

The Pharmacokinetics of Alcohol - Part I

How Does Alcohol Get Into the Blood and What Factors Affect That Process?

**Bruce D. Miller, B.Sc.(PMCOL), M.Sc.
Canadian Forensic Services**

The study of pharmacology is really the study of human biology and is divided into two major areas of research. Pharmacokinetics is the study of the rates and factors involved in the absorption of drugs into the body, their distribution throughout, and ultimately their elimination from the body. Pharmacodynamics is the study of the effects that drugs have upon the body. In the field of medicine, Pharmacologists try to cure the patient chemically, whereas surgeons try mechanically.

Before any discussion about how alcohol becomes distributed throughout the body it is necessary to understand what is meant when we talk about “alcohol”.

Strictly speaking, alcohol is a generic word for a group of organic chemicals that have a hydroxyl radical attached to a saturated carbon atom. The hydroxyl radical is made up of an oxygen atom and a hydrogen atom. For example, the simplest form of alcohol is methanol (gas line antifreeze) that has the formula CH_3OH . The next simplest is ethanol, the alcohol that is found in all alcoholic beverages sold in liquor stores. It has the formula $\text{CH}_3\text{CH}_2\text{OH}$. The -OH group makes alcohols water-soluble. The carbon-hydrogen group makes it easy for alcohols to pass through cell membranes within the human body. As you can see from the formula, ethanol is a very small molecule. Its size is also a positive factor in its ability to be absorbed.

To keep things simple, and consistent with the common parlance, the term alcohol will refer to the intoxicant (ethanol) found in the type of beverages typically purchased from a liquor store.

When studying the pharmacokinetics of alcohol, it is always best to remember that:

1. alcohol passively diffuses from areas of high alcohol concentration to areas of low alcohol concentration. For example, if the concentration of alcohol in the stomach's gastric juices is higher than in the surrounding blood, the alcohol will passively diffuse from the gastric juice to the blood.
2. at any point in time, the blood alcohol concentration is the net effect of absorption, distribution and elimination of alcohol into, throughout, and from the human body.

Once a person takes a drink of an alcoholic beverage, most of the alcohol will be swallowed and pass into the stomach. Very little of the alcohol will be absorbed through the mucus tissue of the mouth. The stomach is like an oblong balloon that has gastric juice sloshing around within it. The outside of the stomach wall has a rich supply of veins. For a molecule of alcohol to be absorbed into the venous blood

surrounding the stomach wall, the alcohol needs to get bounced over to the stomach wall. It has no means of its own to propel it through the gastric juice. Once at the stomach wall, it just passively diffuses across the mucous membrane of the stomach and into the circulating venous blood. Consequently, the motility of the gut influences the ability of the ingested alcohol to be absorbed into the venous blood.

The presence of food within the stomach while a person is consuming alcohol will decrease the amount of alcohol getting into the blood for at least two reasons.

- 1. The presence of food particles within the gastric contents creates an obstacle course for the molecules of alcohol to migrate through before gaining access to the stomach wall and diffusing into the circulating venous blood. Some of the alcohol will be adsorbed onto the food particles and never get into the blood because they are passed in the feces.**
- 2. The presence of food in the stomach also stimulates enzymes, within the gastric mucosa, that break down alcohol to carbon dioxide and water. Therefore, as some of the alcohol is diffusing through the stomach wall, it will be metabolized before being absorbed into the venous blood.**

HINT: If you are going to a party where alcohol is being consumed, and you want to be sociable but remain sober, make sure that you have a good meal immediately before going to the party and don't be shy about eating food at the party. As a host of such a party, make sure that there is lots of food for your guests to eat.

The speed or rate of the passive diffusion from an area of high alcohol concentration to an area of lower alcohol concentration depends upon two factors.

1. The relative difference in the alcohol concentration between one area and the other - the greater the relative difference, the greater the rate of diffusion.
2. The surface area available through which the alcohol can diffuse from one area to the next - the greater the surface area, the greater the rate of diffusion.

Once the alcohol has been absorbed into the venous blood, it is then circulated throughout the whole body. How it is distributed throughout the body, and the factors affecting distribution, will be discussed in Part II.

Bruce D. Miller is a Pharmacologist specializing in forensic toxicology and more specifically in the effects of alcohol on human behaviour and performance. He has appeared as an expert witness in all of the trial division of British Columbia, Alberta, Saskatchewan, The Yukon Territories, Northwest Territories and Nunavut. He has conducted in excess of 30,000 breath alcohol tests, and has the world's largest data bank of human alcohol pharmacokinetic data.