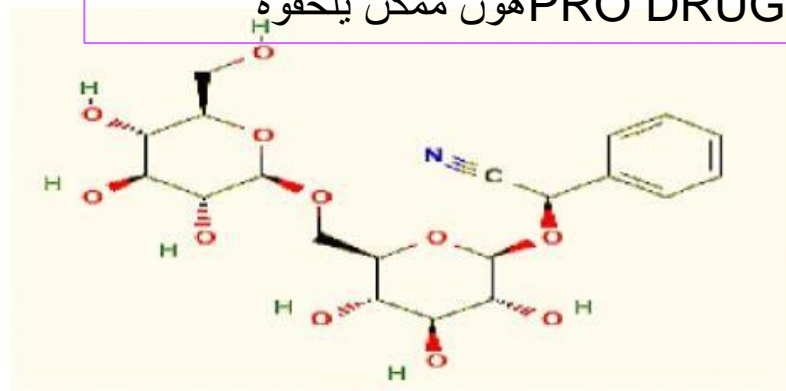
## 1. Natural sources of cyanide:

الماده موجوده ببذور المشمش

- Certain plants contain high quantities of AMYGDALIN (glycoside)....is converted to cyanide in the small intestine by an enzyme (emulsin)

- Plants?? Apple, Peach, Plum, Apricot, Bitter Almond, Black Cherry

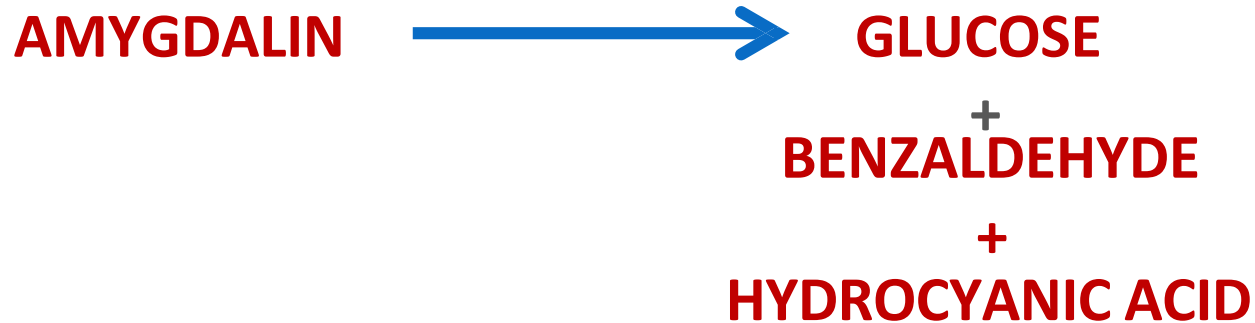
مشكلته انو لو تنفسته رح تموت بدقائق  
واذا اخذ PRO DRUG هون ممكن يلحقوه



Molecular formula:  $C_{20}H_{27}O_{11}$

Synonyms: (R)-Amygdalin; D-Amygdalin; (R)-Laenitrile

- Natural sources of cyanide



# Sources

## 2. Other sources:

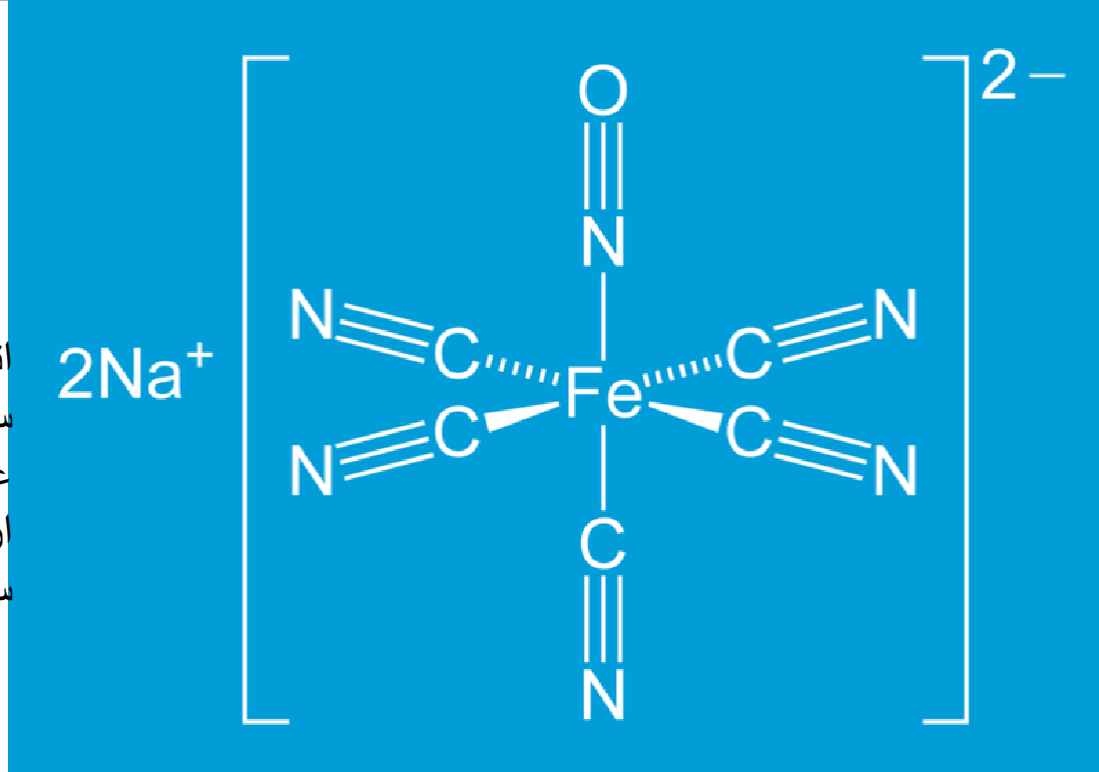
هاد الدواء رح يمر علينا لقدام بتشابتر  
النايترين  
طبعاً هاد الدواء بعطيه IV for MI او عشان  
هيك صرت بطي مع هاد الدواء Lantidot  
cyanide

- The vasodilator drug **nitroprusside** releases cyanide upon exposure to light or through metabolism
- used in plastic manufacturing are absorbed by skin and liberate hydrogen cyanide gas....
- **Acetonitrile: a solvent component of some artificial nail glue removers.....**caused several pediatric death
- Cyanide solution is rapidly absorbed through the skin

بسرعه يمتصه الجلد و يطلع غاز الهيدروجين سيانيد

هاد الاسيتون تبع الاظافر ويطلعو كميه سيانيد كبيره لذلك  
خطير على الأطفال لان حجمهم صغير يعني نسبه وتناسب

اتخلص من  
سميته هاد  
عن طريق  
اربطه مع  
سلفر



## Sodium nitroprusside

- It is rapidly metabolized by uptake into red blood cells with liberation of cyanide. Cyanide in turn is metabolized by the mitochondrial enzyme rhodanase, in the presence of a sulfur donor, to the less toxic thiocyanate

# Cyanide toxicity

الي بدوينت حرا كيد ما رح يروح يوكل  
بذور المشمش او يحط مذيبي ويستني  
جلده يمتصه

ف يروح يجيب هاد السيانيدي ويحطه مع  
اسيد او ماء وهون يكون بثواني مغيب  
وبدقائق يموت

- Deliberate cyanide exposure (through **cyanide salts**) remains an important instrument of homicide and suicide
- .....***highly soluble in water***, and thus readily dissolve to form free cyanide (most toxic form,  $CN^-$  or  $HCN$ )
- **Halogenated cyanide: irritating gases,** cause pulmonary edema and excessive salivation

# Sources

## 2. Other sources:

- **Hydrogen cyanide**.....is a gas easily generated by mixing acid with cyanide salts
- Is a common combustion **by-product of burning plastics, wool**, and many other natural and synthetic products.....poisoning is an **important cause of death from structural fires**
- It is common on autopsy to find CN and CO in blood of those who have succumbed to smoke inhalation

لما نشرح الي  
ماتو رح نلاقي  
بالدم CO-CN  
عندهم



# Toxic dose

- Exposure to **hydrogen cyanide gas (HCN)**, even at low levels (150–200 ppm), can be fatal
- The air level considered immediately dangerous to life or **health (IDLH)** is 50 ppm
- The recommended workplace **ceiling limit (TLV)** is 4.7 ppm
- **Acute cyanide poisoning with nitroprusside infusion (at normal infusion rates) or after ingestion of amygdalin-containing seeds is relatively rare**

# FATAL DOSE

| Name              | Commercial use | Fatal dose |
|-------------------|----------------|------------|
| Acetonitrile      | Solvent        | 120mg/kg   |
| Cyanogen bromide  | Fumigant       | 13mg/kg    |
| Potassium cyanide | Electroplating | 2mg/kg     |
| Hydrocyanic acid  | Fumigant       | 0.5mg/kg   |

- Solutions of cyanide salts can be absorbed through intact skin

# Mechanism of Action

فكرته انو يمنع الخليه  
تستهلك الاكسجين يعني في  
اكسجين بالدم بس ما  
يوصل للخلايا

- CN is a chemical asphyxiant.....inhibits **CYTOCHROME OXIDASE SYSTEM**
- .....**Blocks the aerobic utilization** of oxygen
- Cellular anoxia....CNS, cardiac arrest, and respiratory arrest
- Cyanide readily binds to many enzymes having a metallic component...**binds avidly to heme  $\text{Fe}^{+3}$**  causing cellular hypoxia.

اول اشي ممكن افكر فيه اني اربط  
السيانيد بالدم وبحول الهيم  
للميثيموغلوبيين لانه بربط كويس  
بالسيانيد واخلي الخلايا تقدر تتنفس

# Routes of exposure....absorption

- **INGESTION:** oral absorption is rapid.

هدول حبوب

- Ingestion of cyanogenic plants or nitriles need hours before development of symptoms...conversion of amygdalin to cyanide & nitriles metabolized to cyanide after absorption

نيترايلز عنا

Amygdalin

هدول يصير الهم metabolism وبتدهم ساعات

ليتحولو الى سيناييد

# Routes of exposure....absorption

هاد اسوا اشي وبموت دغري ماحدا يقدر  
يلحقه اسرع طريقه للانتحار واقلها المأ

- **INHALATION:** respiratory absorption is almost **immediate**....the patient become unresponsiveness within seconds and succumb rapidly without supportive care
- **DERMAL:** dermal exposure is **rare** but reported with large surface area exposures. **Nitriles are readily absorbed by the skin....delayed effect**

# Routes of exposure....elimination

السينايد بربطه مع الثيوسلفيت وبتخلص  
منه عن طريق urine

- Cyanide is eliminated from the body by different mechanisms
- Most imp mechanism of elimination (80%) is by irreversible conversion to thiocyanate by rhodanese enzyme....
- .....Requires sulfur donor (thiosulfate) and then eliminated by kidneys
- Excreted in small amounts in urine
- also incorporated into cobalamin (Vit B12)

وبقدر اربطه مع الميثيهموغلوبيين and Vit12

# Clinical presentation

بأول 15 ثانية رح يبطل يقدر يتنفس ويزيد حموضه الدم  
Dyspnea-acidosis  
وخلال 15-30 ثانية رح يصيبه تشنجات بسبب نقص  
الاكسجين الي يوصل للخلايا  
وبعده يوقف قدرته على التنفس خلال دقيقه ل2 ويتبعها  
توقف القلب بدقائق

- Abrupt onset of profound toxic effects shortly after exposure is the hallmark of cyanide poisoning:
  1. 15 seconds after inhalation of a high conc. of cyanide vapor there is a transient **dyspnea.....metabolic acidosis**...increase lactate coz anaerobic respiration
  2. Followed in 15-30 seconds by the onset of **convulsions**
  3. **Respiratory activity stops** two to three minutes later
  4. **Cardiac activity ceases** several minutes later still
- Onset of acute cyanide poisoning depends on the route of adm., cyanide dose, and whether itself or precursor is administered (delayed onset if ingested or need metabolism)

| CN level<br>(mg/l) | Degree of<br>poisoning                 | Signs and symptoms  |
|--------------------|--|---|
| 0.5-1.0            | Mild من هون يبلش التسمم                | Conscious, nausea, headache, flushed                      |
| 1.0-2.5            | Moderate مش واعي ولكن اذا بضربه يستجيب | Stuporous but responsive to stimuli, tachycardia, dyspnea |
| ≥ 2.5              | Severe                                 | Comatose, seizures, cyanosis, CV collapse, death          |

- Whole-blood levels higher than 0.5–1 mg/L are considered toxic



لما الحرامي يدخل يقتلك قبل الفاينل :



# Diagnosis

بما انو التسمم يصير بدقائق فما بزبط اسحب دم فهور لازم يكون  
سريع المسعف او مين ما كان ومن الاعراض يتوقع التسمم  
وحسب المكان الي اعرض فيه للتسمم وبالاضافه الي ريحته  
اما اذا كان ماخذة بلع فبقدر اسحب دم واشوف مستوى السيناييد

- Diagnosis is primarily made by the index of suspicion and clinical judgement
  - Case history, suspicion of exposure, Clinical presentation, metabolic acidosis, multisystem involvement
- odor of bitter almonds.
- Laboratory diagnosis
  - blood cyanide levels can be drawn, but empiric treatment is almost always required before lab results are available
  - arterial pO<sub>2</sub> may be elevated

# Management

- GENERAL MEASURES:

- DECONTAMINATE & PROTECT YOURSELF

- ABCs EVALUATION (O2 100%, intubation, maintain blood pressure)

- TREAT COMA AND HYPOTENSION

- DIAZEPAM or PHANYTOIN TO CONTROL SEIZURES

بحطه حتى  
احمي الرئه

- Immediately place a gastric tube and administer ACTIVATED CHARCOAL\*, then perform GASTRIC LAVAGE

- Give additional activated charcoal and a cathartic

# Management CYANIDE KIT

هاد المحترم يحب يرتبط مع  
الحديد بالميثيموغلوبين اكثر  
من الهيموغلوبين  
عشان ما يضل يلفف عندي  
بالجسم فبحاول احول  
الهيموغلوبين لميثيموغلوبين  
حتى اربطه مع السينايد واقلل  
كميته بالدم

- Cyanide has higher affinity for the iron in methemoglobin than for the iron in cytochrome oxidase
- Nitrites convert the ferrous iron in hemoglobin to the ferric form, yielding methemoglobin

انتبهو نحكي عن Nitrite هو  
الحل للتسمم مش Nitrile

# Management



بكسر Amyl الامبوله وبخلي المريض يشمها  
عشان يساعد لتحويل الدم للميثيموغلوبيين بس  
للأسف هاد ما يكفي ف بعطيه Sodium  
nitrite وهاد يكون iv  
بدنا ننتبه للأطفال لانهم ما بقدررو يتحملو  
الميثيموغلوبيين وعشان اخلي المحترم يربط مع  
السفر بعطيه thiosulfate على شكل iv

- **CYANIDE ANTIDOTE KIT (NITRATE-THIOSULFATE KIT)**

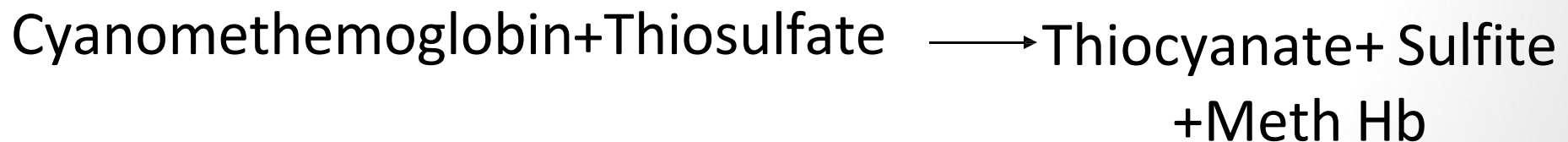
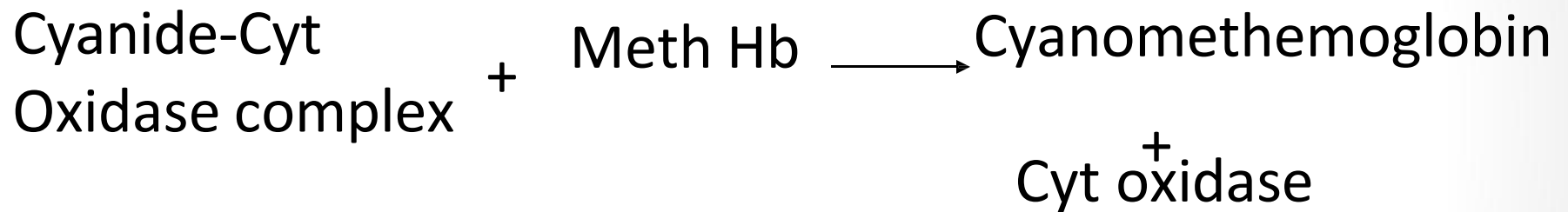
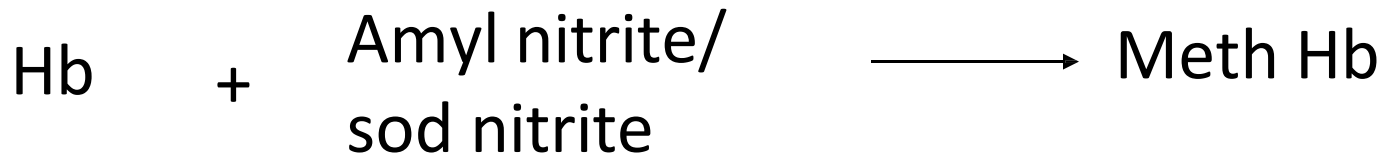
1. **AMYL NITRITE** for rapid inhalation
  - 5% methemoglobinemia
2. **SODIUM NITRITE** solution for i.v injection (300 mg; 6 mg/kg for children)
  - 10%-12% methemoglobinemia
3. **SODIUM THIOSULFATE** solution for i.v injection, 12.5 g
  - If ineffective, half of the dose can be repeated
  - The dose must be corrected for weight

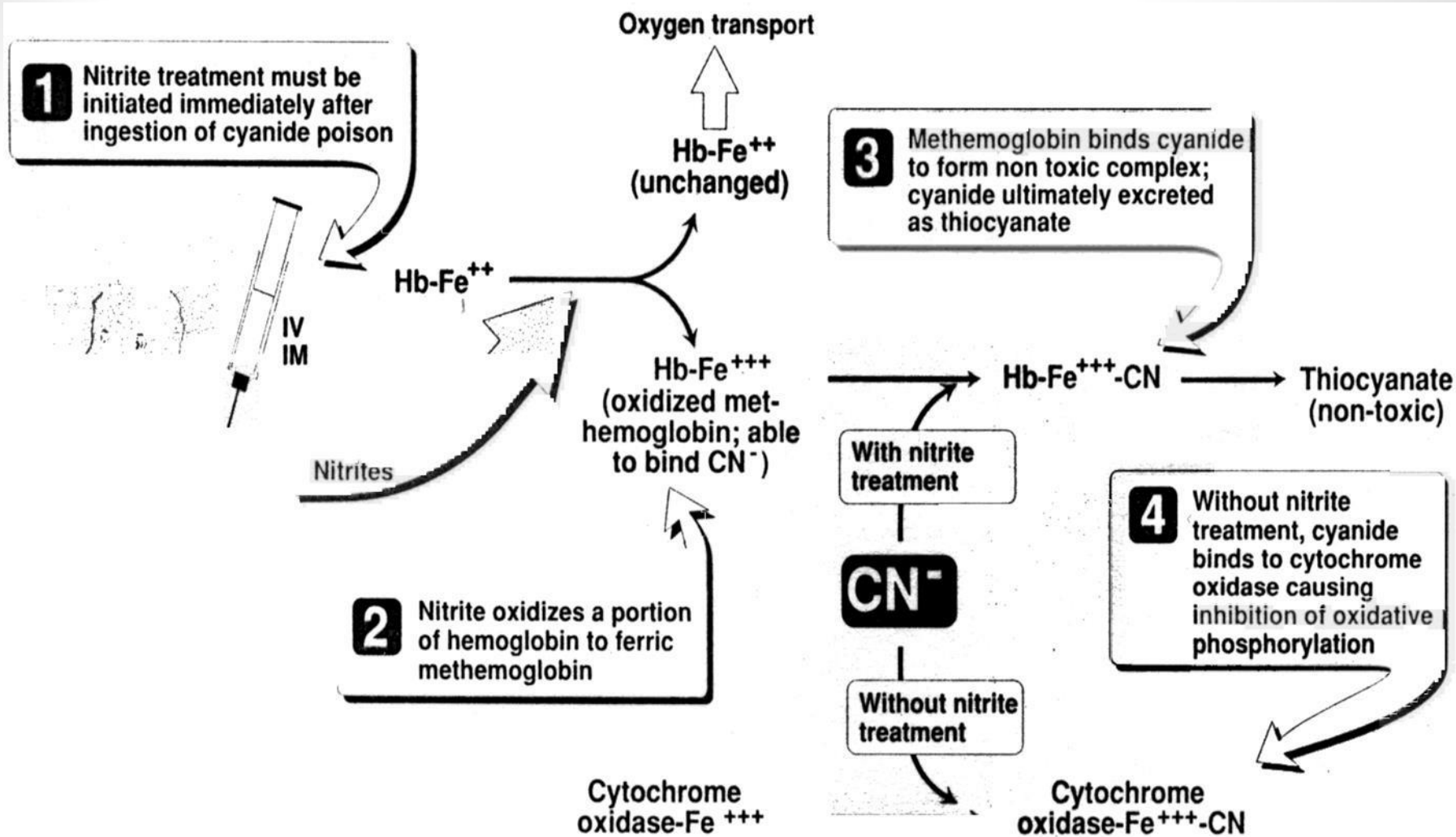
# CYANIDE KIT

نفس الحكي الي  
بالسلايد الي  
قبل

- **3-STEP PROCEDURE:**

1. Break a pearl of **amyl nitrite** under the nose of the victim followed by....
2. I.V administration of **sodium nitrite**, which rapidly increases the methemoglobin level to the degree necessary to remove a significant amount of cyanide from cytochrome oxidase followed by...
3. I.V sodium **thiosulfate**...converts cyanomethemoglobin to thiocyanate & methemoglobin
4. Thiocyanate is much less toxic than cyanide and is excreted by the kidney





**Figure 18.3**  
Treatment of cyanide poisoning with nitrites.



# CYANIDE KIT

هسا صح هم  
ممتازين لعلاج  
التسمم بالسينايد  
ولكنن

- PROBLEMS WITH THE KIT:

- Hypotension with nitrites
- Excessive methemoglobinemia is fatal because methemoglobin is a very poor oxygen carrier...**Caution!!!**
- Thiosulfate is relatively benign
- Methemoglobinemia not tolerated well in children

# CYANIDE KIT

هسا طلعو kit جديده بنستخدمها  
لل VIT12  
عشان يربط بالسينايد

- Recently, the FDA approved a concentrated form of **hydroxocobalamin**, one form of Vit B<sub>12</sub>..... **Cyanokit**)
- .....combines rapidly with CN<sup>-</sup> to form cyanocobalamin (another form of vitamin B<sub>12</sub>)
  - If CO & CN poisoning
  - If renal failure or children
- In acute poisoning, give 5 g of hydroxocobalamin (children: 70 mg/kg) by IV infusion over 15 minutes
- A second administration may be considered
- Also used for prophylaxis of cyanide toxicity from nitroprusside (25 mg/h by IV infusion)
- Well tolerated; allergic reactions are rarely reported

تسمم هالمحروس فبعطيه 5 غرام من الكت  
الي تحتوي على Vit12 وطبعاً نراحي وزنه  
وعمره لمدة 15 دقيقه وومكن بحتاج ارجع  
اكرر هاي الجرعه مره ثانيه

# Management

هسا حولنا السينايڊ ل ثيوسينايد لما ربطناه  
مع السلفر طيب وهاد بتخلص فيه من خلال  
الكليه طيب اذا عنده مشكله فيها رح يتراكم  
ويصير تسمم جديد وهاد يحتاج هسا الى  
hemodialysis

- **Enhanced elimination:**
- Thiocyanate may accumulate in patients with renal insufficiency who do not excrete thiocyanate at a normal rate
- Thiocyanate toxicity is manifested as weakness, disorientation, and convulsions
- Hemodialysis may be indicated in patients who develop high thiocyanate levels while on extended nitroprusside therapy
- Hyperbaric oxygen has no proven role in cyanide poisoning treatment.