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REVIEW ARTICLE

ALCOHOL: A POTENT ANCIENT ANESTHETIC

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ABSTRACT

Surgery was a painful and dangerous business at the start of the 19th century. There were no anesthetics so few operations were carried out. In surgical operations, pain would be intolerable if not controlled. Throughout history, there have been numerous attempts at controlling and eliminating pain. The Chinese developed acupuncture. The Greeks and Romans used alcohol to not only cleanse the body; they also encouraged the patient to drink the alcohol to the point of oblivion. To alleviation of the pain the stage of analgesia was achieved by the administration of *Tikshna Madhya* [Alcoholic preparation] only as *Sushruta* has advised. For overcome the overdose of the Alcohol preparation and other complications like blood loss, electrolyte imbalance etc. Sushruta had advised preoperative food administration. Basically *Sushruta* is the pioneer of surgery he taken care of all the aspects of surgery, one of them preoperative Alcohol, more or less anesthetic, administration is the important principle and is adequately mentioned. According to the study of its properties, absorption, metabolism, elimination and effect, alcohol is found to be a potent anesthetic of those days.

Key words: Tikshna Madhya, alcohol, anesthetics, ancient surgery

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INTRODUCTION

Surgery was a painful and dangerous business at the start of the 19th century. There were no anesthetics so few operations were carried out. Surgery was usually limited to amputating limbs or removing large tumours. Internal surgery like laprotomy was not possible. The best surgeons were the quickest surgeons. The main threat to a patient of surgery is pain. A body experiencing pain can't recover to the best of its ability. Until the advent of effective anesthesia, selective surgery was rarely performed. Undergoing surgery for serious health reasons, accidents, or injury was excruciatingly painful, so very few people opted for surgery unless they had no choice[1].

Throughout history, there have been numerous attempts at controlling and eliminating pain. Doctors used various techniques to dull sensation for surgery. Some doctors used soporifics - sleep-inducing and awareness-dulling agents - and narcotics[2]. Many traditional natural plants were used in the preparation of pain-killing drugs, including marijuana, belladonna, mandrake[3], opium[4] and jimsonweed. Many other drugs were tried, including heroin and cocaine, most with distressing side effects, with opium and alcohol eventually becoming the most common. The Greeks and Romans used alcohol to not only cleanse the body; they also encouraged the patient to drink the alcohol to the point of oblivion[5].

Until the mid 1800s, the anesthesia drug of choice continued to be opium and alcohol. Before the landmark discovery of ether as an anesthetic, patients who needed surgery for either illness or injury had to face the surgeon's knife with only the help of alcohol, opium, or other narcotics. The Chinese developed acupuncture for pain management[6]. As history evolved, so did medicine and the management of pain. While the search for pain control during surgery dates back to the ancient world, it was not until 1846[7][8][9].

Anesthesia in Ayurveda literature: Humans have been using various methods to block pain and awareness for thousands of years. Accounts from prehistory claim that anesthesia was first used over 7000 years ago. There is very little information on what was used or which conditions were treated. Sushruta also had considered this important factor of surgery and for controlling the pain he highly recommended administration of alcoholic preparations during any surgical procedure[10].

The surgeon should allow an appropriate diet to the patient before operation; and concentrated alcohol should be given to those who cannot bear the pain and

are alcoholics. The patient being under the influence of alcohol does not feel the operative procedure[11].

To find out the fact behind this, it is necessary to collect the important information about alcohol and its usage and effect on the human body.

Alcohol:

Alcohol is a drug and that's the bottom line. It has strong and lasting impact on the human body. Alcohol is a general term denoting a family of organic chemicals with common properties. Members of this family include Ethanol, Methanol, Isopropanol, and others. Alcohol, in more general terms is taken as 'Ethanol'[12]. Alcohol arises naturally from carbohydrates when certain micro-organisms metabolize them in the absence of oxygen, called fermentation. Beer, wine and other liquor contain different amounts of alcohol. Traditional wine has approximately 8-14% alcohol. However, the amount of alcohol that a person can drink safely depends on individual's age, sex, weight and family history, genetics etc[13].

Alcohol specifically ethanol, is a nervous system suppressive. It is highly volatile liquid with distinct odor having great affinity towards water. In fact, its high solubility in water makes it one of the most potent depressant of human central nervous system. It is a powerful hypnotic sedative with an array of side effects. Alcohol is classified as a CNS depressant because it slows down the CNS, causing decrease in motor coordination, reaction time and intellectual performance[14].

Routes of Alcohol Ingestion: The only normal route of ingesting alcohol is drinking it--but this is not the only route possible. Other more exotic routes used on occasion are *Inhalation, Injection, Alcohol enema & Transdermal.*

Absorption of alcohol: Alcohol is metabolized extremely quickly by the body. Unlike foods, which require time for digestion, alcohol needs no digestion and is quickly absorbed. Alcohol gets absorbing and metabolizing before most other nutrients. About 20% to 25% of a dose is absorbed directly across the walls of an empty stomach and can reach the brain within one minute[13].

When ingested, alcohol passes from the stomach into the small intestine, where it is rapidly absorbed into the blood and distributed throughout the body. Alcohol is absorbed from all parts of the GI tract largely by simple diffusion, where small blood vessels carry it to the bloodstream. Alcohol is rapidly absorbed in the upper portion of the small intestine. However, the small intestine is by far the most efficient region of the GI tract for alcohol absorption because of its very large surface area. It is generally agreed that of 75%

to 80% a dose is absorbed from the small intestine[12].

The alcohol-laden blood then travels to the liver via the veins and capillaries of the digestive tract, which affects nearly every liver cell. The liver cells are the only cells in our body that can produce enough of the enzyme alcohol dehydrogenase to oxidize alcohol at an appreciable rate. This process reduces the amount of alcohol entering the blood by approximately 20%[15].

Because of this peak blood alcohol concentrations are achieved in fasting people within 0.5 to 2.0 hours, [average 0.75 - 1.35 hours depending upon dose and time of last meal] while non-fasting people within 1.0, and in extreme cases up to as much as 6.0 hours [average 1.06 - 2.12 hours[12].

Blood Alcohol Content [BAC]: The degree to which the CNS function is impaired is directly proportional to the concentration of alcohol in the blood, usually denoted by BAC [Blood Alcohol Content] [16][17]. At high doses, the respiratory system slows down drastically and can cause a coma or death. Understanding BAC is key towards understanding how alcohol affects body and the danger zones of alcohol poisoning. BAC measures the ratio of alcohol in the blood. Hence, a BAC of 0.10 means one part alcohol for every 1000 parts of blood. The Blood Alcohol Calculator can give more specific BAC information based on weight, gender and the time period for drinking.[18]

Distribution of Alcohol: It gets distributed throughout the human body. Alcohol travels through blood and come into the vicinity of cells of almost every organ. Due to its high affinity towards water, it can penetrate almost all cellular membranes resulting in absorption by all organs. Therefore found in body tissues and fluids as they contain water. Absorbed alcohol is rapidly carried throughout the body in the blood and once absorption of alcohol is complete equilibrium occurs such that blood at all points in the system contains approximately the same concentration of alcohol[12].

Effect of food in Absorption: A number of factors influence the absorption process, including the presence of food in the GI tract when alcohol is consumed. Having food in stomach can have a big influence on the absorption of alcohol. The rate at which alcohol is absorbed depends on how quickly the stomach empties its contents into the intestine. Food taken along with alcohol results in lower, delayed blood alcohol concentration peak [the point of greatest intoxication]. It will help slow down the processing of alcohol. There are two major factors involved in this phenomenon. First, the food will dilute the alcohol and delay the emptying of the stomach into the small

intestine, where alcohol is very rapidly absorbed. The pyloric valve at the bottom of the stomach will close in order to hold food in the stomach for digestion and thus keep the alcohol from reaching the small intestine. When alcohol is absorbed from the stomach it is absorbed gradually and in less quantity in comparison with small intestine. So this is why eating a full meal before alcohol consumption helps to keep person from becoming rapidly intoxicated[19].

The type of food ingested [carbohydrate, fat, protein] has not been shown to have a measurable influence on this affect but larger the meal and nearer in time between eating and drinking, the greater the diminution of peak alcohol concentration. Normally, total absorption occurs within 120 - 150 minutes after the cessation of alcohol consumption. Studies have shown reductions in peak alcohol concentration [as opposed to those of a fasting individual under otherwise similar circumstances] of 9% to 23%[12].

Second and equally important is the fact that alcohol elimination rates are inversely proportional to alcohol concentration in the blood. Therefore the suppressed levels of alcohol due to food ingestion cause the body to eliminate the alcohol that is absorbed at a faster rate. For every person no matter the size of liver, it will only digest one standard drink per hour. This is why the suggestion of one drink per hour is recommended. This keeps the liver from being on overload and secondly it enables a person to maintain a safe BAC and achieve the social relaxation effect desired[12].

Elimination of Alcohol: The liver is responsible for the elimination - through metabolism - of 95% of ingested alcohol from the body. The rest of the alcohol is eliminated through excretion of alcohol in breath, urine, sweat, feces, milk and saliva. Understanding the rate of metabolism is critical to understand the effects of alcohol. As a rule of thumb, a healthy person will eliminate one average drink or 0.5 oz [15 ml] of alcohol per hour, with an average of about 9.5 ml/hr. If consumed more than this, the system becomes saturated, and the additional alcohol will accumulate in the blood and body tissues until it can be metabolized. This is why having a lot of shots can result in high blood alcohol concentrations that last for several hours[12].

Factors that affect elimination and metabolism rates: Several factors influence this rate of elimination, with most relating to the water content and fat content of the individual's body. It tends to be higher when the blood alcohol concentration in the body is very high. Also chronic alcoholics may [depending on liver health] metabolize alcohol at a significantly higher rate than the average.

Finally, the body's ability to metabolize alcohol quickly tends to diminish with age[12].

Many factors influence body's ability to absorb and tolerate alcohol. The effects of alcohol vary from person to person just like any other drug. Some of these factors include age, sex, weight, and general health of the person. The amount of alcohol consumed and whether alcohol was consumed with any other drugs are also other factors. It also depends whether the person is used to drinking or not[20].

Effects of alcohol: From the second of taking first sip, alcohol starts affecting body and mind. Alcohol is a depressant drug and slows down the activity of the central nervous system. Alcohol directly affects the brain and its action on the central nervous system affects concentration and coordination. As the BAC increases, more and more centers of the brain are affected. According to research done at University of Chicago Medical Center on alcohol and Anesthetic Actions, it was stated about the ability of alcohol to enhance the effects of the neurotransmitter GABA, which is an inhibitory neurotransmitter. Enhancing an inhibitor would have the effect of making things sluggish, which matches the behavior seen in a drunken person. Glutamine is an excitatory neurotransmitter that alcohol weakens. By making this excitatory neurotransmitter less effective, also get sluggishness[21].

General Effects on Human Body There are different effects of alcohol on human body subject to their concentrations in blood. They are generally classified as ***Stages of alcohol intoxication.*** Here is the comparative study of Anesthetic Vs Alcohol is done on the basis of clinical features which shows that the almost all the clinical features are mentioned are very similar. The comparisons shows stupor is the stage in which surgery can be performed under the effect of alcohol.

Table 1. Comparisons between stages of anesthesia and stages of alcohol.

Stages of Anesthesia[22]		**Stages of Alcohol effect[23]**	
Stage of Analgesia [First Stage]	•Gradual loss of pain sense and consciousness	**Euphoria**	• Decreased self-consciousness Diminution of attention • Beginning of sensory-motor impairment Impaired fine muscle coordination • Loss of efficiency in finer performance tests
Stage of	•Unconscious excitement	**Excitement**	• Sedation

Delirium [Second Stage]	•Breathing is irregular and associated with shouting, breath-holding and coughing.		• Impairment of perception, memory and comprehension Decreased sensatory response • Increased reaction time Reduced visual acuity, Blurred vision • Sensory-motor incoordination; • Drowsiness, Ataxia • Other senses may be impaired
Stage of Surgical Anaesthesia [Third Stage]	•Fully unconsciousness •Feels no pain •Does not move when stimulated		
1. Light Anaesthesia [Plane 1]	•Respiration becomes smooth and automatic as occurs during sleep - important sign of surgical anaesthesia •The rolling of the eyeball stops and the light reflex becomes sluggish •The conjunctival reflex abolished	**Confusion**	• Apathy, lethargy • Dizziness • Increased pain threshold Analgesia • Increased muscular incoordination • Impaired senses, • Disturbances of vision and of perception of color, form, motion and dimensions • Increased ataxia
2. Real surgical Anaesthesia [Plane 2]	•Respiration becomes deeper •Muscular relaxation is complete •The corneal reflex abolished	**Stupor**	• Impaired consciousness • General inertia • Respiratory depression [potentially life-threatening] • Decreased heart rate • sleep or stupor • Severe ataxia • Approaching loss of motor functions • Marked muscular incoordination

			• Markedly decreased response to stimuli • Vomiting [death may occur due to inhalation of vomit [pulmonary aspiration] while unconscious] • Urinary incontinence • Anterograde amnesia • High risk of coma or even death.
3. Deep Anaesthesia [Plane 3]	• Respiration becomes triphasic • The light reflex disappears completely	**Coma**	• Complete unconsciousness • Depressed or abolished reflexes [i.e., pupils do not respond appropriately to changes in light] • Subnormal body temperature • Impairment of circulation • Incontinence
4. Profound Anaesthesia [Plane 4]	• The pause in between inspiration and expiration gradually increases • Respiration becomes gasping in character		• Marked and life-threatening respiratory depression • Markedly decreased heart rate
Fourth stage	• The period between the respiratory stoppage and cardiac failure or death. • During this period the heart continues to beat although the respiration has ceased. • The pupils are widely dilated.	**Death**	• Death from respiratory arrest • Failure of CNS [Central Nervous System] ultimately resulting in Death.

Administration of concentrated alcohol creates harmful effects to the system and makes more rapid action. The level of effect is to be maintained up to the analgesia, if the patient passes on the further stage, may become unconscious, due to alcohol influence. *Sushruta* had to maintain the consciousness of the patient with adequate analgesic effect.

There was no option except concentrated alcohol for developing the analgesia; hence, he strongly advocated food before surgical procedure prior to alcohol administration for desired anesthetic effect.

CONCLUSION:

Undergoing surgery would be excruciatingly painful and intolerable if there is no loss of sensation during surgical procedure. Hence *Sushruta* advised to consume *Tikshna Madya* [concentrated alcoholic preparation] for the sake of painless or less painful surgery. Alcohol is the CNS depressant drug and the present anesthetic drugs available are also of the same group. This was the only option with *Sushruta* & was well practiced in his time. The alcohol can affect the CNS even in small concentrations. As BAC increases the patient's response to stimuli decreases markedly. Alcohol raises the pain threshold as the BAC increases. Hence with all required properties of an anesthetic drug alcohol works as good pain inhibitor. It was used in controlled dose and it was the best option for the anesthetic drug of those days. *Sushruta* has advised to give the light liquid diet just before surgery. The food in stomach inhibits immediate absorption of alcohol and takes sufficient time to absorb which gives controlled effect of alcohol and prevents untoward effects. Oral administration was the only route of administration available at that time to administer nutrients. This prevented the patient going towards the stage of unconsciousness under alcohol influence. So the desired effect of anesthesia without losing consciousness was achieved. Alcohol is a good and potent anesthetic agent used by *Sushruta* in ancient surgical era.

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