
**EVALUATION OF BIOCHEMICAL PARAMETERS INCLUDING,
CARDIOPROTECTIVE AND ATHEROGENIC INDICES IN VITREOUS
HUMOR OF SODIUM CYANIDE POISONED RABBITS**

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DOI: <https://doi-doi.org/101555/ijarp.1628>**ABSTRACT**

Cyanide is a fast acting, potentially and deadly chemical that can exist in various forms. Exposure to sodium cyanide causes serious health effects and can be fatal. This study was designed to evaluate biochemical parameters including, cardioprotective and atherogenic indices in vitreous humor of sodium cyanide poisoned rabbits. The following biochemical parameters were investigated, cardioprotective: (anti-atherogenic index (AAI). TG/HDL-C (Triglycerides (TG), high density lipoprotein cholesterol (HDL-C)), cardiac risk index 1 (CRI-1), cardiac risk index 11 (CRI-11), atherogenic indices: atherogenic index of plasma (AIP), atherogenic coefficient (AC). The biochemical parameters were assessed over 24 hours in rabbits: Group 1 (Test group) received a lethal sodium cyanide dose (1mg/kg), Group 2 (disguised death group) received it post-sacrificed, and Group 3 (control group) was sacrificed without administration. The following were results of parameters investigated: Test group; AAI = 27.08 ± 9.35 , TG/HDL-C = 1.57 ± 0.49 , CRI-1 = 7.44 ± 0.54 , CRI-11 = 5.46 ± 1.01 , AIP = 0.06 ± 0.02 , AC = 4.19 ± 1.93 . Disguised group; AAI = 15.50 ± 10.08 , TG/HDL-C = 1.25 ± 0.11 , CRI-I = 4.81 ± 1.67 , CRI-11 = 2.81 ± 1.09 , AIP = 0.07 ± 0.02 , AC = 3.00 ± 1.48 . Control group; AAI = 27.00 ± 10.13 , TG/HDL-C = 1.40 ± 0.28 , CRI-I = 4.01 ± 0.58 , CRI-II = 2.39 ± 0.81 , AIP = 0.10 ± 0.08 , AC = 4.16 ± 1.42 . The result showed significant increase in levels of CRI-I and CRI-II in test group compare to control and disguised groups. However, there was no significant difference in levels of CRI-I and CRI-II in disguised group compare to control group. Similarly, there was no significant difference in levels of AAI, TG/HDL-C, AIP and AC across the groups. It can be concluded that sodium cyanide is a potential poison

and the elevated atherogenic indices could increase cardiovascular disease risk. Also, the results could be used in death differentiation due to sodium cyanide poisoning.

KEYWORDS: Atherogenic indices, Cardioprotective indices, Sodium cyanide and Rabbits.

INTRODUCTION

Cyanide is a fast acting, potentially and deadly chemical that can exist in various forms ¹. The toxic effects of cyanide in humans and animals are generally similar and are believed to result from inactivation of cytochrome oxidase and inhibition of cellular respiration and consequent histotoxic anoxia. The primary targets of cyanide toxicity in humans are the cardiovascular, respiratory and central nervous systems ². The organs most susceptible to cyanide are the central nervous system (CNS) and the heart ³. Cyanide poisoning may produce some pathologic effects on different tissues that may manifest as alterations in biochemical parameters. Consequently, certain types of cells are damaged and leaked enzymes into the blood, where they can be measured as indicators of cell damage ⁴.

Cyanide being lipophilic could access the circulatory system including the vitreous humor of the eye. The access by cyanide is the basis of the hypoxic and asphyxia mechanism of action. The blood is a major medium for the transportation of cyanide across the body. This seamless relationship explains the pattern of its effect on biochemical parameters ⁵.

The vitreous humor is located between the lens and the retina with similar biochemical composition to that of serum. Sodium cyanide been lipophilic access the vitreous through the eye or blood circulatory system ⁴. It is a fluid that is relatively well protected from postmortem degradation and contamination. Due to its postmortem stability, vitreous humor has high utility in forensic pathology. Antemortem serum biochemical alterations are a regular feature in many diseases and the availability of the antemortem serum levels are useful in establishing postmortem diagnosis of different ailments ⁵. The relative stability of vitreous biochemistry is useful in assessing the antemortem metabolic status and in predicting the antemortem serum biochemistry of an individual ⁶.

MATERIALS AND METHOD

PROCUREMENT OF MATERIALS: Sodium cyanide, 98% purity, produced by Changsha Hekang Chemical Co. Ltd was purchased at Decosmiller Ventures, Ogbete, Enugu, Nigeria

EXPERIMENTAL ANIMALS: The experimental animals were purchased at Sandra Farm, Oyigbo, Rivers state, Nigeria.

PLACE AND DURATION OF STUDY: this study was carried out at Animal House, Applied and Environmental Biology Department, Rivers State University, Port Harcourt, Rivers State, Nigeria, between April, 2020 and November, 2020.

STUDY DESIGN: Twelve (12) rabbits were used for the study. The rabbits were arranged into three groups with four rabbits in each of the group and the study lasted for twenty-four hours.

Group one: The rabbits were sacrificed without administration of lethal dose of sodium cyanide (1 mg/kg sodium cyanide), after thirty minutes, vitreous fluid was collected from the rabbits. This represents the control group.

Group two: The rabbits were sacrificed and lethal dose of 1 mg/kg sodium cyanide was given to the rabbits via injection route. After thirty minutes, vitreous fluid was collected from the rabbits. This represents the disguised death group.

Group three: The rabbits were given lethal dose of 1 mg/kg sodium cyanide through injection route and after thirty minutes vitreous fluid was collected. This group represents actual death from sodium cyanide (Test group).

Sample Collection

Vitreous samples were collected by method postulated by Coe (1989).

BIOCHEMICAL ANALYSIS:

Anti-atherogenic index (AAI) was calculated using a formula developed by Brehm *et al.* (2004)

$$AAI = 100 \times \frac{HDL-C}{TC - HDL-C}$$

TG/HDL-C was calculated using a formular developed by Brehm *et al.* (2004)

Castellic Risk Index (CRI-1, CRI-11) was calculated using a formula developed by Bhardwaj *et al.* (2013)

$$CRI-1 = TC/HDL-C$$

$$CRI-11 = LDL-C/HDL-C$$

Atherogenic Index of Plasma (AIP) was calculated using a formula developed by Othman *et al.* (2020)

AIP= Log (TG/HDL-C)

Atherogenic Coefficient (AC) was calculated using a formula developed by Brehm *et al.* (2004)

$$AC = TC - HDL-C/HDL-C$$

Statistical analysis. Data were expressed as mean \pm SD. Statistical differences between groups were computed using Graph pad prism 7.0 versions. Results were analyzed using one-way analysis of variance (ANOVA) and significance difference between groups was taken at $p < 0.05$.

RESULTS

The results of analysis of biochemical parameters including, cardioprotective and atherogenic indices in vitreous humor of sodium cyanide poisoned was presented in Table 1. The results showed significant increase in levels of CRI-I and CRI-II in test group compare to control and disguised groups. However, there was no significant difference in levels of CRI-I and CRI-II in disguised group compare to control group. Similarly, there was no significant difference in levels of AAI, TG/HDL-C, AIP and AC across the groups.

Table 1: Mean \pm SD of Cardioprotective and Atherogenic Indices of Vitreous Humor.

S/ N	Experimenta l Groups	Parameters					
		AAI	TG/HDL -C	CRI-1	CRI-11	AIP	AC
1	Control	27.00 \pm 10.1 3	1.40 \pm 0.2 8	4.01 \pm 0.5 8	2.39 \pm 0.8 1	0.10 \pm 0.0 8	4.16 \pm 1.4 2
2	Actual death	27.08 \pm 9.35	1.57 \pm 0.4 9	7.44 \pm 0.5 4	5.46 \pm 1.0 1	0.06 \pm 0.0 2	4.19 \pm 1.9 3
3	Disguised death	15.50 \pm 10.0 8	1.25 \pm 0.1 1	4.81 \pm 1.6 7	2.81 \pm 1.0 9	0.07 \pm 0.0 2	3.00 \pm 1.4 8
4	F-value	1.825	0.9051	11.34	12.31	0.3412	0.278
5	P-value	0.2161	0.4384	0.0035	0.0027	0.7198	0.7643

Keys: AAI= anti-atherogenic index, TG= triglycerides, HDL-C= high density lipoprotein cholesterol, CRI-1= cardiac risk index 1, CRI-11= cardiac risk index 11, AIP= atherogenic index of plasma, AC= atherogenic coefficient.

DISCUSSION

The cardiovascular disease risk was assessed in the study, using AAI, CRI-1 and 11, AIP and AC. The result showed no significant difference in the level of AAI across the groups. Of course, this was possible because anti atherogenic index depend on the values of HDL-

cholesterol and in this study HDL-cholesterol was not statistically significant. Theodosios & Moses (2013) reported that HDL-C particles exhibit several anti-atherosclerotic properties. On cardiac risk ratio 1 (CRI-1), this study observed significant difference across the groups. Ridker *et al.* (2001) also stated that CRI-1 calculated as (TC/HDL-C) takes into consideration the levels of total cholesterol and HDL-C, and it is considered to have great prognostic power for coronary heart disease. Abnormal values for CRI-1 are > 3.5 in males and > 3.0 in females Ogbera *et al.* (2009) and Bhardwaj *et al.* (2013). The results of this study revealed that actual death group is at risk of developing coronary heart disease because the total cholesterol level of the actual death was significantly higher compare to control group while the HDL-C levels across the other groups was not significant.

The pattern of cardiac risk ratio 11 is similar to CRI-1 in this study. The mean value was statistically significant. Ogbera *et al.* (2009) and Bhardwaj *et al.* (2013) stated that CRI-11 has more predictive power and abnormal value for CRI-11 is >3.3 and this value is consistent with the results of this study. Therefore, the actual death group might be at higher risk of developing coronary heart disease because the LDL- cholesterol level of the actual death group.

The comparison of the mean values of AIP across the groups did not show any significant difference. Dobiasova *et al.* (2011) and Dobiasova (2006) stated that AIP value of greater than 0.12 increase cardiovascular risk while AIP value lower than 0.11 and 0.11 to 0.21 are reportedly associated with low and intermediate cardiovascular risk. Nwagha *et al.* (2010) also stated that high triglyceride with a raised HDL-C jointly increased cardiovascular risk, but the results revealed unchanged levels vitreous HDL-C and triglyceride, therefore, eliminating the threat of cardiovascular disease in the study group (actual death).

The comparison of the mean values of Atherogenic Coefficient across the groups did not show any significant difference. Brehm *et al.* (2004) stated that Atherogenic Coefficient is dependent on high total cholesterol and decreased levels of HDL-cholesterol in predicting the risk of coronary artery disease. This study revealed that cyanide poisoning increased the CRI-1 and CRI-11 risk factors while the AAI, AIP and AC risk factors were not detected.

CONCLUSION

It can be concluded that sodium cyanide is a potential poison and the elevated atherogenic indices could increase cardiovascular disease risk. Also, the results could be used in death differentiation due to sodium cyanide poisoning.

DICLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

ETHICAL APPROVAL: The Animal Welfare Act of 1985 of the United State of America for research and Institutional Animal Care and Use Committee (IACUC) protocol were strictly adhered to. All experiments have been examined and approved by the appropriate ethic committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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