IRIS
Journal for Young Scientists
© Patna Women's College, Patna, India
http://www.patnawomenscollege.in/journal

Effect of arsenic on the kidney function and blood sugar level in Swiss albino mice

Anu Sharma • Vandana • Shahla Yasmin

Received : December 2010
Accepted : November 2011
Corresponding Author : Shahla Yasmin

Abstract : *An experiment was conducted to study the effect of low dose of arsenic trioxide (3 mg/kg BW per day for 15 days) on the kidney function and blood sugar level of swiss albino mice and to study the protective role of garlic and ascorbic acid on the arsenic induced toxicity. It was noted that arsenic did not cause renal dysfunctioning as assessed by estimation of the serum levels of urea, uric acid and creatinine. However a significant rise in the blood sugar level was seen. Further, pathological changes were evident in the kidney. Therefore it is suggested that water containing even low dose of arsenic is hazardous to the health and should not be consumed. Protective roles of ascorbic acid and garlic were not found in our study.*

Keywords : *Arsenic trioxide, ascorbic acid, garlic, kidney function, blood sugar.*

Anu Sharma
B.Sc. III year, Zoology (Hons.), Session: 2008-2011, Patna Women's College, Patna University, Patna, Bihar, India

Vandana
B.Sc. III year, Zoology (Hons.), Session: 2008-2011, Patna Women's College, Patna University, Patna, Bihar, India

Shahla Yasmin
Head, Dept. of Zoology, Patna Women's College, Bailey Road, Patna - 800 001, Bihar, India
E-mail : shahla_apex@yahoo.co.in

Introduction :

Arsenic is a highly poisonous element with many allotropic forms. Arsenic enters the water supplies either from natural deposits in the earth's crust or from industrial and agricultural pollution. The permissible limit of arsenic in water according to WHO is 10 µg/l. As_2O_3 is considered as a potent human carcinogen, associated with cancers of skin (Rossman et al. 2004), lung, bladder, liver and kidney (Abemathy et al. 1999, and Chu et al. 2006). Additionally, a variety of non cancerous conditions such as diabetes mellitus, hypertension, neurological effects have been associated with chronic exposure to high levels of arsenic in drinking water (Guha 2008). The idea that arsenic-induced toxicity could be modified by nutrients was initially proposed in the early 1930's by Mayer and Sulzberger (1931), who suggested that adequate levels of ascorbic acid, in the diet prevented or reduced occurrence of arsenic induced

anaphylaxis. Efficacy of garlic extract in reducing clastogenic effects of sodium arsenite has also been reported in the past (Roy Choudhary et al 1996).We conducted this experiment because information on the short term effects of low concentration of arsenic trioxide on the kidney function and blood sugar level is lacking. The present study relates to study the effects of arsenic trioxide on the behaviour of female mice, body weight and weight of organs such as liver, kidney, uterus, blood sugar level and serum levels of urea, uric acid and creatinine. Protective roles of ascorbic acid and garlic extract on arsenic induced toxicity were also probed.

Materials and Methods :

Twenty healthy female inbred Swiss albino mice of same age were selected for the present study. All animal treatments and protocols followed in this study received prior approval of the Institutional ethical committee and met the standard laid down by Government of India. After acclimatization to the laboratory conditions, mice were divided into 4 groups, each containing 5 mice. Mice of group A were given arsenic-free distilled water and were taken as controls. Mice of group B were administered As_2O_3 (3mg/Kg BW/day). This dose is within human lethal dose (1–4 mg/kg BW) reported for arsenic (North et al 1997). Mice of group C were concurrently administered As_2O_3 (3mg/Kg BW/day) and L-ascorbic acid (10 mg /Kg BW). This dose of L-ascorbic acid is quantitatively equivalent to the human therapeutic dose (500 mg/day; Sahu and Das 1994) in terms of body weight. Mice of group D were administered As_2O_3 (3mg/Kg BW/day) and garlic extract (100 mg/ kg BW). Garlic was extracted as follows: 30g of garlic bulbs were crushed in 60ml distilled water and squeezed through a double cheesed cloth and the aliquots stored in freezer following Flora et al (2009). This dose of garlic corresponds to the daily dietary intake of 7g of fresh garlic by a person weighing 65 kg. On the 16th day mice were weighed and sacrificed. To determine the renal function, blood samples were collected through cardiac puncture and sent to a reputed laboratory for analysis. Kidneys were then fixed in 10% buffer formalin for histological examinations. It was processed, fixed into blocks and microtomed at 5µ and stained with haemotoxylin and eosin and then observed under the research microscope to study the changes in the cells. Initial and final weights of mice and relative weights of control and arsenic treated mice were compared with Student's t-test. Different blood parameters of the four groups of mice were compared with one-way analysis of variance (ANOVA) followed by Tukey's test. P value less than 0.05 was considered statistically significant.

Results and Discussion

No abnormality was found in the general and feeding behaviour of mice treated with As_2O_3. There was no significant difference in the initial ($F_{3,19}$=2.087, NS) and final ($F_{3,19}$=1.128, NS) weights of the control and arsenic treated mice (Table1). Arsenic treatment in mice for 15 days did not show any significant changes in the weights of liver ($F_{3,19}$=0.235,NS), kidneys ($F_{3,19}$=1.276,NS) and uterus ($F_{3,19}$=0.099,NS), (Table 2).

Haematological analysis revealed insignificant changes in the blood urea level ($F_{3,19}$=1.382,NS) , creatinine level ($F_{3,19}$=1.507,NS) and total protein level ($F_{3,19}$=0.398,NS) (Table 3) of the arsenic treated mice when compared to the control group mice. However, there was a significant change in the blood sugar level ($F_{3,19}$=7.542, P<0.05), (Table 3) of the arsenic treated mice. Light microscopic observations of the kidney of arsenic treated mice showed shrinkage of glomeruli, damage to the walls of Bowman's capsule, pyknosis of nuclei, infiltration of cytoplasm and nuclei into the kidney tubules (Fig 2&3) as compared to control ones (Fig 1).

Table 1 : Comparison of initial and final weights (in g) of mice treated with Arsenic versus control ones. Values are Mean± S.E. (duration of experiment=15 days)

Group	Initial weight	Final weight
Control	27.7±1.237	28.42±1.76
Arsenic treated	28.31±0.95	27.38±0.57
Arsenic+ Vitamin C	29.5±0.82	28.328±0.95
Arsenic+ Garlic extract	25.38±1.66	25.384±1.66

Table 2: Comparison of organ weights (in g) of mice treated with Arsenic versus control ones. Values are Mean± S.E. (duration of experiment =15 days)

GROUP	Liver	Kidney	Uterus
Control	1.5 ± 0.2	0.2 ± 0.01	0.9 ± 0.03
Arsenic treated	1.3 ± 0.1	0.2 ± 0.01	1.0 ± 0.05
Arsenic + Ascorbic acid	1.4 ± 0.2	0.2 ± 0.02	1.1 ± 0.1
Arsenic+ garlic extract	1.3 ± 0.1	0.17 ± 0.01	1.1 ± 0.1

Table 3. Comparison of blood parameters of Arsenic treated mice versus control. Values are Mean± S.E.

Groups	Blood sugar (mg/dl)	Total protein (mg/dl)	Blood urea (mg/dl)	Serum creatinine (mg/dl)
Control	131± 2	4.68± 0.1	29.4 ± 1.3	1 ± 0.03
Arsenic treated	133.6± 1.9	4.6± 0.2	31.6 ± 0.8	1± 0.1
Arsenic + ascorbic acid	139.8 ± 1.3	4.88 ± 0.1	28 ± 1.7	1.04 ± 0.6
Arsenic + garlic extract	122.6 ± 4.2	4.64 ± 0.4	60 ± 25.9	2.5 ± 1.2

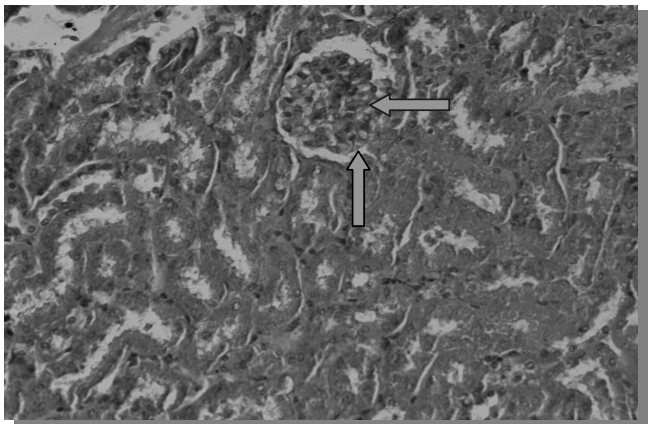

Fig. 1. Kidney of control group mice showing normal glomerulus and Bowman's capsule- H&E. 400X

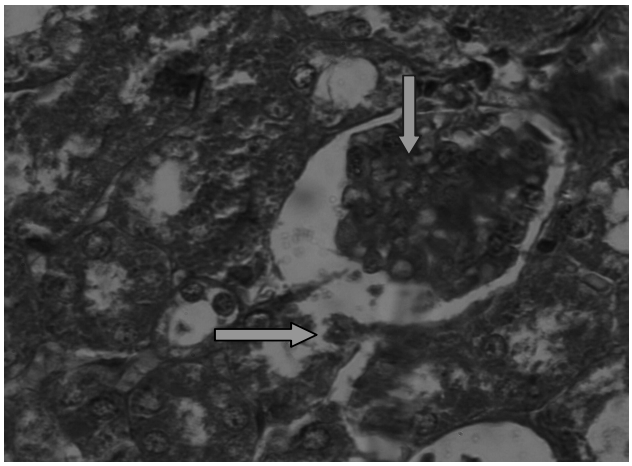

Fig. 2. Mice kidney of arsenic treated group showing shrinkage of glomerulus and damage to the epithelial lining of Bowman's capsule- H &E.400X

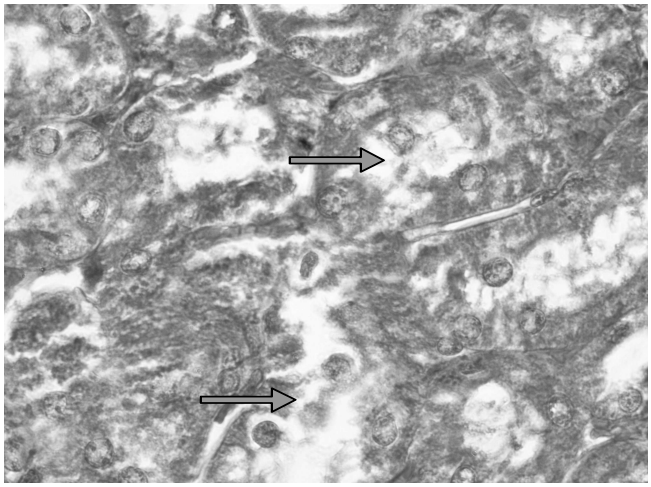

Fig.3. Kidney of arsenic treated mice showing infiltration of cytoplasm and nuclei into the kidney tubule- H &E. 400X

Our study reports a significant difference in the blood glucose level of control group and arsenic treated mice. According to Deborah and Steven (2000) common arsenic trioxide-related toxicities includes hyperglycemia (mild). The altered blood sugar level may be due to islet cells toxicity because arsenic administration can cause severe damage to islet cells in the pancreas (Mukherjee et al 2004).

Conclusion :

The study concluded that a low concentration of arsenic trioxide has no significant effect on the kidney function, probably because it is metabolized in the liver and excreted in the urine. However a significant increase in the blood sugar level was seen which may be due to islet cells toxicity. Therefore water containing even low dose of arsenic trioxide may be hazardous to health and should not be consumed.

Acknowledgement :

We are grateful to Dr. Sister Doris D'Souza A.C., Principal, Patna Women's College and the Research Committee for providing facilities and financial support under the Basic Scientific Research (BSR) Scheme.

References :

Abemathy, CO, Liu YP, Longfellow D, Aposhian HV, Beck B, Fowler B, Goyer R, Menzer R, Rossman T, Thompson C and Michael W (1999). Arsenic health effects, mechanisms of actions and research issues. *Environ. Hlth. Perspect*., 107:593-597.

Chu, HA, Crawford-Brown, DJ (2006). Inorganic arsenic in drinking water and bladder cancer: a meta-analysis for dose-response assessment. *Int. J. Environ. Res. Public Health,* 3: 316–22.

Deborah MR, Steven LS (2000). Risk/Benefit Profile of Arsenic Trioxide. *The Oncologist*, 6: 29-32.

Flora SJS, Mehta A, Gupta R (2009). Prevention of arsenic-induced hepatic apoptosis by concomitant administration of garlic extracts in mice. *Chemico-Biological Interactions* 177: 227–233.

Guha Mazumder DN (2008). Chronic arsenic toxicity & human health. *Indian J.Med. Res.,*128:436.

Mayer RL, Sulzberger MB (1931). Zur. Fur der yahreszeit lichen schwanKungen der Krannai ten. Der Einglus s der Kos t auf. Experimental le sensipilisierungen. Arshiv. Fuer. Dermat und Syph., 163:245.

Mukherjee S, Das D, Darbar S, Mukherjee M, Das AS, Mitra C (2004). Arsenic trioxide generates oxidative stress and islet cell toxicity in rabbits. *Current science*, 86:854-857.

North DW, Gibb HJ, Abernathy CO (1997). Arsenic : Past, present and future considerations. In: *Arsenic- Exposure and Health Effects* (eds. Abernathy, CO, Calderon, RL and Chappell, WR), Chapman and Hall, London. pp 406-423

Rossman, TG, Uddin AN, Bums FJ (2004). Evidence that arsenite acts as a carcinogen in skin cancer. Toxicol. Appl. Pharmacol., 198:394-404.

Roy Choudhury A, Das T, Sharma A, Talukder G (1996). Dietary garlic extract in modifying clastogenic effects of inorganic arsenic in mice: two-generation studies. Mutat. Res., 359:165-170.

Sahu K, Das RK (1994). Reduction of clastogenic effect of clofazimine, an antileprosy drug, by vitamin A and vitamin C in bone marrow cells of mice. Food Chem. Toxicol., 32: 911-915.