WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 6.805
Volume 5, Issue 3, 1499-1506. Research Article ISSN 2277– 7105

EVALUATION OF ANION GAP IN PETROL PUMP ATTENDANTS IN PORT HARCOURT METROPOLIS, NIGERIA

***Kalio Ibiene Sarah[1] and Hanson Asikiya Huldah[2]**

[1]School of Medical Laboratory Science, Rivers State College of Health Science and Technology, Rumueme, PMB 5039, Port Harcourt, Rivers State, Nigeria.

[2]Health Services Department, Medical Laboratory Unit Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt, Rivers State, Nigeria.

Article Received on
17 Jan 2016,

Revised on 08 Feb 2016,
Accepted on 29 Feb 2016

***Correspondence for Author**
Kalio Ibiene Sarah
School of Medical Laboratory Science, Rivers State College of Health Science and Technology, Rumueme, PMB 5039, Port Harcourt, Rivers State, Nigeria.

ABSTRACT

This study was carried out to determine Anion gap in petrol pump attendants exposed to petroleum pollutant in Port Harcourt Metropolis, Rivers State, Nigeria. A total of 32 fuel pump attendants were compared with 32 healthy individuals used as control. Anion gap was calculated from serum electrolyte concentration of the subjects by calculating the difference between primary measured cations (sodium Na^+ and potassium K^+) and the primary measured anions (chloride $C1^-$ and bicarbonate HCO_3^-) in serum. The result shows that mean$\pm$ standard deviation of anion gap in fuel pump attendants is 22.85 $\pm$ 6.69mmol/l while in control, the values are 15.94 $\pm$ 3.53 mmol/l. The result shows that anion gap is significantly higher ($p<0.05$) in fuel pump attendants exposed to petroleum pollutants than in control. This difference can be attributed to over production or decreased excretion of acid. This implies that exposure to petroleum pollutant have adverse effect on production and excretion of protons and anions. Hence it is recommended that fuel pump attendants take necessary precautionary measures during the course of carrying out their duties.

KEYWORDS: Anions gap, Cations, Electrolytes, Petrol pump attendants, Pollutants.

INTRODUCTION

Petrol also called gasoline is a light fuel oil obtained during distillation of petroleum. It is a highly volatile hydrocarbon derived from crude oil. It is used for automobiles and combustion

engines for transport vehicles. Petroleum consist of cycloalkanes, aromatic compounds, organic compounds and trace amounts of iron, nickel, copper and vanadium.

Petrol fumes are produced at petrol stations and depots, as a result of evaporation. This makes it readily inhaled.[1] Other forms of exposure include direct contact on skin and cloths during spillage while dispensing into automobiles. Petrol is a volatile organic compound. Exposure to such compound can bring about adverse health effects such as headache and mucosal symptoms.[2] High concentration of petroleum vapor may affect the central nervous system while very high concentrate may result in unconsciousness and death due to failure to breathe.[3] According to World Health Organization, acute poisoning from petrol occurs during inhalation of vapor, sniffing and ingestion[4], petrol fumes therefore is an environmental pollutant that could cause serious adverse effect in exposed humans.

Anion gap is the difference between primary measured cautions (Sodium Na^+ and Potassium K^+) and the primary measured anions (chloride Cl^- and bicarbonate (HcO^{3-}) in serum. It is measured in patients who present with altered mental status, unknown exposure, acute renal fail and acute illness.[5]

A decrease anion gap may be due to hypoalbuminemia, plasma cell dyscrasia, monoclonal protein, Bromide intoxication and normal variant.[6]

An elevated anionic gap may indicate milk-alkali syndrome, uremia, diabetic ketoacidosis, lactic acidosis, renal failure, exposure to salicylates, propylene glycol and ethanol ethylene glycol.

Studies using laboratory animals have demonstrated the effect of exposure to petroleum.[7] This study therefore sought to evaluate anion gap in petrol pump attendants by (a) determining the concentration of electrolytes in petrol pump attendants and control (b) determining Anion gap in petrol pump attendants and control (c) determining Anion gap base on years of exposure to petroleum pollutants.

MATERIALS AND METHODS

Study Area

The study was conducted within Port Harcourt metropolis in Rivers State of Southern Nigeria. Rivers State is known for it's oil production.

Subjects and Study Design: The study comprised of a total of 64 subjects (aged between 20 and 54 years), consisting of 32 petrol pump attendants from different petrol stations within Port Harcourt that have been directly exposed to petrol vapor in the course of their work and 32 apparently healthy individual who work in a office away from the petrol stations in Port Harcourt metropolis with no known chemical exposure. Out of the 32 petrol pump attendants, 16 were males and 16 were females. Years of exposure ranged between 1 – 5 years.

Participants gave well informed, written and properly understood consent in accordance with Helsinki declaration of 1964 as amended in 1983.[8]

Sample Collection: 5ml of blood was collected from ante-cubital vein of subjects into plain bottle without anticoagulant. Each bottle was labeled with patients name, age and sex. The samples were spun at 1,500 rpm for 5mins to obtain serum samples.

Test Methods: Electrolytes (sodium, potassium, chloride and bicarbonate) were determined using various methods. Potassium and sodium were determined using flame photometer.[9] Chloride meter was used to estimate chloride concentration while Bicarbonate was determined by titration method.[9] Anion gap was calculated using the formula below

Anion gap = $(Na^+ + k^+) – (Cl^- + HCO_3^-)$

Analysis of variance was used to find significance of study parameters between groups while student T- test two tailed independent was used to find significance of study parameters between two groups. Value less than 0.05 was considered statistically different.

RESULT

The study was conducted to determine anion gap in 32 petrol pump attendants and 32 individuals not exposed to petroleum pollutants. Data are presented below:

Table 1: Anion gap and electrolyte concentrate with statistical evaluation (n = 32) for petrol pump attendants and (n=32) for control.

Parameters	Test N=32	Control N = 32	T Value	p value	STD Error of Difference	Significant
Sodium (mmol/l)	$148.19^{\pm}20.03$	135.88 + 2.06	3.458	0.001	3.560	S
Potassium (mmol/l)	$4.38^{\pm}0.26$	3.44 + 0. 36	11.974	0.0001	0.079	S
Chloride (mmol/l)	$107.75^{\pm}6.17$	101.25 + 2.42	5.548	0.0001	1.172	S
Bicarbonate (mmol/l)	$28.56^{\pm}2.27$	21.25 + 3.08	10.808	0.0001	0.676	S
Anion gap(mmol/l)	$22.85^{\pm}6.69$	15.94 + 3.53	5.168	0.0001	1.337	S

at95% interval P <0.05 is considered Significant. S- significant . NS – Not Significant

Table 1 above revealed that mean ± Standard deviation for Anion gap and electrolytes were all increased in fuel pump attendants than in control. All parameters showed significant difference ($P < 0.05$) when compared with control

Table 2: Anion gap and electrolyte concentration of male and female petrol pump attendants with statistical evaluation (n=16) for male and (n=16) for female.

Parameter	Male n=16	Female n=16	T Value	P Value	STD Error of diff.	Significant
Sodium (mmol/l)	158.38 ± 11.83	138 ± 21.63	3.3066	0.0025	6.163	S
Potassium (mmol/l)	4.43 ± 0.31	4.32 ±0.20	1.1927	0.2423	0.092	Ns
Chloride (mmol/l)	109.50 ± 6.04	106 ± 6.00	1.6444	0.1105	2.128	Ns
Bicarbonate (mmol/l)	28.38 ± 1.54	28.75 ± 2.86	0.4556	0.6519	0.812	Ns
Anion Gap (mmol/l)	25.43 ± 6.59	20.28 ± 5.92	2.3254	0.0270	2.215	S

In table 2 above Anion gap was higher in male than in female ($p < 0.05$) while sodium was higher in male than female petrol pump attendants.

Table 3: Anova table for electrolyte (sodium, potassion, chloride, bicarbonate) and anion gap in petrol pump attendants exposed to petroleum pollutants between 1 – 2 years

Sources of variation	SS	DF	MS	F(MSR)	P value	F Critical
Between groups	269308.8	4	67327.2	4872.593	1.7E99	2.479015
Within groups	1174.49	85	13.81753			
Total	270483.3	89				

Table 4: Anova table for electrolyte (sodium, potassium, chloride, bicarbonate) and anion gap in petrol pump attendants exposed to petroleum pollutants between 3 – 5 years.

Sources of variation	SS	DF	MS	F(MSR)	P Value	F Critical
Between groups	221680.1	4	55420.02	328.3512	2.48E42	2.51304
Within groups	10970.88	65				
Total	232651	69				

Table 3 – 4 shows Anova table for Anion gap and electrolyte in petrol pump attendants exposed between 1 – 2 years and 3 – 5 years.

DISCUSSION

In table one, as the data were subjected to statistical analysis using student T test, the mean values for anion gap and electrolyte (sodium, magnesium, potassium and bicarbonate) were

significantly higher ($p < 0.05$) in petrol pump attendants exposed to petroleum pollutants than in control. Anion gap is a mathematical approximation showing the difference between cations and anions that are routinely measured in serum. High values exceeding 17mmol/l as seen in table one for petrol pump attendants, usually indicates significantly increased concentration of unmeasured ions due to conditions such as ingestion of toxic substances.[9] Petrol dispersed by petrol pump attendants contain certain toxic substances and hydrocarbons which get converted into active metabolities in cells. Ingestion of these substances could explain the increase in anion gap in petrol pump attendants compared to control. Petrol pump attendants are exposed through direct contact on their hands when petrol spillage occurs while dispensing petrol into cars. Again, most of the petrol pump attendants work long hours and usually take their meals at their duty post without proper hand washing, some of the petrol pump attendants buy snacks from hawkers who come into the petrol station and as such ingest toxic substances from petrol during contact with food.

Several studies indicate that, high anion gap acidosis is due to over production of organic acids or the concomitant and proportionate reduction in the excretion of anions and net acid as in renal failure.[10,11] In renal failure, serum anion gap is increased as a result of the deceased acid excretion and decreased bicarbonate reabsorption in the tubules.[11] A normal anion gap is only observed if renal damage is predominatly at the tubules aid and there is minimal glomerular damage.

Again, increase anion gap may indicate metabolic acidiosis.[10,12] The anion gap is also slightly increased in the absence of acidiosis by very low potassium concentrations. Hepatic damage as a result of treatment of rats with petrol contaminated diets has been documented in studies[13]while other studies reported disturbance in the transport of metabolities as a result of petrol.[14]

Increase anion gap in petrol pump attendants observed in this study is either from too much acid production or insufficient removal of acids in the body. High anion gap indicates that electrical charge of the fluids are too negative when compared to the cells. This is because charge across membrane is required for many enzymes and in energy production.

Anion gap can be elevated by toxins such as ethylene glycol, methanol, paraldehyde and propyl alcohol.[15] Intoxication from these substances occurs when they are ingested. Metabolism of ingested alcohols occurs through the enzyme alcohol dehydrogenase into

glycolic acid and formic acid. Acidiosis from these toxins occurs over time rather than developing rapidly.[15]

Table 1 also revealed significant increase in electrolyte in petrol pump attendants. Electrolytes help to regulate the body hydration, blood pressure, blood PH, muscle function and the repaire of damaged tissues.[16] Electrolyte dysfunction may result in tissue damage and hereby affect general body organs.

Table 2 revealed significant difference in sodium concentration ($p<0.05$) when electrolyte concentrations and anion gap in male petrol pump attendants were compared to female petrol pump attendants.

The anova tables 3 and 4 revealed that anion gap and electrolyte concentration increased as the number of years of exposure increased. To differentiate if there is statistical significance in the level of exposure to petroleum pollutants, analysis of variance for single factor experiment using F-distribution was carried out on anion gap and electrolyte concentration.

At 95% confidence level (0.05), the MSR (F) calculated for petrol pump attendants exposed between 1-2 years is 4872.593, while, the MSR (F) critical or tabulated is 2.479015. For those exposed between 3-5 years, the MSR (F) calculated is 328.3512, while, the F (critical) or tabulated is 2.51304. In both cases, the MSR (F) calculated is greater than the MSR (F) tabulated. This implies that anion gap and electrolyte concentration differ significantly due to duration of exposure.

This increase in electrolyte concentration and anion gap in petrol pump attendants as the years of exposure increased as observed in the study could be attributed to the metabolism of ingested toxin to glycolic acid and formic acid. The acidosis from these toxins occurs over time rather than rapidly.[15] This could account for increase level of protons and anions as the years of exposure increased which would have contributed to the increase in electrolyte and anion level as observed in this study.

CONCLUSION

The study revealed that anion gap is significantly increased in petrol pump attendants and this increase occurs as the years of exposure to petroleum pollutants increases. This can cause adverse effect on production and excretion of protons and anions. Hence it is advised that

petrol pump attendants take necessary measures which includes the use of protective covering in the course of carrying out their duties.

REFERENCES

1. Cecil R, Ellison K, Elison RJ, Larnimaa K, Margary S A, Mata JM, Morcillo L, Muller JM, Petetrson DR, Short D, Simpson BJ. Exposure Profile: Gasoline Concawe Report No. 97/52; 1997.
2. Steinemann AC. Prevalence of Fragranced Consumer Products and Undisclosed Ingredients. Environmental Impact Assessment Review., 2009; 29: 32-38.
3. Chilcott RP. Petrol Toxicological Overview. Health Protection Agency., 2007; 2: 1 – 16.
4. WHO Basic Analytical Toxicolsogy, Petrol Www.Who.Int/Ipcs/Publication/Training Poisons / Basic Analytical Tox/En/Index 11, Html - 101k., 2011.
5. Basic Metabolic Panel: Arup Lab Test Arup Laboration. National Reference Laboratories 2006 – 2012. Available At Http/Www.Aruplab.Com.
6. Cho KC. Electrolyte And Acid Base Disorder. 2012, New York Mcgraw-Hill.
7. Uboh FE, Akpanabiatu MI, Alozie Y, Edet EE, Ndem JI, Ebong PE. Comparative Effect of Vitamins A and E on Gasoline Vapour-Induced Haematotoxicity And Weight Loss In Male Rats. International Journal Of Pharmacology., 2009; 5(3): 215-221.
8. World medical organization. Declaration of Helsinki. British Medical Journal., 1986; 313(7070): 1448-1449.
9. Ochei J, Kolhatkar A. Medical Laboratory Science, Theory And Practice, 7th Edition, Tata Mcgraw Hill Publishing Company Limited New Delhi., 2008; 185.
10. Emmett M. Anion Gap Interpretation: The Old and The New, Journal Of Chinical Practical Nephrology., 2006; 2: 4-6.
11. Kraut JA, Kurtz I. Metabolic Acidosis Of Chronic Kidney Disease (Ckd) Diagnosis, Clinical Characteristics And Treatment, American Journal Of Kidney Disease., 2005; 45: 978-993.
12. Gabow PA, Kaehny WD, Fennessey PV, Goodman SI, Gross PA, Schrier RW. Diagnostic Importance of an Increased Serum Anion Gap. New England Journal of Midecine., 1980; 303: 854-8.
13. Uboh, FE, Ebong PE, Eka OU, Eyong EU, Akpanabiatu MI, Effect of Inhalation Exposure to Kerosene and Petrol Fumes Indices in Rat. Global Journal of Environmental Science., 2005; 3(1): 59 – 63.

14. Lam HR, Ostergard G, Guo SX, Ladefoged O. Bondy SC. Three Weeks Exposure of Rats to Dearomatized White Spirit Induces Oxidative Stress in Brain, Kidney And Liver. Journal of Biochemical pharmacology., 1994; 47(4): 657 – 667.
15. Kraut JA, And Madias NE. Serum Anion Gap: Its Uses and Limitations in Clinical Medicine. Clinical Journal Of The American Society Of Nephrology., 2007; 2(1): 162 – 174.
16. Clayten JA, Rodgers, S. Blakey J. Avery A. Hall IP. Thiazide Diuretic Prescription and Electrolyte Abnormalities In Primary Care. British Journal of Clinical Pharmacology., 2006; 61(1): 87 – 95.