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ACUTE EFFECT OF CONSUMPTION OF RELATIVELY LARGE DOSE OF ALCOHOL ON THE SMALL INTESTINE OF WISTAR RATS

[1*]M. O. Odigie., [1]E. S. Ehebha., [1]A. J, Uyovwiesevwa, [2]M. A. Omoirri., [2]N. U. Madubogwu and [3]I. B. Chukwurah

[1]Department of Physiology, Faculty of Basic Medical Sciences, Delta State University, Abraka, Delta State, Nigeria.
[2]Department of Pharmacology and Toxicology, Faculty of Pharmaceutical Sciences, Nnamdi Azikiwe University, Akwa, Anambra State, Nigeria.
[3]Department of Pharmacology and Tharapeutics, College of Medicine, Nnamdi Azikiwe University, Akwa, Anambra State, Nigeria.

***Corresponding Author: M. O. Odigie**

Department of Physiology, Faculty of Basic Medical Sciences, Delta State University, Abraka, Delta State, Nigeria.

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ABSTRACT

Though classified as a depressant, the amount of alcohol consumed often determines the end effect. However, little or no existing record(s) relays this effect on the activity of the gastrointestinal tract. Hitherto was current study undertaken to investigate the acute effects of a relatively large dose of alcohol on the small intestine in wistar rats. Thirty (30) male Albino rats of between 138g and 185g were procured from the breeding colony of the Animal House Division of Emma-Maria Biomedic Laboratories and Consultancy, Abraka, Delta state. The animals were then transported (in plastic baskets) to the Animal House of the Faculty of Basic Medical Sciences, Delta state University, Abraka where they were acclimatized for ten days at 28 ± 2ºC, relative humidity 60-70 % and 12hr light/ dark cycle. During study period, animals were supplied with standard grower mash diet (Composition of the grower's marsh: Protein -19.0% Fat -2.85% Fibre -6.00% Calcium -1.00% and phosphate -0.45% Energy -2875 KGC) and water *ad libitum*, in standard wire meshed wooden cages for 10 days prior to commencement of the experiment, following which they were grouped into; Group I (control group), which received normal feed and water *ad libitum* for 31, 61 and 91days respectively. Group II (Experimental) rats received 7% alcohol with normal feed and water *ad libitum* for 31, 61 and 91days respectively. For each treatment per week, animals' weights were determined and recorded with the electronic weighing balance every 7 days (weekly). Following period of administration, animals were sacrificed by cervical dislocation and blood samples collected by cardiac puncture, assayed and compared in each rat (with control). In each case, photomicrograph of the small intestine was also obtained, whilst comparing histo-architectural changes. Upon statistical comparison (using the student t-test), study found alcohol to cause a statistically significant decrease in body weights across groups, with an increase in antioxidant enzyme activities in the small intestine.

KEYWORDS: Alcohol, Small Intestine, antioxidant

INTRODUCTION

Alcohol is a member of a group of chemical compounds and, in popular usage, to the specific compound ethyl alcohol, or ethanol.[1&2] The Arabic word denotes kohl, a fine powder of antimony used as an eye makeup. The word "alcohol" originally denoted any fine powder; the alchemists of medieval Europe later applied it to essences obtained by distillation, and this led to the current usage.[3&4]

Alcohols are a class of organic compounds containing the hydroxyl group, OH, attached to a carbon atom. Alcohols have one, two, or three hydroxyl groups attached to their molecules and are thus classified as monohydric, dihydric, or trihydric, respectively. Methanol and ethanol are monohydric alcohols.[5] Alcohols are further classified as primary, secondary, or tertiary, according to whether one, two, or three other carbon atoms are bound to the carbon atom to which the hydroxyl group is bound. Alcohols, although analogous to inorganic bases, are neither acid nor alkaline.[6] They are characterized by many common reactions, the most important of which is the reaction with acids to form substances called esters, which are analogous to inorganic salts.[7&8] Alcohols are normal by-products of digestion and chemical processes within cells and are found in the tissues and fluids of animals and plants.

Historically, alcoholic beverages were first used in China, and are thought that alcoholic drinks were used as part of celebrations, when taking oaths for offices, and in occasions like births, deaths and marriages.[9] While moderation was officially encouraged in the 1116 BC, the Chinese treasury was reportedly fattened by alcohol

sales. By 800 BC, barley and rice beer began to be produced in India. When Plato arrived on the scene, he advised that wine was beneficial to health and happiness, but only in moderation (400 BC).[10 & 11] As time passed, one philosopher after another began to criticize drunkenness. One assumes the alcoholic problem must have been becoming more pronounced.[12] For instance, Alexander the great was known for his drunkenness as well as his ability to conquer other cultures.

Alcohol is a colourless volatile flammable liquid, C_2H_5OH that is the intoxicating constituent of wine, beer and spirit.[13 & 14] Alcohol is a drug. It is classified as a depressant, meaning that it slows down vital functions – resulting in slurred speech, unsteady movement, disturbed perceptions and an inability react quickly. As for how it affects the mind, it is best understood as a drug that reduces a person's ability to think rationally and distorts his or her judgment. about half the alcohol humans drinks is known to be detoxified by the peroxisomes of the liver cells in the gut; with premature atrial contractions, liver damage (and several other conditions) frequently accompanying failure of the body to detoxify alcohol in healthy people.[15 & 16]

Of the many organ systems that mediate alcohol's effects on the human body and its health, the gastrointestinal (GI) tract is particularly important with is numerous roles. First, the GI tract is a known site of alcohol absorption into the bloodstream and, to a lesser extent, of alcohol breakdown and production.[17] Second, the direct contact of alcoholic beverages with the upper GI mucosa is known to cause several metabolic and functional changes that may lead to marked mucosal damage.

Alcohol-induced gut inflammation is believed to promote several disease states both within the GI tract, in the form of gastrointestinal cancers and inflammatory bowel disease (IBD), and outside the GI tract, in the form of, for example, liver disease and neuro-inflammation.[18] Several lifestyle factors such as smoking and diet affect the incidence and severity of IBD, most likely by modulating gut inflammation.[12] Alcohol consumption also may influence the course of IBD through associated gut inflammation[9]; however, its effect in patients with IBD only has been studied in a few small studies. One study[15], for example, examined the impact of 1 week of moderate (24 g to 36 g ethanol daily) red wine consumption on clinical disease activity and other non-invasive markers associated with increased risk of future disease flare. The study found no significant changes in indices of clinical disease but did find subclinical increases in markers for disease activity, including intestinal permeability. Such findings suggest that chronic alcohol consumption could increase long-term GI tract functionality and supports the need for additional study.

Aim of Study

Recently, studies have suggested that chronic alcohol may affect GI morpho-functions. This study was therefore designed to investigate the acute effect(s) of consumption of relatively large dose of alcohol on the small intestine of wistar rats. Specifically, study examined the effect of variable doses of alcohol on duodenal anti-oxidant activity. Study also investigated the effect of alcohol intake on duodenal histo-architecture as well as body weight changes.

MATERIALS AND METHOD

Study Design

Study was designed using albino wistar rats as experimental model. Male wistar rats consisting of a total of thirty males were procured. The study involved a control group and a test group. The age range of the male rats was between fifteen weeks to eighteen weeks. The rats were weighed using electronic balance. The average weight of the male rats before the commencement of the experiment ranged from 138.4g to 185.4g.

Group 1: (control group) received normal feed and water *ad libitum* for 31, 61 and 91days respectively.

Group 2: (Experimental group) received 7% alcohol with normal feed and water *ad libitum* for 31, 61 and 91days respectively.

The weight of the animals were determine using electronic weighing balance to collected the weight every 7 days (weekly).

Animal Procurement

This study was conducted at the Animal House Faculty of Basic Medical Sciences, Delta State University, Abraka. A total of thirty (30) experimental male Albino rats weighing between 138g to 185.4g were used in this study and they were procured from the breeding colony of Animal House Division of Emma-Maria Biomedic Laboratories and Consultancy, Abraka, Delta state and transported with plastic baskets to the Animal House Department of Physiology, Faculty of Basic Medical Sciences, Delta state University, Abraka. They were acclimatized for a period of ten days in (28 ± 2ºC, relative humidity 60-70 %, and 12hr light / dark cycle). During the entire period of study the animals were supplied with standard grower mash diet (Composition of the grower's marsh: Protein -19.0% Fat -2.85% Fibre -6.00% Calcium -1.00% Available phosphate -0.45% Energy -2875 KGC (Animal Care Services Konsult (NIG) LTD), Asaba, Delta State) and water *ad libitum*, in a standard wire meshed wooden cages for 10 days prior to commencement of the experiment within July 24 to September 28 2013. In this study, all the animal experimentation was carried out according to the guidelines of Institutional Animal Ethics Committee (IAEC).[11]

Sample and Organ Collection

Dose of Ethanol Administration

The dose of alcohol used in this study was 10ml/100g body weight.

Concentration of Ethanol Used

The concentration of alcohol used in this study was seven percent. This seven percent ethanol was got by measuring out twenty one milliliters of absolute ethanol and mixing it with two hundred and eight-nine milliliters of distilled water as the source of their drinking water.

Route of Alcohol Administration

The route of administration of alcohol in the study was Orally (PO). The required calculated volume of alcohol was administered per day.

Experimental Procedure

Method of Sacrifice

At the end of treatment with the alcohol, the rats were fasted overnight and the time of sacrifice the weighed was taken and then anaesthetized by placing them in a closed jar containing cotton wool sucked with chloroform anaesthesia and a laparectomy was carried out and blood samples were collected from vena cava into lithium heparin bottles. The tubes were then centrifuged at 4000rpm for 10 minutes to obtain serum for biochemical enzymes using spectrophotometer methods with reagent kits. And small intestine was opened and the length of the small intestine and the distance travelled by the active charcoal and weight of small intestinal content was determined, also small intestine was immediately removed and weighed. A portion of small intestine suspended in ice cold saline and 10% of small intestine homogenate was used for further analysis. And also immediately a portion of the small intestine tissue was fixed (suspended) in cold 10% formol-saline

Preparation of Tissue for Microscopic Examination

The process of preparation of tissue for histological examinations is separated into the following stages.

Tissue Processing

This is a preparatory treatment that entails impregnation of the specimen with an embedding medium to provide a support and suitable consistency for microtomy. The stages include dehydration, impregnation and embedding. Dehydration involves removal of water from The Tissue by passing it through graded solutions of alcohol from 70% to 100%. The small intestine tissues were passed from low concentration (70%) to high concentration (100%). This was to allow for complete dehydration. In clearing, small intestine tissues were treated with xylene, a substance which is both miscible and with alcohol and molten paraffin wax.

Embedding which is also called casting was done by filling a mold with molten paraffin wax, orienting the small intestine tissue in the mold to ensure it being cut in the right plane and finally cooling the mass to promote solidification.

Sectioning and Mounting

The small intestine tissue was processed using the paraffin wax method with an automatic tissue processor by the following schedule.

70% alcohol for two hours
90% alcohol for two hours
95% alcohol for two hours
Two changes of absolute alcohol for two hours each
Two changes of xylene for two hours
Two changes of paraffin wax for two hours each
Two samples was embedded in paraffin wax at 70 degrees centigrade and cut with a rotary microtone 4µ.

Tissue Staining

The staining technique employed in this study was the haematoxylin and eosin staining techniques. It includes the following stages:

Dewaxing and dehydration
Staining in Erlich's H haematoxylin for 15minutes
Rinsed in water for 15minutes
Counter stained with 1% eosin for 1minute
Dehydrated, cleared and mounted.

Photomicrography

Stained tissue images were captured using digital microscopic eyepiece 'Scoptek' Dcm 500, 5.0mega pixels connected to USB 2.0 computer.

Ethical Issues

Experimental protocols were executed in strict compliance with commendations and guides for the care and use of laboratory animals. Study adhered to the code of conduct stipulated by the Institute for Laboratory Animal Research.[15]

Statistical Analysis

Results were expressed as Mean ± SD (standard deviation) and statistical significance of the treatment effect was analysed with the student's t-test, using the statistical package for social sciences (SPSS) version 20. p-values < 0.05 were considered to be statistically significant.

RESULTS

Table I: Comparative Changes in Body Weights of Alcohol Treatments to Wistar Rats for 30 days.

Change in Body Weight (g) for 30 days			
	Initial	**Week 4**	**Weight change in percentage**
Group 1	102.98±3.27	126.70±4.40*	18.72
Group 2	96.44±10.74	146.38±14.49*	34.12

Values are expressed as mean ± Standard deviation (SD), * = Significant difference at p < 0.05

Table II: Comparative Changes in Body Weights of Alcohol Treatments to Wistar Rats for 60 days.

Changes in Body Weight (g) for 60 Days			
	Initial	**Week 8**	**Weight change (%)**
Group 1	102.66±3.40	159.40±5.33	35.60
Group 2	81.74±2.95	165.00±11.07	50.46

Values are expressed as mean ± Standard deviation (SD), * = Significant difference at p < 0.05

Table III: Comparative Changes in Body Weights of Alcohol Treatments to Wistar Rats for 90 days.

CHANGES IN BODY WEIGHT (g) FOR 90 DAYS			
	Initial	**Week 13**	**Weight change in percentage**
Group 1	104.56±4.29	213.00±10.68	50.91
Group 2	104.42±7.87	201.00±12.08	48.05

Values are expressed as mean ± Standard deviation (SD), * = Significant difference at p < 0.05

Table IV: Effect of Alcohol consumption on duodenal weight and motility of Wistar rats after 30 days.

Small Intestine			
	Weight (g)	Length (cm)	Distance travelled (cm)
Group 1	4.82±0.29	87.66±4.16	46.76±8.52
Group 2	5.86±0.45	92.60±3.46	68.20±4.58*

Values are expressed as mean ± Standard deviation (SD), n=5 Significant differences (^P < 0.05): (*) increase when compared with control, (^) decrease when compared with control.*

T**able V: Effect of Alcohol consumption on duodenal weight and motility of Wistar rats after 60 days.**

Small Intestine			
	Weight (g)	**Length (cm)**	**Distance travelled (cm)**
Group 1	5.32±0.21	85.00±2.92	54.60±3.12
Group 2	5.36±0.09	84.80±6.09	54.20±2.73

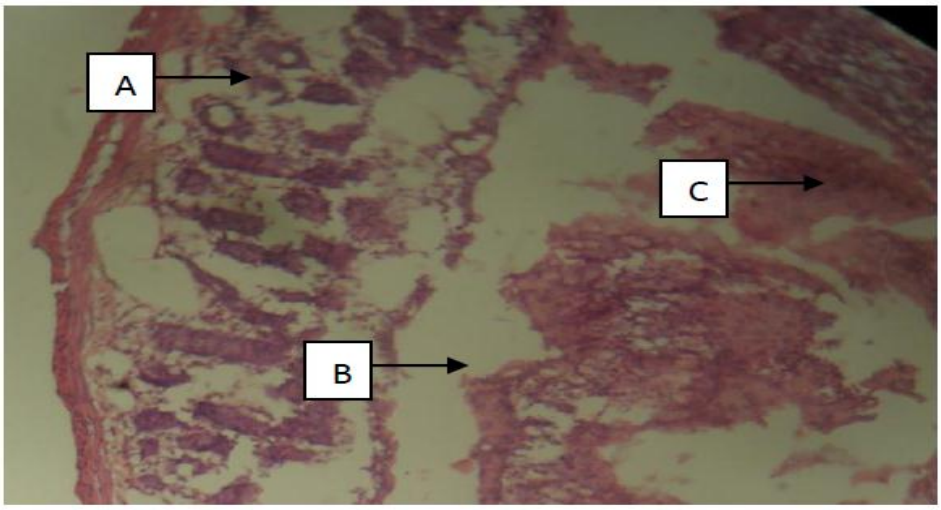
Values are expressed as mean ± Standard error of mean (S.E.M), n=5 Significant differences (^P < 0.05): (*) increase when compared with control, (^) decrease when compared with control.*

Table VI: Effect of Alcohol consumption on duodenal weight and motility of Wistar rats after 90 days.

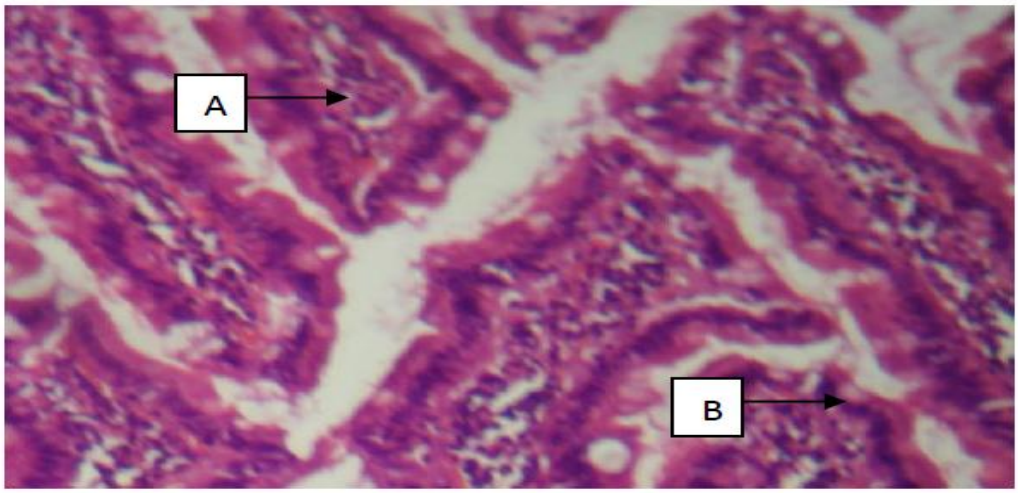
Small Intestine			
	Weight (g)	**Length (cm)**	**Distance travelled (cm)**
Group 1	4.5400±0.86	89.20±8.79	46.60±4.81
Group 2	5.2400±0.07	80.20±6.22	59.00±4.39

Values are expressed as mean ± Standard error of mean (S.E.M), n=5 Significant differences (^P < 0.05): (*) increase when compared with control, (^) decrease when compared with control.*

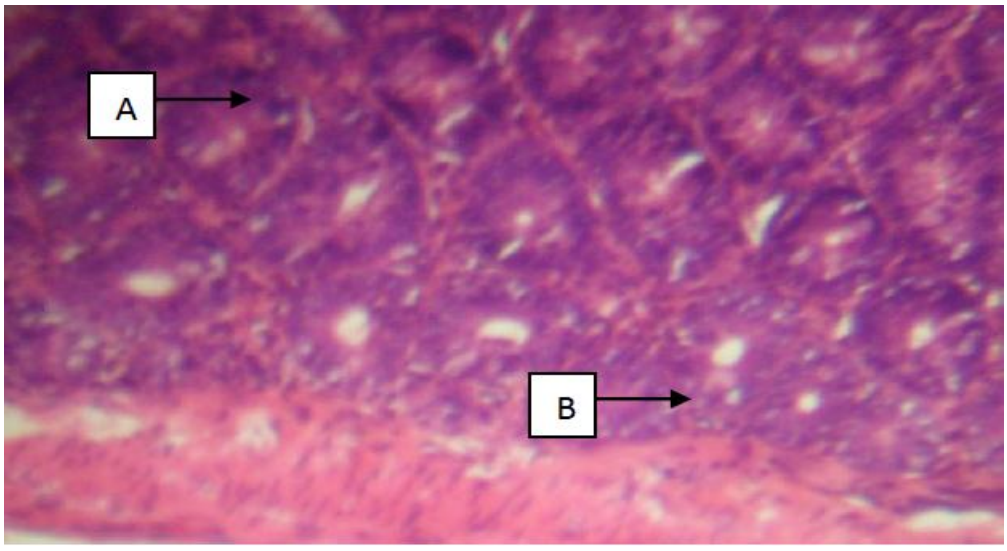
Photomicrograph of the effect of 7% alcohol on the duodenum of Wistar rats



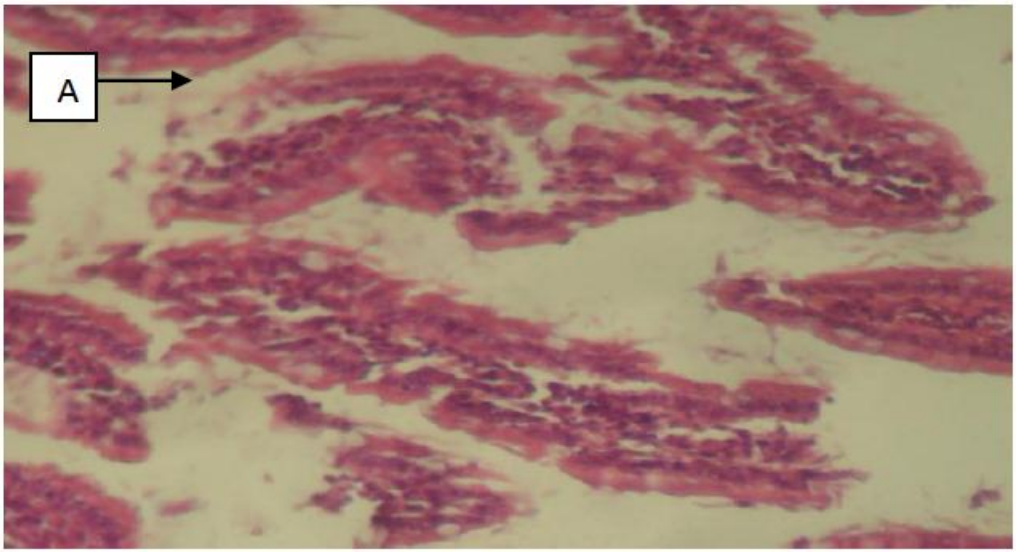
Control: Normal Rat Small Intestine composed of mucosa A, submucosa B and muscularis propria C (H&E x 100)



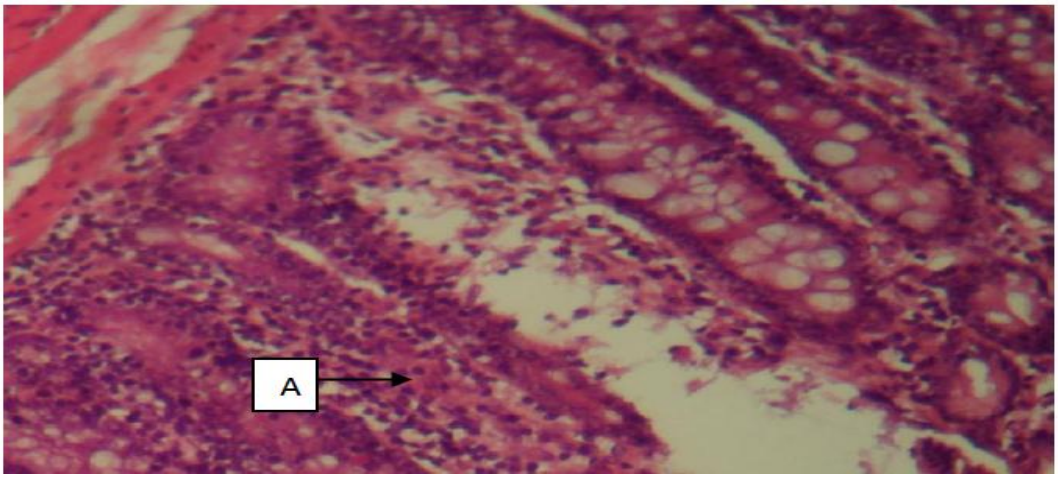
Control: Normal small intestine mucosa showing epithelia lining A and lamina propria B (H&E x 10)



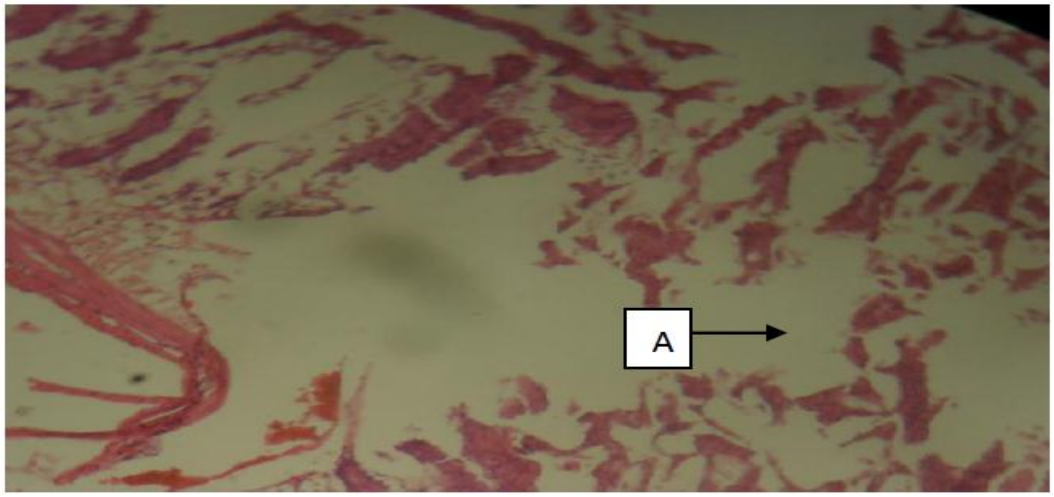
Same slide as above showing mucosal glands A and muscularis mucosa B (H&E x 10)



Rat Small Intestine treated with 7% Alcohol 30 days showing mild mucosal devitalisation A (H&E x 10)



Rat small intestine treated with 7% alcohol for 60 days showing focal superficial erosion A (H&E x 10)



Rat Small Intestine treated with 7% alcohol for 90 days showing patchy mucosal erosion A (H&E x 100)

Figure I: showing the Histology of the Small Intestine (Duodenum)

DISCUSSION

Alcohol abuse, like smoking, is associated with the development of cancers of the tongue, larynx (i.e., the organ of voice), and pharynx; both alcohol consumption and smoking independently increase the risk for these tumors.[19] Epidemiological studies also strongly indicate that chronic alcohol consumption, especially of distilled spirits, markedly contributes to the development of

esophageal cancer.[18 & 19] Thus, after adjusting for smoking habits, heavy beer drinkers have a 10 times greater risk and heavy whisky drinkers a 25 times greater risk of developing esophageal cancer, compared with people who consume less than 30 g of alcohol (i.e., about 2 standard drinks) daily.

Alcohol-induced digestive disorders and mucosal damage in the GI tract reportedly cause a variety of medical problems. These include a loss of appetite and a multitude of abdominal complaints, such as nausea, vomiting, feelings of fullness, flatulence, and abdominal pain.[20] Diseases of the liver and pancreas may contribute to, and aggravate these complaints. Thus, about 50 percent of alcoholics with an initial stage of liver damage (i.e., fatty liver) and 30 to 80 percent of patients with an advanced stage of alcohol-induced liver injury (i.e., alcoholic hepatitis) report some symptoms of abdominal discomfort.[19] These abdominal complaints can lead to reduced food intake, thereby causing the weight loss and malnutrition commonly observed in alcoholics.

In addition to causing abdominal complaints, alcohol plays a role in the development of cancers of the GI tract. It is likely, however, that alcohol does not cause GI-tract cancers by itself but acts in concert with other cancer-inducing agents (i.e., as a cocarcinogen).[20] Heavy alcohol consumption has also been associated with the development of tumours in the colon and rectum. However, the relative risk of cancer is higher for rectal cancer than for colon cancer.[21] Moreover, the increased risk of rectal cancer appears to result mainly from heavy beer consumption, whereas distilled spirits appear to have no effect.

Result of this study on the effect of alcohol on intestinal weight and motility in Wistar rats are presented as Mean± SD. From table IV, the result shows consumption of alcohol for the period of 30days causes significant ($p<0.05$) increase with the distance travelled by the activated charcoal in the 7% alcohol treated groups, compared to control group and moderate increase but no significance at ($p > 0.5$) were observed with intestinal weight and length in the 7% alcohol treated groups, compared to control group which was also observed with 60 and 90 days of treatment with 7% Alcohol.

Table I: shows the effect of alcohol on the body weight of Wistar rats, data were express in mean± SD. From table I, body weight of control rats (group I) show as significant increase with percentage difference of (18.72%) when compared initial weight to final body weight at 30 days interval and same was also observed with groups 2 (34.12%). From table II, body weight of control rats (group I) show as significant increase with percentage difference of (35.60%) when compared initial weight to final body weight at 60 days interval and same was also observed with groups II (50.46%). From table III, body weight of control rats (group I) show as significant increase with percentage difference of (50.91%) when compared initial weight to final body weight at 90 days interval and same was also observed with groups II (48.05%). Summarily from this study, alcohol is seen to inhibit absorption of a variety of nutrients. The importance of these absorption disorders in the development of nutritional disturbances in alcoholics, however, is unclear. In alcoholics with limited pancreatic function or advanced liver disease, digestion of nutrients may be a more significant problem than impaired absorption disorders.

CONCLUSION

Through multiple pathways, alcohol is known to induce gut inflammation, which in turn promotes broad-spectrum pathologies, both within and outside the GI tract. In fact, many alcohol-related disorders, including cancers, liver disease, and neurological pathologies, may be exacerbated or directly affected by this alcohol-induced gut inflammation. Chronic ingestion of alcohol also induces mild tubulo-interstitial disease, and this might be due to a direct proliferative effect of alcohol on the proximal tubular cell. Additionally, chronic alcohol ingestion induces renal microvascular disease that alters renal autoregulation and results in glomerular hypertension. These combined effects could provide a mechanism for the relationship of metabolic syndrome with early renal disease. Therefore, chronic alcohol consumption should be reduced in other to advent the possible risk associated with chronic ingestion of alcohol.

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