Original Research Articles

Histological Effects of Chronic Consumption of Soft Drinks on the Intracranial Visual Relay Centres of Adult Wistar Rats

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ABSTRACT

Background: Effects of chronic consumption of cola drinks on the intracranial visual relay centres namely superior colliculus and lateral geniculate body of adult wistar rats were studied.

Methods: Rats of both sexes with average weight of 200g were equally assigned into three groups of n=8 each. The rats in groups [A] and [B] were respectively given [Brand A] and [Brand B] of different brands of cola drink for thirty days liberally. The group C (control) received equal volume of distilled water as placebo for the same period. On day thirty-one of the experiment, the animals were sacrificed by cervical dislocation. The superior colliculus and lateral geniculate body were carefully dissected out and quickly fixed in 10% formal saline for histological study.

Results: The rats in the treated groups showed some cellular degenerative changes, hypertrophy, sparse cellular population, pyknotic nuclei with some microcystic changes, edema and vacuolation in the stroma of the superior colliculus and lateral geniculate body as compared to the control group.

Conclusion: Chronic consumption of cola drinks may therefore have adverse effect on visual sensibilities by affecting the microanatomy of the superior colliculus and lateral geniculate body. It is recommended that further studies aimed at corroborating these observations be carried out.

Keywords: *soft drinks, histological effects, superior colliculus, lateral geniculate body, wistar rats*

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Introduction

Cola soft drinks are dark amber colored carbonated soft drink with a sweet bubbly taste. It is flavored with caffeine hence it belongs to the cola category of the family of soft (non alcoholic) drinks commonly referred to as soda pop. Soda pop contains mainly water, sugar and chemicals in the form of flavors, colorings, preservatives and sweeteners. The rate of consumption of these drinks is alarming especially in the affluent countries. For instance, the American and Australian consumes about 562mL and 310mL per day per person, while 63% of Irish children consume about 375mL per day per person [1,2].

Similar to the perception on herbal medicines, most people view soft drink consumption as fairly innocuous. However, there are number of serious health issues associated with regular consumption of soft drinks. One peer-reviewed study has reported 25 separate harmful effects associated with the consumption of carbonated soft drinks [3]. Numerous scientific studies have shown that soft drinks have a deleterious effect on bone health including mineralization problems in children [4].

Consumption of soft drinks containing sugar has been linked to weight gain and an increased risk for development of diabetes mellitus, possibly due to caloric imbalance along with the provision of large amounts of rapidly absorbable sugars. There is a probable link between the consumption of sugar-sweetened soft drinks and excess weight gain as well as cardiovascular disease [5-7]. There is also the associated risk of cancer[8-10], the formation of kidney stones[11], and a strong correlation with dental caries and erosion of teeth[12]. Aspartame is a synthetic sweetener and preservative which is of low caloric value added to soft drinks, of which one of the principal metabolites and deleterious effects is acute intoxication by methanol in humans and animals [13-15]. Although there is argument it is consumed low the toxicological dose [16], it has a potent to cause blindness, headaches and neurolog al changes amongst others [17].

The superior colliculus and lateral geniculate body constitutes the intracranial visual relay centres. The lateral geniculate body in mammals process visual informatio and participates in the regulation of circadian function through its projection to the circadian pacemaker of the hypothalamus [18,19].

The superior colliculus is a paired structural component of the mid-brain. It is concerned with ocular movement. It acts as an integrative center sub-serving visual perception. It co-ordinate responses evoked by a variety of sensory signals with behavioral movements that direct the head, eyes and ear towards the environmental stimulus. Thus, the superior colliculus has a critical role in visual localization, orientation tracking movements, accommodation and pupillary reflex [18, 20, 21]. Any pathology of superior colliculus may impair vision and vision-dependent responses.

Further, the cognitive functions of the superior colliculi have been documented to include a critical role in the ability to direct behaviors toward specific objects, even in the absence of the cerebral cortex [22]. Whether there is any toxic effect on the histology of superior colliculus has not been reported. This study investigates the histological effects of chronic consumption of cola drinks on the superior colliculus of adult Wistar rats. Also, it appears that soft drink consumption is not as harmless as generally believed. It would therefore be worth while to examine the effects of excessive cola drinks consumption on the superior colliculus in animal model such as wistar rat. This study is based on the premise that any histological distortion of the superior colliculus could impact on cognition [23].

Materials and Methods

Ethics: The School of Basic Medical Sciences, University of Benin granted approval for the care and use of laboratory animals before the work began. The rats were obtained and maintained in the Animal Holdings of the Department of Anatomy, School of Basic Medical Sciences, University of Benin, Benin

City, Edo State, Nigeria. The animals were liberally fed with grower's mash (obtained from Edo Feeds and Flour Mill Limited, Ewu, Edo State, Nigeria), which was made available at all times.

Animals: Twenty-four adult wistar rats of both sexes with average weight of 200g were equally and randomly assigned into three groups (A, B and C). Groups A and B were assigned into 'Brand A' and 'Brand B' cola drink that the group was going to be given, while group C (control) was given water liberally.

Brand [A] & Brand [B] cola drinks administration: The rats in Groups A and B were given different de-identified cola drinks respectively labeled brand A and brand B. The cola drinks were given liberally, as the control group was given water. That is, the drinks were always there for them daily, but usually changed twice daily for a fresh one after cleaning the container.

The rats were sacrificed by cervical dislocation on the thirty-first day of the experiment. The skulls were opened using bone forceps to expose the brain of the rats. The superior colliculus and lateral geniculate body were quickly dissected out and fixed in 10% formal saline for routine histological study.

Histological study: The tissues were dehydrated in an ascending grade of alcohol (ethanol), cleared in xylene and embedded in paraffin wax. Serial sections of 7 microns thick were obtained using a rotary microtome. The deparafinised sections were stained with routine haematoxylin and eosin procedures. Photomicrographs of the desired results were obtained using research photographic microscope in the Department of Anatomy, School of Basic Medical Sciences, University of Benin, Benin city, Edo State, Nigeria.

Results

The sections of the superior colliculus and lateral geniculate body from the control animals showed normal histological features with the neurons appearing distinct and of various sizes. The neuron and glial cells appeared normal and showed no vacuolation in the stroma of the superior colliculus and lateral geniculate body.

The section from [Brand A] and [Brand B] treated groups with cola drinks revealed some cellular degenerative changes, hypertrophy, sparse cellular population, pyknotic nuclei

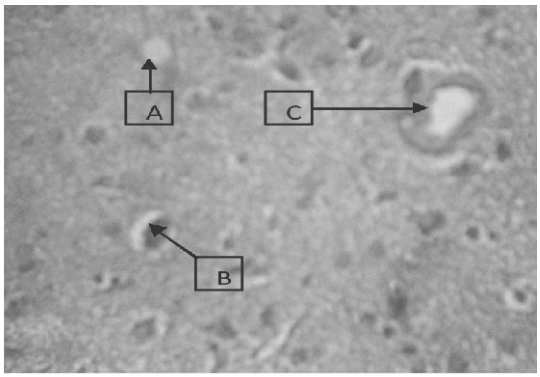

Fig.1A: Treated brand A section of the superior colliculus showing A=vacuolation, B=hypertrophied cell C=pyknotic nucleus (H & E method x400)

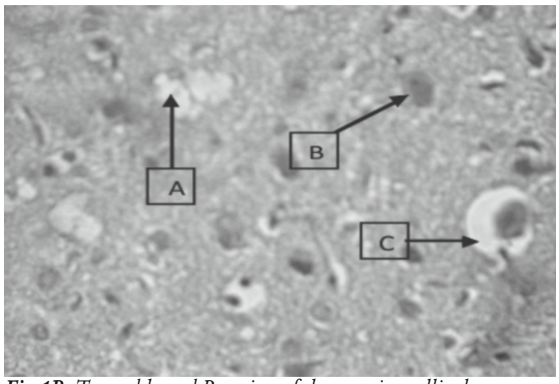

Fig.1B: Treated brand B section of the superior colliculus showing A=vacuolation, B=hypertrophied cell C=pyknotic nucleus (H&E Method x400)

with some microcystic changes, edema and vacuolation in the stroma of the superior colliculus and lateral geniculate body as compared to the control group with that of the Brand B cola a bit more remarkable.

Discussion

The results of this experiment showed some cellular degenerative changes, hypertrophy, sparse cellular population, pyknotic nuclei with some microcystic changes, edema and vacuolation in the stroma of the superior colliculus and lateral geniculate body as compared to the control group of the adult Wistar rats. It could be inferred from this results that chronic consumption of cola drinks resulted in increased toxic effects on the intracranial visual relay centres of adult Wistar rats. There was a decrease in cellular population observed in the treated groups of Brands [A] and [B] cola soft drinks. Neuronal degeneration due to toxic agents could be progressive and may include shrinkage of the neurons [24]. Brands [A] and [B] cola soft drinks may have acted as toxin to the cells of the superior colliculus and lateral geniculate body thus affecting their cellular integrity. It could

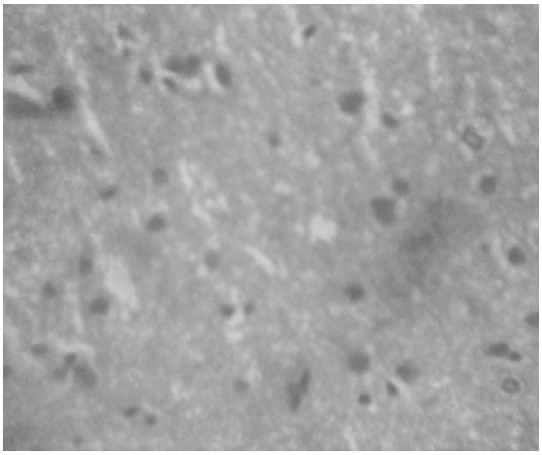

Fig.1C: *Control section of the superior colliculus (H & E method x400)*

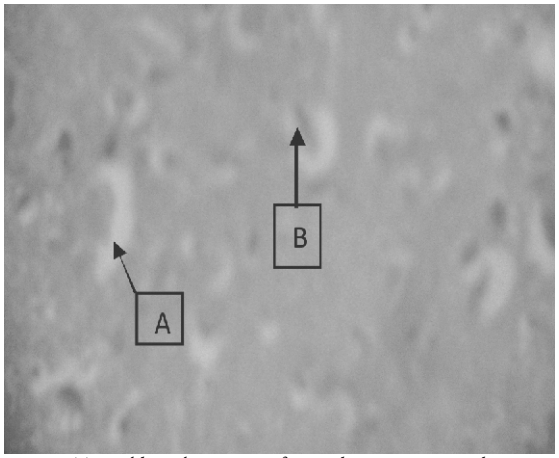

Fig 2A: *Treated brand A section of LGB showing A=vacuolation, B=pyknotic nucleus (H & E method x400)*

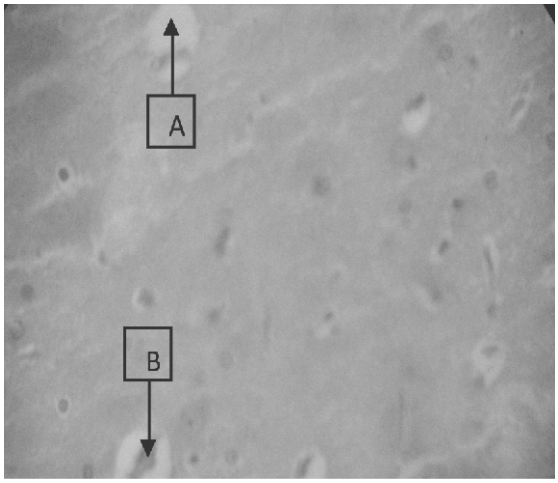

Fig 2B: *Treated brand B section of LGB showing A=vacuolation, B=pyknotic nucleus (H & E method x400)*

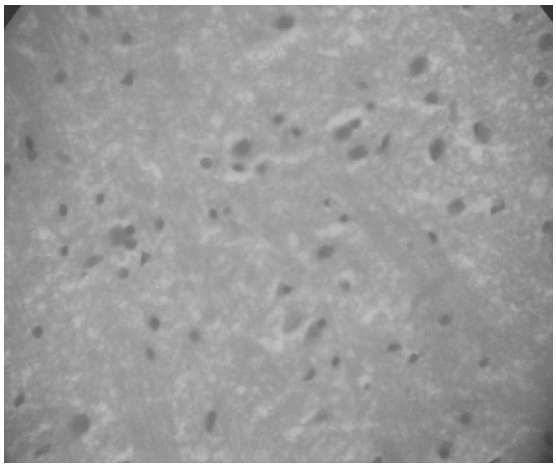

Fig 2C: *control section of LGB (H & E method x400)*

be inferred from this results that prolonged consumption of the soft drink resulted in increased toxic effects on the superior colliculus and lateral geniculate body micro-anatomy. The decrease in cellular population observed in this study may have been as a result of cell death caused by the toxic effect of cola drinks. Beside the aspartame content of cola being an excitoneurotoxic agent [17], excessive sugar in the drink has potential for the development of several diseases, with implication of oxidative damage. Hence, there is now special cola drink formula that is sugar-free.

It has been reported previously that chronic administration of chloroquine resulted in the cellular degenerative changes, sparse cellular population and vacuolation appearing in the brain of adult Wistar rats [25, 26]. This report advances further the vulnerability of the brain, and the intracranial visual relay centre in particular.

Excessive consumption of soda drinks could lead to hyperglycaemia because of the high sugar content. Therefore, one salient factor common to toxic potential of cola soft drinks is the oxidative damage hypothesis. Cognitive functions and neuronal change as in neurodegeneration is impacted by oxidative stress. This triggers insulin secretion and neurons lack the capacity to store glucose. Hence, during hypoglycaemia, the brain experiences an energy crisis and consequences including tissue hypoxia [27]. Further, excessive and prolonged soda drink consumption creates a hyperglycaemic state and can diminish the body's ability to respond to insulin which may enhances brain damage. It has been hypothesized that the importance of considering all co-antioxidants acting within a unified physiological process is that antioxidant interactions are complex and determine whether antioxidant shows a positive or negative effects [28]. Especially, it is possible for administration of even a normal daily dose of an antioxidant to yield pro-oxidant radicals that may not be regenerated early enough. The net effect is increased OS, which is negative and unwanted. The point here is that excessive consumption of soda (sugary) drinks could cause neuronal damage and impaired cognitive functions through oxidative stress. This report presents evidence of the possibility of such micro-anatomical damage. Therefore, we also recommend biochemical analysis as adjunct study to corroborate this report.

Limitations

This study is limited in some ways. The cola drinks used in this experiment contain sugar. Whether they also contain aspartame was not determined and effort to verify this was unsuccessful. We acknowledge that consumption of cola drinks is not as liberally provided to humans as in the experimental animals.

However, our report thus provides indication of toxic potential to cognitive function with a histological perspective that has applicability in post-mortem examinations. To our knowledge, this is the first report on the histological effect of soft drinks on intracranial visual relay centres.

Conclusion

The study revealed that chronic consumption of soda pop drinks could cause some morphological changes in the stroma of the

superior colliculus and lateral geniculate body of adult Wistar rats. These histological changes may affect the visual sensibility functions of the superior colliculus and lateral geniculate body in the adult Wistar rats. We suggest further studies aimed at corroborating these observations in humans.

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