

ASPHYXIANTS

Asphyxia

- **Asphyxia** or **asphyxiation** is a condition of severely deficient supply of oxygen to the body that arises from abnormal breathing or other reasons

TYPES OF NOXIOUS GASES

BY HENDERSON & HAGGARD - 5 GROUPS

1. Irritants
2. Chemical
3. Simple
4. Volatile
5. Systemic

1. Irritants — Injures Air Passages — Inflammation
Ex- smoke , tear gas , ammonia, formaldehyde
1. Chemical — CO , H₂S , CS₂ , CN , Arsine (combines with Hb and prevent oxygenation)
2. Simple — Inert gases acts mechanically by displacing O₂
(CO₂ . Helium , methane, nitrogen)
3. Volatile — Acts after absorption into the blood - tissue toxic.
4. Systemic poisons — insecticide , arsine , stibine.

CARBON MONOXIDE

colorless tasteless, Blue Flame ,non-irritative, lighter than air , incomplete combustion of carbon .

Action :-

200 – 300 times more affinity for Hb than O₂.

Displaces O₂ from Hb – COHb – stable compound

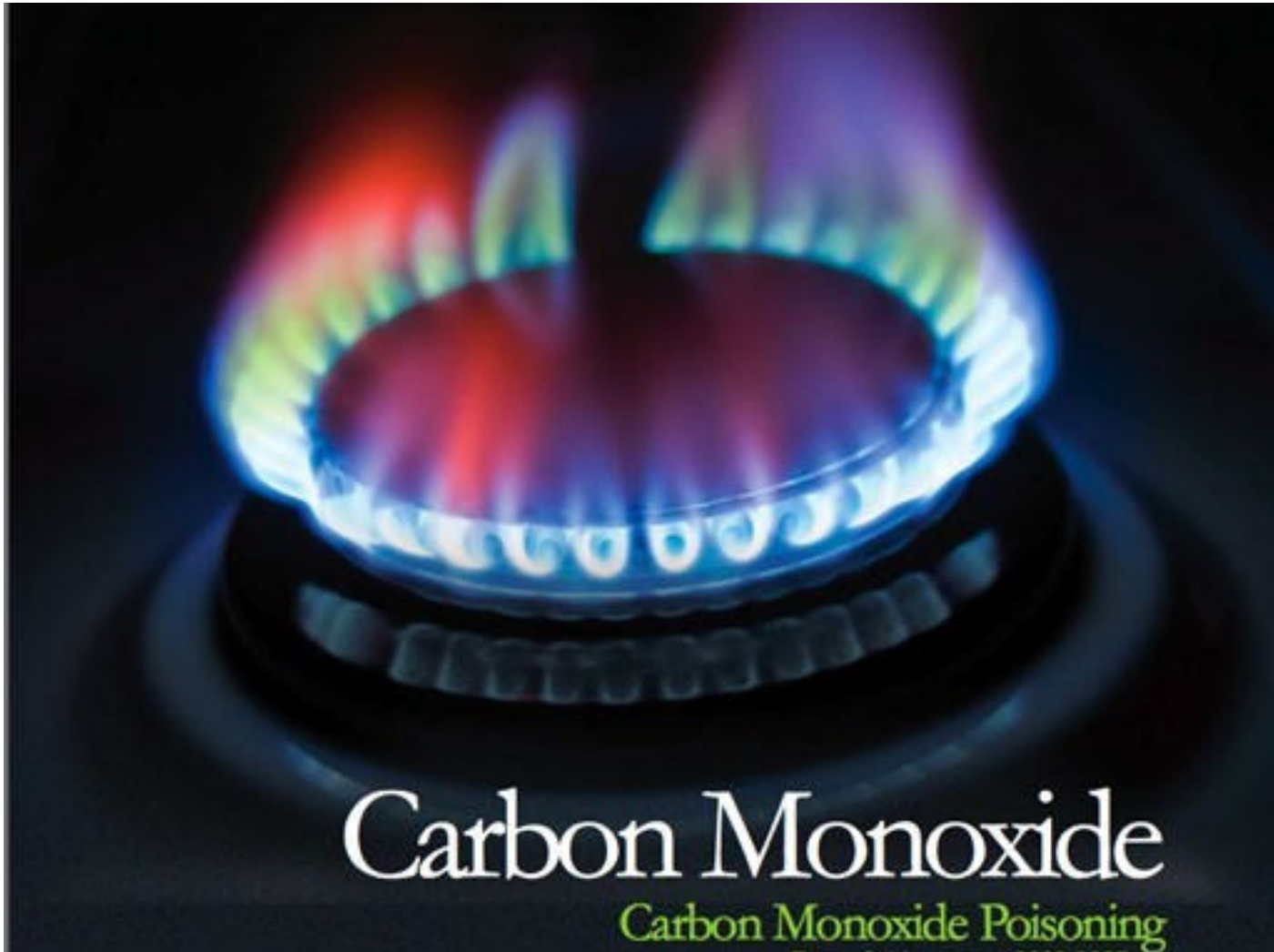
Death due to anemic anoxia .

Potent cellular toxin by binding to the Hb & myoglobin.

Blocks Cytochrome A₃ & Cyt – P 450 – hence intracellular respn.

COHb interferes with the release of O₂ from the little oxy hemoglobin that has been remained.

After somatic death the cells continue to extract the oxygen from oxy Hb at the peripheral capillaries – causes blue staining.



- in COHb, poisoning cells cannot break COHb hence cannot extract oxygen.
- hence for this reason blood under the skin & tissue will be in cherry red color.
- About 15% of CO in extra cellular tissues combined with myoglobin & hemoproteins

ELIMINATION

$\frac{1}{2}$ life of CO at room temperature is 4-5 hrs.

Reduced by 100% O_2

It is not metabolized / not lost through the skin, perspiration, bile, urine & faeces.

CO is not absorbed by the body after the death.

It is eliminated through the lungs only



coal gas, smoke from fires & fumes from defective heating appliances – furnace , stove , oil lamps, water heaters.

fumes furnaces, explosion of mines & exhaust fumes of internal combustion engines.

Exhaust gas of motor cars – 1-7% of CO – makes the small garage poisonous in 5-10 min.

Diesel engine produce far less CO than petrol engine.

During Hb catabolism 0.4-0.7% of COHb is produced with in the body.

In hemolytic anemia COHb levels may reach 8%.

symptoms progress with the rise of saturation of the CO in blood.

Regression of symptoms roughly corresponds to the clearance of the CO from the Blood.

Damage caused by the CO poisoning is mainly due to the suboxia.

CNS – monoplegia / hemiplegia , impairment of intellectual functions, personality changes, cerebellar damage & severe parkinsonism may occur / may be delayed by several weeks after apparent therapy.

Isolated bullous lesions with thick cellular fluid due to inflammatory reaction in the surround skin, localized by external pressure and are due to tissue hypoxia.

Rarely involve fingers & toes.

Signs of carbon monoxide poisoning



Headaches



Nausea



Dizziness



Breathlessness



Collapse



Loss of
consciousness

COHb %

0 – 10 %

10 – 20%

20 – 30%

30 – 40%

40 – 50%

50 – 60%

60 – 70%

70 – 80%

Above
80%

SYMPTOMS

No appreciable symptoms

Breathlessness on moderate exertion, mild head ache.

Throbbing headache, irritability, emotional instability, disturbed memory, judgement & rapid fatigue.

Headache, nausea, vomiting, dizziness, dim vision, confusion.

Inc. confusion, hallucinations, ataxia, rapid respn. & collapse with attempts of exertion.

Syncope / coma with intermittent convulsions, rapid respn., tachycardia with a weak pulse & pink / red color of skin.

Increasing depth of coma with urine & faecal incontinence

Profound coma with depressed / absent reflexes, thready pulse, shallow irregular respn., & death.

Rapid death from respiratory arrest.

OTHER IMPORTANT POINTS

Saturation required to cause the death varies with age and the health.
Death usually occurs when 80% of Hb is saturated with CO.

Senility / co-existing respiratory or circulatory diseases / anaemia / in association with CNS depressant drugs like barbiturates, alcohol result in significant decrease in the lethal saturation of the COHb & death can occur from as little as 30% saturation.

CO can cross the maternal blood to foetal blood & may cause IUD of the foetus even though the mother survives.

Rate of CO combining with the Hb varies with the atmospheric conc. & rate of respiratory exchange.

Physical activity increases the rate of saturation.

Children saturate their blood more rapidly than adults because of their rapid rate of respiratory exchange.

DELAYED POISONING :- Atrial fibrillation, BBB's, AV blocks, abnormal left ventricular function, decreased cognitive ability, mental retardation, psychosis, parkinsonism & incontinence.

Delayed Deaths :- Coma is accompanied by the degenerative changes in the brain & capillaries.

wide range of symptoms – blindness to decerebrate rigidity.

Humidity, high environmental temperature & physical activity – inc. respiratory rate – hence the absorption of CARBON MONOXIDE.

Upper limit of safety of CO in air is – 0.01%

conc. of 0.5 – 1% of CO in air – 75% saturation in 2-15 min
death occurs :-

0.2% gas in air – 4 hours 0.4% gas in air
– 1 hour

10% gas in air – 20 – 30 minutes.

Low conc. in the air needs longer periods to cause the death.

- Remove the patient to fresh air –
if conscious & breathing no treatment is needed.
- During 1st ½ hour 40 – 50% of CO is eliminated from the nonfatal cases.
- After that 15% is eliminated every hour.
- Any patient with COHb levels more than 25% -
Hyperbaric oxygen mixed with CO₂.
- Gastric lavage in the early course of treatment prevents aspiration pneumonia.
- Whole blood transfusion is helpful. Rest for 48 hrs.
- Avoid stimulant drugs.
- Prophylactic antibiotics to combat lung infections.
- Cerebral oedema treated with fluid restriction , steroids & mannitol.
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- cherry red discoloration of the skin, mucosa, conjunctiva, nail-beds, blood tissues & organs & areas of hypostasis.
- CN poisoning & exposing the body to the cold cause similar red discoloration as that of CO.
- Cherry red – dark green – brown with the onset of decomposition.
- Blood is fluid, hyperemia is general, serous effusions.
- Blistering of the skin in the dependant areas.
- Congestion of the lungs with pink fluid.
- Bronchopneumonic consolidation of lungs.
- petichae over the pleural, pericardial, meningeal membranes & necrobiosis of the heart muscle.
- bilateral symmetrical necrosis of the basal ganglia – Putamen / Globus Pallidus most characteristic lesion.

Punctiform hemorrhages in the white matter of the brain.

In India suicide by the CO is rare.

Accidental poisoning is the most common cause.

Homicide is uncommon unless victims

Tests :-

15 ml water + 2 drops suspected blood – pink color

Tannic acid added to the suspected – cherry red in COHb
(kunkel's test)

oxyhemoglobin turns deep brown.

Few drops of blood added to soln. of 10%NaOH –

COHb – pink color (Hoppe-seyler's test)

Normal blood – Brownish Green.

Spectroscopy characteristic bands of COHb.

- If only tissue is available – water is used to extract blood from the Liver, Spleen, Kidneys, Lungs & other organs.

- Heavy smokers may have blood CO level up to 10-12%.
- CO persists for many weeks after death & may be detected after putrefaction / embalming & prolonged burial.
- Cherry Red color of the tissue persists even if the tissue is placed in formaldehyde.
- Embalming also do not changes the color of viscera.
- It is preferred to use anti coagulants in specimens for examination.
- Irreversible brain damage due to high sustained COHb may show the good conc. in the brain tissue , since it is not the product of putrefaction.

In some cases of fatal poisoning blood analysis may not show the signs of the COHb poisoning – shifting of the patient to the fresh air and resuscitation.

Vapour / gas intoxication :-

10 ml of Heart Blood collected prior to the autopsy CO little tendency to clot.

Cells tend to separate from the plasma in the blood vessels & organs. Since CO is contained in the cells , care should be taken in getting the sample.

Tightly sealed in air tight gas light container. Blood need not be kept under oil because COHb is extremely unstable compound.

If sufficient blood not obtained – spleen / muscle should be sent for test.

Pieces of lung – tightly sealed & refrigerated.

In a badly burnt body – CO can be detected in sero sanguinous fluid. CO gas cannot be absorbed by the body after the death.