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Carbon Monoxide Poisoning From Recreational Boating

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Lake Havasu boaters revel in the activity of being seen with their boats whether moving or not. On a typical in-season weekend, thousands of boats will line the shores of Lake Havasu on both the Arizona and California sides. While the boats are tied-up, people will congregate in shallow waters around the boats to socialize and stay cool. Some boaters will run the engines while the vessel is in place to operate the electricity for the booming sound systems for music. Unfortunately, with low wind and high activity in the Lake Havasu Bridgewater Channel, carbon monoxide (CO) that belches from the boat exhausts lays low on the water. Over the past twenty years, carbon monoxide poisoning has been attributed to numerous deaths and non-fatal drownings.[1] This article will discuss what carbon monoxide is, how it affects humans, a review of CO incidents on lakes, first aid, and methods of prevention.

Carbon monoxide is a gas that is poisonous to the human body. This odorless and tasteless gas combines strongly with myoglobin, the oxygen transporting and storage protein of muscle. CO also combines with the respiratory enzymes necessary for oxygen use in cells which directly stops vital cellular functions. When humans breathe sufficient quantities of carbon monoxide it disrupts the oxygen transport process within the body, including uptake and utilization. Hemoglobin binds with CO 200 to 300 times more easily than oxygen, rendering it difficult and time-consuming to eliminate from the body once inhaled. CO has a half-life of it takes about 5 ½ hours. Therefore it takes 5 ½ hours before half the CO leaves the body and then

takes another 5 ½ hours for yet another half (down to 25% of the total) to leave the body. This slow release of CO makes this gas a long-term deadly prospect.[2]

Carbon Monoxide is the gas that results from incomplete oxidation during combustion. This is a common by-product of things like tobacco smoke, exhaust from automobiles, trucks, gas-powered equipment, and both gasoline and diesel fueled boats.[3] CO by itself is physically lighter than air is, which makes it unnoticeable when inhaling it. Moreover, while one may suspect that its "lightness" would allow it to float away, other substances in the air provide an atmospheric blanket keeping it in place in stagnant areas.

Boat related carbon monoxide poisonings are a common occurrence in the United States. According to the Colorado River Law Enforcement Association, (CRLEA) estimates that between the years 1990 and 2008 there were 810 carbon monoxide poisonings resulting in 149 deaths. Of that population, more than 18% are from the California-Nevada-Arizona region. CO poisoning typically occurs with people swimming around or under pontoon boats where motors are idling, or where the vessel had immediately been in use. Another high-risk area and activity for CO poisoning to occur is with people sitting on the rear transom of the boat during water skiing activities.

Symptoms of Carbon Monoxide Poisoning may include:

- Dull Headache
- Weakness
- Dizziness
- Nausea
- Vomiting
- Shortness of breath
- Confusion
- Blurred Vision
- Loss of Consciousness

Carbon monoxide poisoning is particularly dangerous to those who have been drinking alcoholic beverages or who may be sleeping.[4]

In 2003, the City of Lake Havasu in conjunction with Mohave County requested that the Arizona Department of Health Services (ADHS) conduct research to determine the levels of carbon monoxide within the Bridgewater Channel area. The ADHS examined the concentrations of carbon monoxide in the exhaled air of 62 volunteers at Rotary Beach during the 2003 Memorial Day Holiday weekend. The exhaled CO sampled and analyzed in the field, was used as a measure of the amount of carboxyhemoglobin (COHb) in the person's blood. This measurement serves as a good indicator of the carbon monoxide exposure level. The results of the study indicate that citizens were exposed to large concentrations during the investigation. "The percent COHb among non-smoking participants increased from an average of 1% between 10 am and 2 pm to 11% between 6 pm and 8 pm (Figure 1). Similarly, among smokers, the average percent COHb increased from 3% between 12 pm and 2 pm to 13% between 6 pm and 8 pm."[5] Most people can tolerate carbon monoxide levels of 1-70 parts per million (ppm), as CO levels increase symptoms present, at sustained levels above 150 ppm serious symptoms and even death can occur.[6] The study further indicates that those who remained in the area longer had a significantly greater concentration of COHb in their blood than those who were transient visitors.

The Double Angel Foundation, a not-for-profit, Colorado based awareness organization specializes in education of the dangers of Carbon Monoxide Poisoning on and around recreational boats. Their recommendation is that there be no swimming along side or behind a boat while engines are running, or within fifteen minutes after shutdown. This appears to be sufficient time for the air to circulate and have no "pooling" of CO gas. The ADHS study recommended to Lake Havasu City that bio-monitoring studies be conducted in the Bridgewater

Channel are and other parts of the lake to determine whether CO is a widespread or concentrated problem in Lake Havasu. Those studies resulted in new city ordinances that protect people from CO poisoning. The ordinances include no idling while beached (or at anchor), no stopping while navigating and no swimming in the channel. In addition, the ordinance states that a vessel must be underway within one minute of the start up. Lake Havasu City has posted signage in the Bridgewater Channel are that indicates the dangers of carbon monoxide poisoning and how to comply with the ordinances. The city also has monitoring stations within the channel area and when levels increase, bright red lights begin to flash warning people of the dangers. All of these efforts keep the concentrations of accumulated carbon monoxide gas to a safe and tolerable level.

Even with all the precautions, ordinances, and rules carbon monoxide poisoning can still occur. Each boater and passenger shares a responsibly in prevention. However, in the unlikely event one is exposed to carbon monoxide even for a short period it is important to remove them from the area and get to fresh air. Some of the effects of headache or nausea may persist after exposure has ended. An unconscious victim needs medical intervention via a 911 emergency call.[7] The ideal first aid for CO poisoning is breathing pure 100% medical grade oxygen. Severe cases require treatment in a hyperbaric chamber. A hyperbaric chamber is a specially designed chamber where a victim of CO poisoning breathes oxygen under increased pressure to reverse the effects of the poison gas.

While carbon monoxide poisoning incidents have been rare over the last few years on Lake Havasu, it is important to be vigilant in preventing future accidents. Making boats aware of the invisible hazard of CO poisoning Understanding the causes of the problems is the first step. Knowing how to administer first aid and obtaining help is the second step. Helping others understand potential issues is a third step. Responsible boaters should be trained in CPR and first

aid as well as proper boat handling procedures. Safety on Lake Havasu and on all waterways is just as important as having fun. For more information check out some of the links listed below.

LINKS

American Red Cross – Training & Certification

http://www.redcross.org/take-a-class

Arizona Game and Fish Department – Boating Safety Information

http://www.azgfd.gov/outdoor_recreation/BoatingEducationCategorypage.shtml

Double Angel Foundation – Raising Awareness of the Dangers of Carbon Monoxide Poisoning

http://doubleangel.org/

Divers Alert Network – First Aid and Oxygen Administration Training

http://www.diversalertnetwork.org/training/courses/

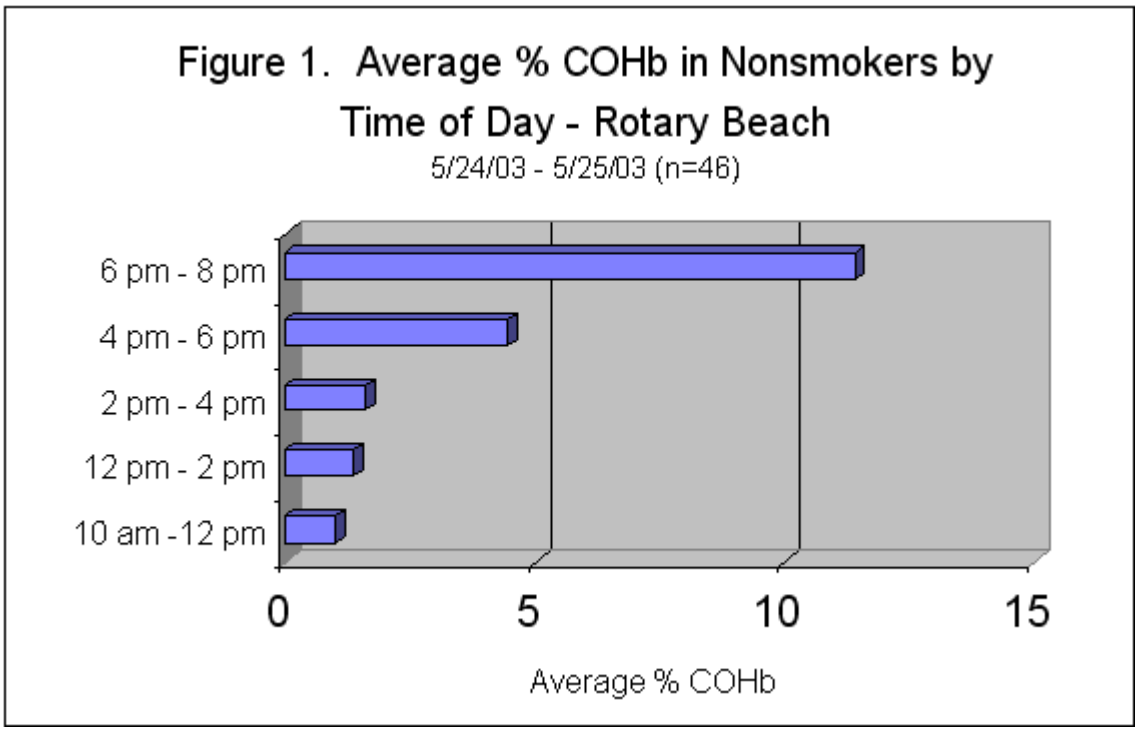
Lake Havasu City Convention and Visitors Bureau – Boating Safety

http://www.golakehavasu.com/activities/boating/boating_safety.aspx

Official Boater Safety Education Online

http://www.boat-ed.com/arizona/

Figures



Time of day when CO levels are highest during holiday weekend.

Humble, W., Hadzihasanovic, M., & Cox, R. (2003).

Photographs

Lake Havasu Bridgewater Channel Photo Courtesy- Kathy A. Weydig

Bridgewater Channel Boat Safety Sign and CO Warning Station

Photograph Courtesy: Kathy A. Weydig

Swimmers in Bridgewater Channel – Photo Courtesy: Nathan Adler

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[2] Hamilton, R., & Silverstein, J. (2001). Diving Physiology. In J. Joiner (Ed.), *NOAA diving manual: Diving for science and technology* (4th ed., pp. 3-11 to 3-12). Flagstaff, Ariz.: Best Publishing - US Department of Commerce

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[4] Carbon monoxide poisoning. (n.d.). Retrieved November 26, 2014, from http://www.mayoclinic.org/diseases-conditions/carbon-monoxide/basics/symptoms/con-20025444

[5] Humble, W., Hadzihasanovic, M., & Cox, R. (2003, June 1). ATSDR - Health Consultation - Rotary Beach at the London Bridge, Lake Havasu City, Arizona. Retrieved November 15, 2014, from http://www.atsdr.cdc.gov/HAC/pha/rotarybeach/rot_p1.html

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