Research on carbon monoxide harm to human body and protective measures

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Abstract. Carbon monoxide which is an invisible and scentless gas, is commonly encountered in various settings such as industrial operations, transportation systems, and domestic environments. It is primarily produced through the incomplete combustion of carbon-rich materials. The World Health Organization reports that more than 100,000 individuals receive medical attention for carbon monoxide poisoning annually, with many fatalities occurring due to delayed intervention. The long-term health implications of continuous exposure to even low levels of carbon monoxide are significant, particularly for vulnerable groups like the elderly, expectant mothers, and those with existing respiratory or cardiovascular conditions. Therefore, it is imperative to enhance our understanding of the origins of carbon monoxide, its toxic effects, and the strategies to mitigate its risks. This article aims to delve into the detrimental effects of carbon monoxide on human health and to suggest a range of preventative measures aimed at diminishing the likelihood of carbon monoxide exposure.

Keywords: carbon monoxide poisoning, preventative measures, toxic effects, carbon monoxide harm

1. Introduction

Carbon monoxide is a highly dangerous gas that is widely found in industry, transportation and household life, and is mainly produced when carbon-containing materials are burned. According to the World Health Organization (WHO), more than 100,000 people are treated for CO poisoning every year, and many cases are not treated in time that resulting in death [1]. In addition, the potential health hazards of prolonged exposure to low concentrations cannot be ignored, especially for the elderly, pregnant women, and individuals with cardiopulmonary diseases. Therefore, in-depth understanding of the source, toxicological mechanism and protective measures of CO has important public health significance. The aim of this paper is to analyse the adverse effect of carbon monoxide on human health and protective measures.

2. Sources of carbon monoxide

2.1. Transportation

Motor vehicle emissions are the main source of carbon monoxide pollution in cities, especially in areas with traffic congestion. Due to low engine operation efficiency, carbon monoxide emissions will be greatly increased [2]. In areas with high traffic, such as city centers or congested areas during rush hour, carbon monoxide concentrations often reach dangerous levels. With increasingly strict environmental protection policies, many cities have begun to promote electric vehicles (EVs) and hybrid vehicles, and the popularity of these technologies is expected to significantly reduce carbon monoxide emissions from vehicles. However, the popularity of electric vehicles still faces some challenges, such as high cost and imperfect charging facilities.

In addition, public transportation in cities, such as buses and subways, can also be a source of carbon monoxide emissions. These problems are especially serious in older public transport facilities. Therefore, updating vehicles, improving fuel efficiency, and promoting the use of electric vehicles will be key measures to reduce carbon monoxide pollution in the future.

2.2. Industrial Production

Some industrial processes, such as steel production, chemical manufacturing and mining, also produce large amounts of carbon monoxide. For example, carbon monoxide is widely produced as a by-product in the metallurgical industry and can pose a serious health hazard to workers if not handled properly [3]. Industrial sites such as steel plants and fertilizer plants, due to incomplete combustion in the operation process, often release a large amount of carbon monoxide, and workers in these places are exposed to a high concentration of carbon monoxide for a long time, which is easy to lead to poisoning.

With the advancement of industrialization, how to reduce harmful gas emissions while ensuring production efficiency has become the focus of attention of governments and enterprises. It is an effective way to reduce carbon monoxide pollution from industrial sources to strengthen the control technology of pollutants in industrial production, improve the utilization rate of resources and improve the emission standards.

2.3. Household combustion equipment

Devices such as gas water heaters, coal stoves and fireplaces commonly found in homes, especially during winter heating, are prone to the accumulation of carbon monoxide due to poor ventilation or aging of the equipment [4]. In particular, gas water heaters and old-fashioned coal stoves, due to incomplete combustion, may lead to a sharp rise in the concentration of carbon monoxide in the indoor air, which can lead to poisoning events.

Therefore, it is very important to improve the design and regular maintenance of household combustion equipment, especially for old gas equipment, which should be replaced or overhauled in time to ensure its safe operation. At the same time, the installation of a carbon monoxide alarm can monitor the concentration of carbon monoxide in the air in real time, and issue an alarm before the danger occurs, reducing the occurrence of poisoning incidents.

2.4. Natural environment

Natural events, such as volcanic eruptions and forest fires, also release carbon monoxide, and although such sources account for a relatively small percentage of global carbon monoxide emissions, they can have significant local environmental impacts at specific times and places [5]. For example, forest fires will burn a lot of organic matter, produce a lot of smoke and carbon monoxide, especially in the case of strong wind, smoke may be blown to the city or the countryside, resulting in a sharp decline in air quality, and even lead to carbon monoxide poisoning.

Therefore, for natural disasters such as forest fires and volcanic eruptions, it is necessary to strengthen early warning systems and emergency response measures, timely environmental governance and evacuation measures to reduce the health hazards of carbon monoxide.

3. Harm of carbon monoxide to human health

After entering the human body, carbon monoxide enters the blood mainly through the respiratory tract and combines with haemoglobin to form carboxyhaemoglobin, which significantly reduces the oxygen carrying capacity of the blood and leads to hypoxia of the whole-body tissues [6]. The main effects of CO on the human body are as follows.

3.1. Nervous System

The nervous system has an extremely high demand for oxygen, so the most common symptoms of carbon monoxide poisoning are headache, dizziness, confusion, etc., and in severe cases can even lead to coma and brain damage. Long-term sequelae such as memory loss and cognitive impairment may occur after prolonged exposure to carbon monoxide poisoning [7]. Some studies have also found that long-term exposure to low concentrations of carbon monoxide may be associated with the development of depression and other mental health problems.

3.2. Cardiovascular System

Carbon monoxide exposure can also have serious effects on the cardiovascular system. Acute poisoning can cause arrhythmia, heart muscle damage, and even cardiac arrest. Epidemiological studies have shown that long-term exposure to low-concentration carbon monoxide will significantly increase the incidence and mortality of cardiovascular diseases [8]. Especially in patients with a history of heart disease, the risk of carbon monoxide poisoning is higher, so it is particularly important to protect susceptible groups, especially those with cardiovascular disease.

3.3. Respiratory System

High concentration of carbon monoxide can lead to symptoms such as shortness of breath and dyspnoea, especially for patients with chronic respiratory diseases [9]. In addition, long-term exposure to low concentrations may worsen the condition of patients, making respiratory infections and other respiratory diseases more severe.

3.4. Other Impacts

Carbon monoxide poisoning is a serious health concern that can manifest in a variety of symptoms, including muscle weakness and blurred vision, which can be particularly hazardous for pregnant women. The exposure to CO during pregnancy poses a significant risk not only to the mother but also to the developing fetus. Studies have indicated that carbon monoxide can cross the placental barrier, leading to higher concentrations of carboxyhemoglobin (COHb) in the fetus compared to the mother. This increased level of CO in the fetus can result in a slower elimination rate, putting the fetus at a greater risk for adverse effects. The detrimental effects of CO poisoning on the fetus are multifaceted. It has been associated with an increased risk of spontaneous abortion, stillbirth, anatomical malformations, and neurological disabilities. The severity of these outcomes can vary depending on the level of CO exposure and the stage of pregnancy.

4. Protective measures for carbon monoxide poisoning

4.1. Improvement of combustion equipment

Improving the design and maintenance of combustion equipment to ensure complete combustion is the basis for preventing carbon monoxide poisoning [11]. Check household gas equipment regularly to ensure that it is working properly to avoid carbon monoxide production.

4.2. Installation of carbon monoxide alarms

The installation of carbon monoxide alarms in homes and industrial places can monitor the concentration of carbon monoxide in real time, issue an alarm when danger occurs, and take timely measures to avoid poisoning [12]. Carbon monoxide alarms should become standard equipment in every home and public place, especially during winter heating.

4.3. Increase of public awareness

Strengthening public awareness of carbon monoxide hazards through publicity and education is an important measure to reduce the occurrence of poisoning incidents [13]. Regular community lectures and health education activities on carbon monoxide protection are carried out to enhance residents' self-protection ability.

4.4. Government policies and regulations

The government has passed legislation to limit carbon monoxide emissions from motor vehicles and industry, and encourage the use of clean energy, which has effectively reduced carbon monoxide pollution in the environment [14]. In the future, the government should continue to strengthen the

supervision of carbon monoxide emissions, and encourage the promotion of low-emission technologies and clean energy to further reduce environmental pollution.

5. Conclusion

As a colourless and odourless "invisible killer", carbon monoxide poses a serious threat to human health, and the number of deaths caused by carbon monoxide poisoning is still high globally every year. Through improving equipment design, popularizing carbon monoxide alarms, strengthening public education and other measures, carbon monoxide poisoning incidents can be effectively prevented. In addition, the government should further strengthen the supervision of carbon monoxide emissions and promote the popularization of clean energy. Future research should focus on the health effects of long-term low concentration exposure and develop more efficient protective equipment and strategies.

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