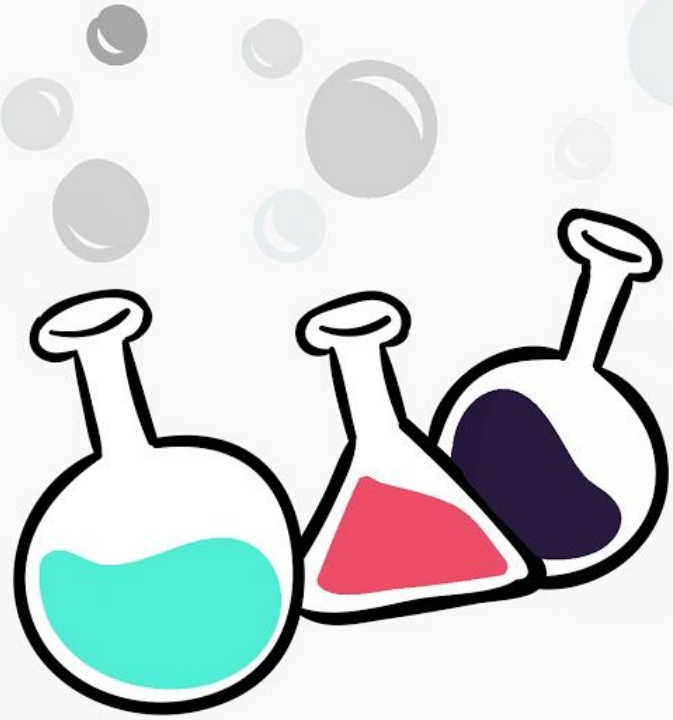


Inhaled toxins

Team leaders: Khalid alzahrani - Abdullah aljunaydil

Objectives:

- Not given.

Done by:

Norah Alakeel

Revised by:

Luluh Alzeghayer

[Color index : Important | Notes | Extra | Editing file]

Inhaled toxins

In general not common , but we need to know it in case it happens and you need to know the basics

Paracelcus:

- Everything is a poison.
- Only the dose differentiates a poison from a remedy

Basics:

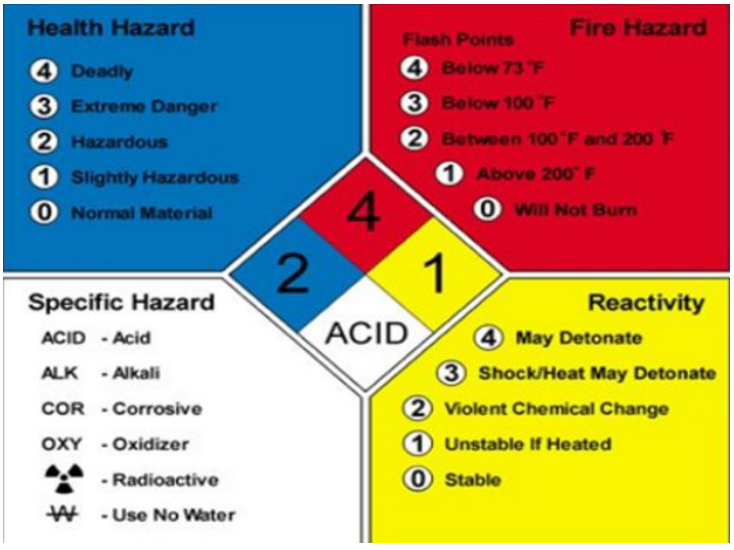
- Be familiar with your area.
- Mostly it's 1 material.
- MSDS Materail safety(system) data sheet www.msdssearch.com

-There is something called **HAZMAT** (hazardous material), disinfectant products used for sterilization is considered HAZMAT , so any HAZMAT (found in labs, bedside, hospitals needs backup system to deal with it .
زي مثلا السنة الي راحت صارت مشكلة في المواد المستخدمة في تعقيم ال endoscope ففقلنا القسم ولبسنا HAZMAT suit و نظفنا كل شي

-**what to do in case there is a release of toxic material ?** we need to know what we are dealing with by reading the MSDS and NFPA (See pic)
مثلا الصوديوم لما احط عليه ماء راح يقب , باختصار الي يشتغل شغل يتضمن التعامل مع مواد سامة لازم يعرف خصائص المادة الي يتعامل معها بشكل يومي عن طريق قراءة ال MSDS تبعها

- In our hospital there is something called as "hyperbaric chamber"(high pressure of oxygen) used in treating some diseases (some still experimental, for neurological diseases) this chamber is considered a high risk hazard الاكسجين العادي نخاف منه كيف عاد لو مضغوط زي الي صار بحريق مستشفى جازان قبل كم سنة

- **Concurrent Trauma**
- **NFPA** National Fire Protection Association



EXTRA:
I take the substance then I SCALE it in each category(health hazard , fire hazard, reactivity ,specific hazard)
الفكرة اني امسك المادة واقيمها حسب الصورة , مثلا اقول بالنسبة للhealth hazard 1 and for fire hazard 0 while for reactivity 3

- **Physical Properties:** state, particle size, conc, solubility, boiling-melting points, color, odor, flash point, thermal & pressure reactions
- **Chemical Reactions**
- **Classification Systems**
- **Biologic Interaction:** duration, exposure limits,RR & depth, host defense, warning Sx.
- **Basic Toxicology:** dose-response relationship (not for Cancer).

- **Toxico-kinetics:** what the body does to poison (absorption, distribution, metabolism, excretion).
- **Toxico-dynamics:** cellular & molecular MOA of a poison.

It is the same as pharmacodynamics and pharmacokinetics but this is toxins, All chemical substances at certain doses become toxins

Toxidromes: constellation of S&S that let us think of specific toxin

1. **Irritants:** ammonia, chlorine, phosgene.
2. **Asphyxiant**: Simple (CO2, Nitrogen), Systemic (CO, cyanide, sulfides, azides).
3. **Cholinergic**: excess Ach.
4. **HCO (hydrocarbons):** (propane, toluene – chloroform) They affect endocardium making it very sensitive and lead to Arrhythmia

Poison Rx Paradigm: ABCDE

So in intoxication we have to ask (what happen, when , where, what and so on) after that we should control the area احتواء المنطقة

we can divide the areas into:

1) **HOT area** where toxication happened, we need to take caution ما يدخلوها الا الدفاع المدني والناس المدرّبين,
2) **WARM** area نكون لابسين ملابس أقل حماية من الهوت وعادة هي المنطقة الي نستقبل فيها المرضى

we should 1- open airways and 2- apply C spine (in case there is trauma)

3) **COLD area** وهي المنطقة الآمنة زي المستشفى نفسه

A: Alter Absorption(remove, decontaminate, dilute, 2ry contamination). Antidote (few)

B: Basics

C: Change Catabolism

D: Distribute Differently

E: Enhance Elimination

Basic Summary:

- **Identification (Dx)** I should identify the toxin, and make sure it is really toxin not something else
- **The rest is easy; you can look it up, call an expert.**
- **The emergency response as planned.**

When I have 2 persons having the SAME SYMPTOMS بنفس الوقت نتيجة نفس الأعراض يعني شبه مستحيل اثنين تجيهم مرض عضوي

NO Way 2 person presenting with cardiac symptoms will have MI at the same time!

Irritants مهيجة

Case 1

RC (red crescent) called and brought 6 pts from a factory.. Local disaster, No communication..

Sx:lacrimation, rhinorrhea, burning sensation in the throat, laryngospasm, stridor..

I can keep cholinergic in mind but there is something that doesn't match cholinergic such the irritation part

Local corrosive effect, water solubility: causes irritation and inflammation		
High:	**Moderate:**	**Slight:**
• **Ammonia,** • **Formaldehyde** • **HCl** • **SO2** **(nostril till vocal cords, mainly mucous membrane)** highly soluble > mucous membrane in (eyes, nasopharynx, respiratory system) > so immediate lacrimation, salivation, upper respiratory symptoms	**Cl_2** **(upper RT > lower).** less solubility so may reach the nasopharynx > affect 1-airway 2-swallowing 3-sensation in that area	• **NO2** • **phosgen** **(unaware, delayed).** worst (لما احس بشي مهيج على طول راح اطلع من المكان) وهنا تكمن المشكلة بهذا النوع بحيث اني اتنفس واخذ راحتي لاني ما احس فيه وراح يوصل لين ال alveoli leading to destruction of it

Action

Decontamination

A: Suction, +/- ETT(endotracheal tube) To insure patent Airway

B: O2, Nebulization for the constriction**, +ve PEEP**(positive end-expiratory pressure)

C: IVF, monitor overload to avoid non-cardiogenic pulmonary edema

D: AMS(Altered mental status) **or Sz** (seizure)because of {**hypoxia**}

E: Undress The most IMP**, ventilation with 100% Ox.**

لان لو المادة لسى موجودة على ملابسهم المريض والطبيب وكل الطاقم الطبي والمستشفى كمان يتأثر

Asphyxiants خانقة

Case 2:

<u>January night</u>, a 22 yo male brought by his friend from Estraha, unconscious, forehead contusion.

The friend said he became dizzy before brief Seizure & typical post-ictal confusion. مدروخ ومو عارف فينه

Mildly pale, Tachycardic no Hx of seizure in the family, no previous seizure

Now the companion is having headache..

when only ONE guy had the Symptoms the approach was about seizure (did he fall?), but when the companion is also affected it hints that there is toxicity, other hints here are (ESTRAHA AND JANUARY) يعني شتاء وبرد و شابين نار ,لما يشبون نار في مكان مغلق راح يطلع من الفحم CO

CO has:

1- higher affinity to molecules in hemoglobin (competes with oxygen)

(hemoglobin normally carry 4 oxygen molecules to the peripheral tissue> in PT there is slight acidosis so RIGHT shift > offloading of oxygen (delivery)and takes CO2)

2-loss of offloading leading to hypoxia, when I measure O2 it is normal ! but patient is tachypneic and may turn to cyanosis after a while

They are NOT mechanical (no irritation)

Simple asphixants:	Systemic asphyxiants:
CO2, Smoke, Methane, Propane, Helium, Nitrogen, ANY gas.. We are breathing air with a concentration of oxygen 21% , so when I breath something that does not have the 21% is THE PROBLEM (DISPLACEMENT) زي الي يطيحون في البيارات هذا سبب الوفاة feces excrete methane	• **Carbon-monoxide** • **Met-Hb forming compounds: nitrites** • **Cyanogenics** (substances that form cyanide) • **Sulfides, Azide** They are breathing 21% but something else is added to it that affect **transportation** of O2

SYSTEMIC Asphyxiants

CO

Carboxy-Hb → decrease transport & release.

- Binding to myoglobin:

- **impairs tissue O2 delivery**
- **CO binds to cytochrome oxidase in mitochondria inhibiting O2 utilization and aerobic metabolism** Affect ATP production

- Lipid peroxidation in CNS on the LONG term may lead to sequela

MetHb

Nitrite/Nitrate, aniline.

MET means META = beyond, **Not meth**

- **Oxidize Fe+2 (ferrous) to +3 (ferric) in Hb ,(Met-Hb) → Incapable of transporting O2 →Hypoxia, decrease ATP**
- **Direct vasodilatation**
- **Brownish blood, cyanosis (10% MetHB).**

pathognomonic (although it is specific but we don't wait for it b.c it seen in only 10-15% of conditions)

- **T ½: 1-3 hr**

Cyanogenics:

- **Body eliminates non-toxic levels of cyanide.**

موجود بالطبيعة في بذور التفاح لكن لو اكلت كم بذرة ماراح اموت جسمي يقدر يتصرف لحد معين

- **Cyanide has a high affinity for Fe+3, binding with it in the cytochrome oxidase.**
- **Free cyanides binds to cytochrome oxidase → aerobic metabolism.**
- **high risk for 2ry contamination.**
- **Air hunger, AGMA(anion gap metabolic acidosis), LA(lactate) > 10**

Air hunger is a compensatory mechanism for acidosis seen in cases where burning of plastic produces cyanide, so we treat both CO and cyanide

- **"arterialization" of venous blood**

since they lose the unloading of oxygen to Peripheral tissue so blood comes back to vein as it is

Azides & Sulfides

- **Similar to Cyanide but with local Irritation**
- **2ry contamination**

Azides: VD (vasodilation)

Sulfides: rotten eggs smell

(gas eye, knock down)

common approach in toxicology we follow smell but the problem is 1) I can miss in case of open area 2)I shouldn't wait for the smell 3) smell sensation is SUBJECTIVE (huge variation between person in responding to olfactory stimuli)

مثال على كذا لما يجيبون لك الشرطة واحد مشتبه فيه انه سكران ويقولون ايش رايك يحسبونك تغطي عليه لكن لقوا بدراسات أنه خمسين بالمئة ما يشمون ريحة الكحول

Poison Paradigm Treatment:

Alter Absorption & Elimination:

100% Oxygen & adequate ventilation

CO: 300 min > 90 min > 30 min

NORMAL half life of CO is 300 min so what we do is to give 100% O2 (15 L of oxygen) the half life will drop to 90 min (shorter half life >lesser

HBO (hyperBaric oxygen)

INDICATIONS:

1. **Cardiac manifestation:** chest pain, tachycardia, ischemic ECG finding

risk), and when we use hyperbaric chamber it will drop to 30 min	TREATMENT: dont do cath, b.c they have normal heart and coronary the only defect that O2 is not reaching the myocardium 2. **cerebral manifestation** 3. **Lactic acidosis** means CO + cyanide (2 toxins cannot handle alone) 4. **>25% of CO** normal person can handle 2-3% of CO but more than 25 is an indication for HBO, **pregnancy (15%)** we decrease the CO to protect the fetes **Irritant gases & Azides: no Ad (antidote)**

Antidotes:

1- Methylene blue:	2- Nitrite
• antidote used in **(Cardiac, cerebral or MetHb> 30%)** **"Not cyanosis"** مو يعني cyanosis اسمه ازرق يعني • **contraindication:** **1-G6PD** not common in our community **2-MetHb red def** (Methemoglobinemia) • **DOSE:** IN YOUR LEVEL not IMP **1-2 mg/kg over 5 min, repeat 30-60 min.** • **Side effect :** **Nausea, vomiting, Headache, blue-green urine** I should inform the patient, **hemolysis** thats why # in G6PD	• antidote used in **(cyanogenic & sulfide.)** **1-Induces MetHb (binds to cyanide instead of cytochrome oxidase)** عشان اشغله عن المايتوكندريا **2- Nitric Oxide.** • **contraindication: Allergy, MetHb > 40% or iatrogenic, CO, hypotension, severe RF.** • **DOSE:** **Amyl-:1 amp inhalation 30 sec/min for 3 min.** **Low efficacy + ?abuse. D/C if Na-nitrite.** **Na: 1 amp IV over 5 min.**
Sodium Thiosulfate:	**Hydroxocobalamine: VITAMIN B12**
For cyanogenic only. • **Side effect : n, v, site injection** • **DOSE: 1 amp IV over 15 min** **Hepatic Rhodanese: catalyses** enzyme that is normally found in our body but in small amounts, so add more to help reducing the level of cyanide in our body **Cyanide + Thiosulfate → Thiocyanate (less toxic & excreted in urine)** **The main rate limiting factor detoxifying cyanide**	**For cyanide, CO, confined fire.** • **Side effect :everything turns red.** urine, sputum, lacrimation • **DOSE:5 g IV over 15 min.** • **MOA: distribute CN differently.**

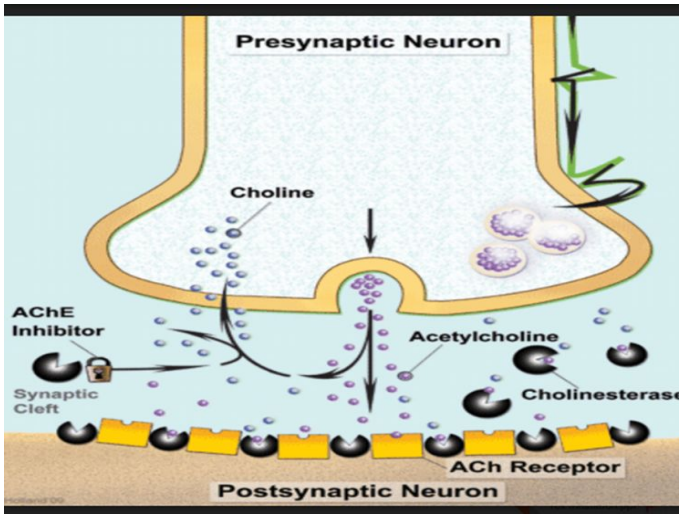
Cholinergic

Case 3:

2 janitors 2 عمال جابهم كفيلهم من سكنهم في المزرعة **were brought by their sponsors, they were: Unconscious, Seizing,** one having **miosis,** the other has **mydriasis, fasciculation, sweating, lacrimation, urination,** one having HR of 50 bpm **Bradycardia,** other having HR of 150 bpm **Tachycardia**

-SIGNS OF CHOLINERGIC (SLUDGE), the variation in heart rate and eyes is due to acting in different receptors (Muscarinic or Nicotinic)

- what we see in this pic is DIAZIN يسمونه الجرة organophosphate which unfortunately very common In our society and easy accessible
- We have a lecture about it but it IMP to be mentioned here b.c it overlap with toxic inhalation



- Ach (neurotransmitter) travel through synapse, then hydrolyzed by acetylcholinesterase enzyme in synaptic cleft
- organophosphate blocks acetylcholinesterase enzyme > no destruction> CONTINUED Ach release > repeated order forever >neuron become fatigued and paralyzed

PNS	
MUSCARINIC: **(Para-sympathetic & Neuro-effector)** **Smooth Muscle & GI**	**NICOTINIC:** **(Sympathetic & Para-)** **NMJ, Autonomic Ganglia**
• **Diarrhea** • **Urination** • **Miosis** • **Bradycardia, Bronchorrhea, Bronchospasm** (The 3 killer B's), bronchorrhea is fluid in bronchus • **Lacrimation** • **Emesis** • **Salivation, Sweating, Secretion**	• **Mydriasis** • **Tachycardia** • **Weakness** • **HTN** • **Fasciculation**
CNS (M & N):	
Confusion -Convulsion -Coma	

Aging:

-Minutes → nerve agents (Soman)

-2 days → pesticides

-when organophosphate attach to ACHestarse enzyme in the beginning it is covalent binding (reversible) but after a while it becomes (irreversible) كل ما كانت هذه المدة اسرع كل ما كان أخطر

-organophosphate FIRST discovered as pesticide then turn to be weapon how ? they invent drugs (soman) by decreasing this interval (Instead of 2days to 2 min !!!)

- There is an additional treatment (pralidoxime) given during this 2 days يريحنا من موضوع الأجينج but is useless after irreversible binding (when there is irreversible binding what happens? I CAN NOT STOP SO I will wait until nerves regeneration which takes MONTHS so I will keep the patient intubated forever > huge cost on hospital

Management:

DECONTAMINATION

A: Secretion → Suction + Atropine

If there is fluid build up it will lead to airway blockage ,so suction improve patency of airway , And atropine causes bronchodilation and reduction in airway resistance

B: Breathing

C: If patient is **Hypotensive →** give **(fluid + Atropine)** to improve circulation

D: If patient has **Seizures →**give **Benzo** then you can give**→ Atropine + 2- PAM**

Atropine	Pralidoxime: (2 PAM, Protopam)
Competitive antagonist M only • **Para-sympatholytic.** • **Cannot counter-react nicotinic Sx** • **No Ach-estrase regeneration.** • **DOSE:** **0.5 – 2 - 6 mg IV, (0.01-0.04 mg/kg) q5min, till killer Bs resolve** 50 carton or more !!!!! HUGE DOSE IN ONE PATIENT since high dose may lead to volume overload so better to give in small doses	• **Dephosphorylate (reactivate) phosphorylated Ach-estrase, that not yet irreversibly covalent bonded** • **Also it binds to free organophosphate** تشبيه: مثلا حرامي بيي يسرق سيارة هل راح يسرق سيارة فيها السواق والا الفاضية ؟ الفاضية طبعا لما اعطي هذا الدواء راح امنع الحرامي يسرق الرسبتور لكن لو لحق يسرق قبل ما يجي السواق راح يصير الضرر للابد • **Indications: Nicotinic or CNS** • **Relative CI: MG** (myasthenia gravis), **Renal failure , No airway kit.** • **SE: laryngospasm** • **DOSE: 1 – 2 mg IV over 5 – 10 min, -infuse 500 mg/h for 24 h**

Pyrethrins

- **Neurotoxic**
- **Na channels: greater influx: depolarization & hyperexcitation**

acts on NON mammalian لا ثدييات حشرات وأقل > neurotoxicity

- **In mammalian liver → IgE-Anaphylactic Shock** (allergic, irritant)

ARE they organophosphate ? NO

Case 4:

الي يشمون الغراء والبنزين (HYDROCARBONS) unfortunately now they have access to better thing so we don't see it.

> sensitization of endocardium, on long term affect the CNS

السيناريو عادة طلاب ثانوي يشمون صمغ يدخل عليهم المدير فجأة ويقومون يركضون وزي ما قلت يشتغل على القلب <when they run the

sympathetic nervous system will work (fight or flight) what will happen to a sensitive heart ? SVT VT VF and may die

Case 5:

غاز مسيل للدموع مو على الأعصاب

- Riot Control Agent: **Any chemical not listed in a schedule which can produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination or exposure**
- **A toxic chemical and delivery system.**

- Biological and Toxin Weapons Convention (BTWC).

MCQ's

1) Young laboratory worker presents with inhalation injury. Which of the following pulmonary irritant gases will produce alkaline reaction if inhaled in large amount?

a. Chlorine
b. Ammonia
c. Phosgene
d. Sulfur Dioxide

2) 10-year-old girl is brought to the ED in the month of January by an ambulance with decreased level of consciousness. She was found in a room where family used burning coal for warming. Which of the following is the appropriate antidote for this poisoning?

a. Nitrate
b. Oxygen
c. Methylene blue
d. Physostigmine

Answers : 1-B , 2-B