

## Tetrahidrokannabinol kullanımının kolaylaştırdığı karbonmonoksit zehirlenmesi: İki olgu sunumu

### Carbonmonoxide intoxication facilitated with the use of tetrahydrocannabinol: Report of two cases

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#### ÖZET

Karbonmonoksit (CO) renksiz, kokusuz, tam olarak yanmayan non irritatif özellikte bir gazdır. Yüksek seviyede solunduğunda letal etkiye sahiptir. Önemli bir halk sağlığı sorunu olan karbonmonoksit zehirlenmesi ülkemiz için özellikle kış aylarında görülen, oldukça sık rastlanan morbidite ve mortalite nedenidir. Literatürde CO intoksikasyonlarına madde bağımlılığının da eşlik ettiği bildirilmiştir. Tetrahidrokannabinol (THC/esrar) maddesinin kullanımı sıklığı sigara, alkol, kafein gibi bağımlılık yapıcı maddelerden sonra gelmektedir. Bu çalışmamızda, kanlarında THC saptanan ve CO entoksikasyonu sonucu ölen olgular üzerinden, esrarın nöropsikiyatrik ve bilişsel yetenekler üzerinde oluşturduğu etkiler tartışılmıştır.

**Anahtar Kelimeler:** Karbonmonoksit, tetrahidrokannabinol, intoksikasyon, otopsi, adli toksikoloji.

#### ABSTRACT

Carbon monoxide (CO) is a colorless, odorless gas with the non-irritative feature that does not completely burn. A high level of respiration has a lethal effect. Carbon monoxide poisoning, which is a major public health problem, is the frequently encountered cause of morbidity and mortality in Turkey, especially in the winter months. It has also been reported in literature that CO intoxications go hand in hand with substance addiction. The use of tetrahydrocannabinol (THC/marijuana) often leads to the dependence on substances such as cigarette, alcohol and caffeine. In this study of cases where death resulted from CO intoxication and THC was determined in the blood, the effects created by the drug on the neuropsychiatric and cognitive capacity are discussed.

**Keywords:** Carbonmonoxide, tetrahydrocannabinol, intoxication, autopsy, forensic toxicology.

## INTRODUCTION

Carbon monoxide (CO) is a colorless, odorless gas with the non-irritative property that does not completely burn (1). As it is heavier than air, it can easily get accumulated in unventilated areas (2). A high level of inspiration has a lethal effect. This effect is achieved through the prevention of the oxygenation of tissues associated with a hemoglobin rate 230-245 fold greater than oxygen (3-5).

The reduction in oxygen-carrying capacity of blood caused by carboxyhemoglobin (COHb) and a shift to the right of the oxygen hemoglobin disassociation curve which accompany a state of hyperventilation make it more difficult for oxygen to be transferred

to tissues (2,6). Furthermore, that the cytochrome C and cytochrome P450 systems are blocked with the competitive inhibition effect of CO has been shown in previous studies (7,8).

Incomplete burning of gases used for heating and lighting, incomplete burning wood, coal, water gases, smoke from barbecues, cigarette smoke and vehicle exhaust gases are the leading agents causing poisoning (9, 10). Deaths occurring as a result of incompletely burned fuel constitute approximately 30% of CO-origin deaths (11).

CO poisoning, which is a major public health problem, is one of the most frequently encountered causes of morbidity and mortality in Turkey, especially in the winter months. It is noticeable CO

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intoxications, which are currently seen more often than intoxications from other toxic substances, are preventable deaths (12).

The clinical signs of poisoning differ from one another according to the length of exposure, the concentration of CO in the environment and the alveolar ventilation capacity (13,14). Although cases of death have been reported in literature at a level of 33% COHb, the lethal threshold is generally accepted as 60%-70% COHb (15, 16). As a result of clinical examinations, the length of exposure to CO is reported to be a stronger indicator than the level of COHb determined in the blood (10,17,18). CO triggers these effects depending on the concentration in the environment. The lethal effect of CO can be seen within 5 minutes in the death cases stemming from exhaust in a closed garage (19).

It has also been reported in literature that CO intoxications accompany substance addiction (19). The use of tetrahydrocannabinol (THC/marijuana) is often followed by dependence on substances such as cigarette, alcohol and caffeine (20). THC is generally the first illegal drug to be tried. As progression to substances such as heroin and cocaine is often seen, it is known as a bridging substance (21). In a previous study, it was reported that 12% of the population have tried drugs at some point in their life. In Turkey the rate of use has been calculated as 4%, with a greater rate determined in adolescents compared to adults (22).

In this study of cases where death resulted from CO intoxication and THC was determined in the blood, the effects created by the drug on the neuropsychiatric and cognitive capacity are discussed.

## CASE 1

### Case History

On the basis of the statements taken from the relatives, a 23-year old male was found uncon-

scious in the driving seat of a car on which he was working. The ambulance service was called, the first aid was applied at the scene, but as no response was obtained during the interventions, the death was confirmed. In the forensic examination of the scene, 100mg Sildenafil tablets were found on the victim.

### Autopsy findings

In the external examination, the body was determined as 185 cm tall and 75-80 kg in weight. Marks of death had formed pale red and pink in color, there was a hyperemic appearance on the anterior surface of the face and chest, and there were several old healed cuts on the left forearm. There were no findings of cutting or penetrating instrument wounds, firearms wounds, signs of hanging, marks of strangulation or suffocation, or trauma.

When the skull was opened, the brain and cerebellum were 1759 g in weight, the surface and cross-sections were hyperemic and edematous, there were no abnormal findings in the brainstem apart from hyperemia and oedema, and the cerebellar tonsils were seen to have become more pronounced.

When the chest was opened, there was no free blood or fluid in the chest cavity, the internal surface of the chest wall was hyperemic, both lungs were free, the right lung weighed 802 g and the left lung 720 g, the pulmonary surfaces were seen to be hyperemic, intensely asphyctic hemorrhagic and pink in color and there was intense edematous fluid and hemorrhage in the cross-sections. The heart weighed 415 g, a hyperemic appearance was seen on the surface, there was no significant narrowing in the coronary arteries and the myocardial cross-sections were seen to be hyperemic. In the examination of the neck organs, the esophagus lumen were natural, there was no abnormality in the tongue and the thyroid glands were seen to be hyperemic.

When the abdomen was opened, the pancreas, liver and spleen were seen to have a hyperemic appearance, the stomach was empty, no abnormality was seen in the intestines or the skeletal system, the blood was slightly paler than normal color and watery in consistency, and hyperemia was seen in all the soft tissues.

### Toxicology Findings

With the CO-oximeter method, 68% COHb was determined in the femoral blood. With the CEDIA method, 71ng/mL THC was determined and THC positivity was determined in the urine with the CEDIA-GC/MS method. Apart from these findings, no toxic substance was determined in any other samples (gall bladder, intraocular, stomach contents etc).

### Histopathological Examination

Hyperemia was observed in the brain, cerebellum and brainstem, no characteristics of note were observed in the heart muscle and coronary arteries, congestion and atelectasia were determined in the lungs, congestion in the liver and kidneys, and necrotic epithelium cells were observed in the prepared anal smear but not in the spermatozoa.

### Autopsy Result

The cause of death was reported as CO poisoning as a result of the high level of 68% COHb in the blood in the chemical examinations. It was concluded that the level of 71ng/mL THC determined in the blood and THC positivity in the urine were not influential in the death of the individual (Table 1).

## CASE 2

### Case History

A 22-year old male was found lying in the passenger seat of the same vehicle as 'Case 1'. The ambulance service was called, first aid was applied at the scene, but as no response was obtained during the interventions made, the death was confirmed.

### Autopsy findings

In the external examination, the body was determined as 181 cm tall and 75-80 kg in weight. Marks of death had formed pale red and pink in color, there was foaming bloody material around the mouth and nose, there was parchment-like plaque in the chest wall (possibly associated with cardiopulmonary resuscitation), remnants of black dye were observed on the finger pulp of both hands and there were no findings of cutting or penetrating instrument wounds, firearms wounds, signs of hanging, or any trauma.

When the skull was opened, there was widespread, asphyctic bleeding below the scalp, the brain and cerebellum were 1391 g in weight, and the surface and cross-sections of the brain and cerebellum were hyperemic and edematous.

When the chest was opened, both lungs were free, the right lung weighed 871 g and the left lung 877 g. Externally, an anthracotic, pale red tone was observed, oedema and scattered mottled, asphyctic bleeding and the cross-sections were seen to be edematous and mottled. In the examination of the neck organs, the esophagus lumen were natural, the thyroid cartilage, hyoid bone and neck vertebrae were intact and foaming blood was observed in the trachea.

When the abdomen was opened, the surface and cross-sections of the pancreas, liver and spleen were seen to have an appearance of congestion, the stomach was empty, the external surface and cross-sections of the small and large intestines were natural and blood exposed during the autopsy was pale colored and watery in consistency.

### Toxicology Findings

With the CO-oximeter method, 69.6%COHb was determined in the femoral blood. With the Cedia method, 30ng/mL THC was determined and THC positivity was determined in the urine with the Cedia-GC/MS method. Apart from these findings, no toxic substance was determined in any other samples (gall bladder, intraocular, stomach contents etc).

**Table 1:** Blood THC and COHb levels of cases

|               | <b>THC Level</b> | <b>COHb Level</b> |
|---------------|------------------|-------------------|
| <b>Case 1</b> | 71ng/ml          | 68%               |
| <b>Case 2</b> | 30ng/ml          | 69.6%             |

## Histopathological Examination

Hyperemia was observed in the brain and cerebellum, no characteristics of note were observed in the heart muscle and coronary arteries, congestion was determined in the liver and kidneys. The anal smear not including sperm was seen to have been recorded.

## Autopsy Result

The cause of death was reported as CO poisoning as a result of the high level of 69.6% COHb in the blood in the chemical examinations. It was concluded that the level of 30ng/mL THC determined in the blood and THC positivity in the urine were not influential in the death of the individual (Table 1).

## DISCUSSION and CONCLUSION

CO intoxication occurs in various forms such as accident, suicide or murder. It has been reported that CO deaths in Turkey occur mostly as a result of accident, followed by cases of suicide and cases of murder are extremely rare (23,24). Great differences are seen in the rates of CO deaths because of socio-economic and climate differences of countries and cases of CO-originated suicide have been reported more often in foreign countries (25,26).

By absorption from the stomach and lungs, narcotics have an effect on the central nervous system, causing impairment in the sense of time, loss of concentration and a slowing of physical movements. With a feeling of over-confidence, an individual may undertake actions which he would not normally dare to do. Although the direct effects of THC dissipate in 3-4 hours, impaired orientation, circulation and motor functions may continue for

up to 24 hours. It has been reported in literature that even after days or weeks, these impairments may emerge with the effect of THC stored in fat cells (27).

Some studies have shown that in some cases CO intoxication could be caused by the use of substances or drugs (19). There could be a facilitating effect in CO intoxication of a secondary effect of the substance used or because of the neuropsychiatric status of the individual caused by substance use. After cigarettes and alcohol, narcotics are known to be the most frequently used illegal addictive substance (20).

Therefore, with the foresight that substance addicts could be exposed more frequently to all kinds of intoxication, the social environment is important, or if they are under treatment, it is important to design and create an environment of close and careful observation. That tablets with Sildenafil active substance were found on one of the cases suggests that THC could have been used for pleasure or to provide courage. Behavioral effects are primary among the acute effects of THC use. In addition to mind alterations, behavioral changes can cause the emergence of characteristics which are not in the individual's personality, such as courage and initiative in various environments.

It is possible that the process of CO intoxication is facilitated through the effect on mood and behaviour required to be shown at the time of using THC. Neuropsychiatric changes such as the loss of concentration, impaired reasoning, feeling of relaxation associated with the removal of mental inhibitions, impaired perception of time and weakened reflexes prevent the individual from demonstrating the attitude and behaviors required at the time of an event (28).

When all this is taken into consideration, in addition to the primary damage of substance abuse, by predicting that it could be a cause of death as the result of an accident with secondary effects, there must be increased awareness on the subject of preventing addiction, the necessary precautions must be taken in respect of accidents which could occur and education must be provided.

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