

## Industrial use of lethal substance and its easy access to artisan makes life insecure: A case of potassium cyanide poisoning

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### Abstract

Poisoning is one of the main contributors to the mortality and morbidity in both developed and developing countries. Poisoning is a common method of suicide and one of the common causes of death in developing countries, followed by accidental and in some cases homicidal. Cyanide poisoning is a suicide method that can either kill quickly or with horrific symptoms, depending on how the substance is administered. Industrial use of cyanide includes electroplating, metal processing, and extraction of ores, photographic processes, production of synthetic rubber and manufacture of plastics. A 26 year old male artisan was working in gold manufacturing factory. He had no history of any kind of depression or addiction neither had any chronic disease when he commits suicide by consuming potassium cyanide at working place. At autopsy, bluish pink colour post-mortem lividity noted over back, chest and abdomen with lip and fingernails cyanosis. All visceral organs were severely congested. Stomach mucosa haemorrhagic with erosion seen at places. Histopathological report showed greenish discolouration on cut section of liver and kidney with pulmonary and cerebral oedema present. Chemical analysis report of viscera came positive for potassium cyanide. Present case discusses as to how easy access of lethal industrial substance to person made his life perilous.

**Key words:** Suicidal poisoning, Potassium cyanide, Gold manufacturing factory.

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### Introduction

The word poison is evolved from the Latin word "potion" that is to drink.<sup>(1)</sup> The father of toxicology, Paracelsus, once wrote, "Everything is poison, there is poison in everything, only the dose makes a thing not a poison".<sup>(2)</sup> Poison is a substance (solid, liquid or gaseous) which if introduced in the living body, or brought into contact with any part thereof, will produce ill-health or death, by its constitutional or local effects or both.<sup>3</sup> Poisoning is a common method of suicide and one of the common causes of death in developing countries, followed by accidental and in some cases homicidal. Pattern of poisoning in any region depends on variety of factors such as availability of poison; socio-economic status of population, cultural influence.<sup>(4)</sup> Cyanide occurs as gas or liquid or solid. In its gaseous state it is referred to as hydrogen cyanide; the liquid form is referred to as hydrocyanic acid or prussic acid; salts of cyanide occurs as solids (white, crystalline powder). The odour of cyanide, especially the gas, is described as "bitter almond" in nature. However, it cannot be perceived by everybody. Hydrogen cyanide is a colourless flammable gas with a faint bitter almond odour. Hydrocyanic acid is the liquefied form of hydrogen cyanide, and is a bluish white liquid with a faint, bitter almond odour. Potassium, sodium and calcium cyanides are white, deliquescent, non-combustible solids with a faint bitter almond odour.<sup>(5)</sup> Potassium cyanide is colourless crystalline salt, similar in appearance to sugar, is highly soluble in water. Most potassium cyanide is used I gold mining, organic synthesis, and electroplating. Smaller

applications include jewellery for chemical gliding and buffing.<sup>(6)</sup>

### Case History

A 26 year old male artisan was working in gold manufacturing factory. He had no history of any kind of depression or addiction neither had any chronic disease as per police information when he commits suicide by consuming potassium cyanide at working place. He found unconscious state in the room where gold gilding and buffing work was being done. His friends taken him to nearby hospital for treatment where doctor declared him dead before admission and sent his body for post-mortem examination.

An autopsy was conducted on dead body after receipt of inquest. On external examination, built was normal with no external injuries were found on body. Rigor mortis well developed in all limbs with flexion at wrist and interphalangeal joints seen in both upper limbs. Bluish pink colour post-mortem lividity noted over back, chest and abdomen and anterior aspect of thighs. Lips and fingernails cyanosis noted. Both eyes were congested and glassy. Bluish discolouration of gums noted. All visceral organs were severely congested. Both lungs show white caseous necrotic areas of tuberculosis with congestion and oedema. Brain parenchyma shows oedema with congested meninges. Stomach contains minimal fluid with mucosa congested, eroded and haemorrhagic. Post-mortem blood looks like brick red colour. Tissue and viscera kept for histopathology and chemical analysis examination reports respectively.



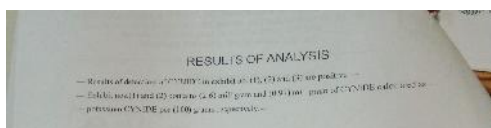
**Fig. 1: Shows bluish pink colour post-mortem lividity over face, chest and upper limbs.**



**Fig. 2: Shows post-mortem lividity over back.**



**Fig. 3: Shows eroded and haemorrhagic stomach mucosa**



**Fig. 4: Shows result of chemical analysis positive for potassium cyanide.**

### Discussion and Conclusion

Suicidal, homicidal and accidental poisoning due to consumption of cyanide substance is not common in developing countries, reason being no availability and difficult procurement of cyanide substances. However these substances are being commonly used in industry and laboratory for various manufacturing purposes. In such circumstances, people who work in such area are highly at risk of having accidental or suicidal poisoning from such lethal substances. Suicidal poisoning by cyanide can be seen in some occupational groups having ready access to cyanide e.g. pharmacist, chemists, and medical or paramedical personnel. Homicide by cyanide is not evident nowadays since it is rare, but cases of homicide by cyanide had been reported in past. Cyanide has been used legitimately to kill convicted criminals in some of the states of the USA.<sup>(5)</sup>

Toxicity and fatality of cyanide compound depends upon the state in which it is administered in the body. Inhalation of 1 part in 2000 of hydrogen cyanide can

kill person instantaneously, 1 part in 10,000 within a few minutes, and 1 part in 50,000 within a few hours. The upper limit of safety is 1 part in 100,000. 50 to 100mg of hydrocyanic acid is fatal. Fatal dose for potassium and sodium cyanide is 100 to 200mg. The minimum lethal dose for KCN and NaCN has been estimated to be about 3mg/kg.<sup>5</sup> A number of prominent persons were killed or committed suicide using potassium cyanide, including computer scientist Alan Turing, polymer chemist Wallace Carothers, Danish writer Gustav Wied, and Slobodan Praljak, a wartime general in Republic of Croatia, committed suicide by drinking from a vial containing potassium cyanide during the reading of his sentence in the Hague on International Criminal Tribunal on November 2017.<sup>(7)</sup>

Absorption is rapid across both skin and mucous membrane. Ingestion of cyanide salts results in the release of HCN through the action of hydrochloric acid in the stomach, and is subsequently absorbed as the cyanide ion. Cyanide is distributed to all organs and tissues via the blood, where its concentration in red blood cell is greater than that in plasma by a factor of 2 or 3. Metabolism occurs mainly in the form of conversion to thiocyanate by the enzyme rhodanese (present in the mitochondria of liver and kidneys), which needs sodium thiosulfate for effective functioning. Half-life for the conversion of cyanide to thiocyanate is between 20 minutes to 1 hour. Some amounts of cyanide are excreted in the breath and sweat producing the characteristic bitter almond odour. Toxic effect of cyanide is mainly attributed to its production of a histotoxic anoxia by inhibition of cytochrome oxidase. Cyanide causes direct neurotoxicity through lipid peroxidation due to inhibition of antioxidant enzymes.<sup>(5)</sup>

Acute poisoning of cyanide causes various manifestations in respect to different systems such as CNS includes headache, confusion, convulsions and coma; CVS includes bradycardia, hypotension and ventricular dysrhythmias; RS includes tachypnoea followed by bradypnoea, non-cardiogenic pulmonary oedema and cyanosis; GIT includes nausea, vomiting, abdominal pain, and some salts cause corrosion. Brick-red colour of skin and mucous membranes is said to be characteristic. It is due to increased haemoglobin oxygen saturation in venous blood because of decreased utilisation of oxygen by tissues. The skin feels cold and clammy to the touch. Cyanosis is a late feature. For diagnosis of cyanide some test has been used such as Lee-Jones test, quantitative assays by pyridine/barbituric acid method and serum cyanide level. If serum cyanide level is greater than 2.5mg/L and 3mg/L leads to respiratory depression and death respectively. For antidotal treatment purpose three-step Eli Lilly cyanide kit approach is employed. This comprises first step- amyl nitrite, second step- sodium nitrite and third step- sodium thiosulfate.<sup>(5)</sup>

Meticulous post-mortem examination is imperative in suspected cyanide poisoning cases. Prior to the starting of autopsy examination complete history as to the place of incident, occupation of deceased and psychological condition of deceased need to be obtained from reliable source. It will help in ascertaining the manner of death. Colour of post-mortem lividity in fair person gives idea about the suspected cyanide poisoning. Organ rich in RBC such as spleen shall be kept for chemical analysis since it gives highest percentage of cyanide poison.

In present case deceased was suffering from pulmonary tuberculosis, this has been diagnosed on autopsy as well as on histopathology. Greenish discoloration of liver and kidneys were noted on histopathology report. Viscera report of chemical analysis came positive for potassium cyanide. Stomach and part of intestine contains (2.6mg) and liver, spleen and kidney contains (0.97mg) of cyanide calculated as potassium cyanide per 100gm respectively. Owing to long standing disease deceased might have committed suicide by consumption of potassium cyanide. In this case death might have been averted if he could not have been accessed the poison easily. So in order to avoid such incidents the easy access to lethal substance must be prohibited and other appropriate measures to be taken to prevent the accidental exposure to poison.

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