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Review Article

THE IMPACT AND EFFECT OF ALCOHOL ON THE CARDIOVASCULAR SYSTEM, THE CNS AND CANCER

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ABSTRACT

The consumption of ethanol can have beneficial and detrimental effects on the function of the heart and cardiovascular system, depending on the amount consumed. Ethanol is known as a depressant that reduces the stimulation within the central nervous system. The chemical formula for ethanol is C_2H_5OH, with a molar mass of 46.068 g/mol. The low weight of the molecule allows a greater chance of diffusion and distribution in all body fluids and tissues. Alcohol affects various systems in the body start as the CNS by acting on its receptor sites. Long term drinking has been shown to have an effect on the cardiovascular system such as cardiomyopathy, and irregular heartbeats. This paper aims to analyze the detection of alcohol in the body, and its long and short term effects on the body's system.

Keywords: ethanol, detrimental, beneficial, diffusion

Absorption of Alcohol: Alcohol found in beverages is chemically known as ethanol or also known as ethyl alcohol. Ethanol is a thin clear liquid and considered to be a burning taste with high volatility.[1] These beverages, such as hard liquor, beer, and wine all contain different amounts of ethanol. The higher the percentage of alcohol a beverage has, the stronger it will become. The gastrointestinal tract absorbs alcohol after consumption then delivers the ethanol in the blood throughout the whole body. The liver metabolizes the majority of the ethanol, around 0.5 oz of alcohol per hour, and a small quantity of ethanol is eliminated during exhalation or urination. If individuals were to drink two or three drinks per hour, this could lead to intoxication due to the high levels of ethanol in the blood. Many factors can attribute to this such as an individual's weight, gender, amount of food and other drugs in their system.[2] Consumption of alcohol slowdowns brain functions and affects the way an individual think, feels and also plays a role in their behavioral actions. Alcohol is quickly absorbed into the blood and can be measured within minutes of having an alcoholic drink. The low molecular weight allows easily diffusion and circulation in all body fluids and tissues. After one hour of drinking alcohol,

ethanol levels in the blood reaches its highest peak.[1] Consumption of food before drinking can be one factor that increases the time it takes for the blood alcohol to reach its highest point. Detecting the level of alcohol can be done by testing a person's blood, urine, breath, and saliva. In large amounts, alcohol acts as a sedative and depresses the central nervous system. Short term effects of drinking alcohol include blurred vision, slurred speech, drowsiness, vomiting, breathing difficulties, impaired judgment, and blackouts. Some long term effects are liver damage, high blood pressure, brain damage, ulcers, and alcohol poisoning.[2]

Gas chromatograph is a process used to detect the level of ethanol in the blood by gas. One common separation technique used is headspace gas chromatography. Headspace gas chromatography is used to analyze volatile organic compounds of a solid or liquid matrix. Some common analyses are blood alcohol and toxicology screening, residual solvents in pharmaceuticals, flavor components from food and beverages, and fragrances in perfume and cosmetics.[3] There are two kinds of headspace: Static and Dynamic Headspace. Static headspace is used when compounds are generated in closed vials. An aliquot of the headspace is taken and injected on the detectors. The second type of headspace is dynamic headspace. The product that is analyzed is swept by the headspace and injected onto the detector after trapping on a cartridge, and desorption.[4] Headspace gas chromatography is favorable because it prevents nonvolatile residue accumulation in the inlet and column entrance while also simplifying sample preparation. It holds the entire matrix in a vial while transferring volatile components into GC inlet and column. The volatile components from mixture is extracted from non-volatile sample components and isolated in the headspace; an aliquot of the vapor in the headspace is then separated of all of the volatile components and then analyzed by Gas Chromatography.[5]

Alcohol effects on CNS:

Alcohol affects the brain by interfering with its communication pathways which subsequently will affect the brain's anatomy and function. The hippocampus is the elongated ridges on the bottom of each lateral ventricle of the brain. The Hippocampus is considered to be the core of emotion, memory, and the autonomic nervous system. Studies show that adolescents and young adults between the ages of 13–21 who were identified with alcoholic disorders had smaller bilateral hippocampal volumes. Furthermore, the gray matter volume in the brain has significant neurodevelopment during adolescence, which is susceptible to the effects of alcohol.[6]

Individuals who started drinking at an earlier age and had a longer duration of alcohol had even smaller hippocampal volumes.[7] Similar results were reported in another study where lesser volumes of the left hippocampal were observed in adolescents that consumed alcohol.[8] These studies suggest that the hippocampus plays a role in alcohol use disorders among adolescents. The frontal lobe has several functions such as differentiation tasks, emotions, memories, integration of novel stimuli, and cognitive flexibility. It was determined that adults who are heavy drinkers usually have smaller prefrontal regions.[6] Reports have shown that the prefrontal cortex in adolescents can be more susceptible to the effects of alcohol than other brain regions. This is because the prefrontal cortex of the brain continues to develop throughout adolescence and young adulthood of a person's life.[9]

The cerebellum gets information from the sensory systems, the spinal cord, and other parts of the brain. The cerebellum regulates and coordinates voluntary motor movements such as posture, balance, coordination, and speech, resulting in a smooth and balanced muscular activity. It is also important for learning motor behaviors. Studies, determined that consumption of alcohol can also damage the cerebellum in adolescents; the cerebellar volumes in adolescent boys were much less than those in the controls.[10]

Alcohol effects on cardiovascular system:

The heart is another organ that is affected by the consumption of alcohol. Studies have shown that the consumption of alcohol over a long period of time and is connected to cardiomyopathy.[11] The cardiovascular system consists of the heart and blood vessels. Blood is pumped around the body by the heart via blood vessels through arteries, capillaries, and veins. When an individual consumes alcohol, it is absorbed directly into the bloodstream mainly via the stomach and small intestine. Through the consumption of alcohol, the cardiovascular system can be affected. This can cause a momentary increase in heart rate and blood pressure. Long-term and consistent heavy drinking can lead to a continuous increase in heart rate, high blood pressure, weakened heart muscle, and irregular heartbeat.[12] All of these factors can increase the risk of alcohol related problems such as a heart attack or stroke.

Alcohol can also have an effect on the heart rate. Studies have found that individuals who regularly drink heavy alcohol can have episodes of tachycardia, which is an increased heart rate due to problems in the electrical signals that produce a heartbeat.

Drinking alcohol can also increase an individual's blood pressure. High blood pressure, also known as hypertension, is a measure of the amount of force blood places against the blood vessel walls. High blood pressure occurs when the blood is pumping with more force than normally through the arteries. Even if an individual does not drink alcohol regularly, consuming alcohol even on a single occasion there will be a temporary rise in their blood pressure.[13] Heavy regular drinking can lead to hypertension. High blood pressure can cause arteries to become thick and hard which can result in a heart attack or even a stroke. The Australian Heart Foundation suggests that an individual should not consume more than two standard drinks in a day. Researchers have discovered that if an individual consumes more than the recommended which is not more than two standard drinks a day, then there will be an immediate rise in blood pressure, which increases the risk of developing hypertension.[14]

Another effect of alcohol on the heart is the weakening of the heart muscles. The heart's job is to provide nutrients and oxygen throughout the body. The heart does this by producing the pressure for blood to travel throughout the body, making sure that the blood only goes in one direction. The rate of recurrence and force of the heart's contractions alter depending on the requirements of the individual's body. The heart muscle is called myocardium, and when the heart muscle is damaged, it is called cardiomyopathy. Furthermore, researchers have linked cases of damaged heart muscles to heavy alcohol consumption. Blood circulation throughout the body can become very challenging if they develop dilated cardiomyopathy. Dilated cardiomyopathy is caused when the heart muscle within an individual becomes weakened and causes the four

heart chambers to become larger which results in weaker contractions.[13] Developing cardiomyopathy causes the heart not to function because of the heart does not pump effectively, and this can further lead to congestive heart failure.

Consuming alcohol has also been linked to a variation in the heart's rhythm which is called arrhythmia. Changes to the heart's electrical system, which can result from medications and stimulants, blocked signals, irregular pathways, and irritable heart cells, can all cause arrhythmias to occur. There are two common types of arrhythmias. The first is known as bradycardia; this is when an individual's heart is beating too slowly for the body's requirement. The second type is known as tachycardia; this is when the heart beats too fast, and the body cannot sustain its pace.[14]

Both of these arrhythmias can lead to an individual having either a cardiac arrest or a stroke. Researchers have determined that atrial fibrillation is the most common occurrence, also known as acute cardiac rhythm disturbances. Most individuals who have atrial occurrences have been linked to the consumption of regularly drinking alcohol. Studies indicated that after holidays or weekend's atrial fibrillation has been more present because during this time consumption of alcohol is higher.[14]

When the upper chambers of the heart known as the atriums begin to shake rather than beat regularly, it is commonly known as a type of arrhythmia such as atrial fibrillation. The consumption of alcohol causes atrial fibrillation through various mechanisms ranging from single consumption, to multiple consumptions. The blood is not able to be distributed effectively as it's supposed to. This can then lead to an accumulation of blood in the atrium, which can result in a clot and result in an ischemic stroke.[13]

Alcohol effects on the Liver:

Alcoholic consumption can also affect the body's liver. This digestion occurs in individuals at the cellular level. The metabolism of alcohol can occur in three different ways, which leads to the formation of acetaldehyde.[15] Acetaldehyde also known as ethyl acetaldehyde is one of the key metabolites of ethanol. Acetaldehyde is extremely damaging for human health and is regarded as a Group I carcinogen, which is a substance causing cancer.[16]

The consumption of alcohol can be linked to the increasing risk of liver disease. Fatty liver disease occurs when large quantity of alcohol is consumed, and there is an accumulation of fat in the liver. This fatty deposit can happen after a single drinking session, or a continuous heavy drinking habit. Alcoholic hepatitis is a consequence of continuous and regular drinking of alcohol. It is a result of inflammatory changes which is brought on because of the damage to the liver.[15] Severe cases can also be fatal. If an individual continues to drink alcohol on the regular which is above the suggested limit then it can continue it can lead to alcohol cirrhosis. Alcoholic cirrhosis affects the structure and function of the liver. Liver cirrhosis occurs in the late stage of scarring which can result from different types of liver diseases and conditions, such as hepatitis and chronic alcoholism.[16] Cirrhosis of the liver generally takes years to develop from the use of regular alcohol use. Also, liver cirrhosis is the most frequent cause of illness and death due to extensive and harmful aspects of drinking alcohol.

Alcohol linked to cancer:

The body contains lots of cells, which each having its responsibilities and requirements for the body. In the body, healthy cells are developed, replicates, and regularly die without bringing any injury to the body. Cells are composed of genes, of which are composed of DNA. When cells develop, there can be an alteration in the DNA. This alteration is known as a mutation, and it is caused when a cell is not producing, duplicating, or dying as it should. These mutations can at random, can be a genetic mutation, or also occur from alcohol consumption.[17]

Mutated cells can divide on its own without any regulation. This process can form lumps or growths which can form tumors. These cancer cells do not function as they should because they have no limitations. Cancer cells grows and divides and if this process was to continue then the untreated cancer cells could attack and destroy neighboring tissues[17]. Cancer cells can supersede the signals from molecules that communicate with damaged cells to self-destruct because they do not repair themselves or die.[18]

Cancers caused by alcohol are linked to several sites of the body such as oropharynx, larynx, esophagus, liver, bowel, stomach, and female breast. Researchers have discovered the threat of alcohol caused by cancer rises with the amount of alcohol consumed. Alcohol consumption damages the cells of the body and increases the risk of alcohol-caused cancer.[19] There are various mechanisms related to how alcohol causes cancer. When alcohol is broken down it then forms acetaldehyde. When acetaldehyde forms, it bonds with DNA cells that are replicated and damages cells.

In regards to tissue damage within the body, when consuming alcohol, it increases the absorption of other carcinogens which are cancer causing agents. The consumption of alcohol can also have an effect on the individual's hormone levels. Researchers suggest that in breast cancer, it appears that the consumption of alcohol can have an interference with the metabolism of estrogen, and elevates the circulating levels of sex hormones.[20]

In esophageal cancer, the consumption of alcohol is the main threat. The cancer located in the esophageal is called esophageal squamous cell carcinoma. Individuals who have a genetic mutation that is inherited has a deficiency in an enzyme that metabolizes alcohol and has been connected esophageal squamous cell carcinoma.[21] In regards to liver cancer, alcohol consumption is also a risk factor and one of the main causes of liver cancer which is also known as hepatocellular carcinoma.

Numerous researchers have studied the link between breast cancer and the consumption of alcohol. These studies have consistently found an increased risk of breast cancer associated with increasing alcohol intake. Some studies indicated that women who have consumed more than 45 grams of alcohol each day, will eventually have one and a half times the risk of developing breast cancer. Individuals who consume alcohol the risk of breast cancer was much greater in each stage across within every ten grams of alcohol per day, which is less than one drink.[22]

In colorectal cancer, the alcohol consumption is linked with a greater risk of cancers in the colon and rectum. Studies have shown that the connection between alcohol consumption and colorectal

cancer was evident in individuals who drink regularly 50 or more grams of alcohol each day and had 1.5x the possibility of developing colorectal cancer; in every ten grams of alcohol consumed each day, there was a slight increase in the risk of colorectal cancer.[23]

CONCLUSION

Alcohol is a well-known depressant that has a psychological and social impact on individuals. Numerous studies have indicated the impact alcohol has on the body, especially the nervous system. Individuals who drink alcohol moderately may provide various health benefits, like limiting the risk of heart disease and ischemic stroke. However too much of any substance can be harmful. Consuming too much alcohol will start to deteriorate the body and affect the body's internal organs such as the brain, heart, liver, and pancreas.

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