Assessment of low ABSPI among arsenic exposed and non-exposed populations: A pilot study

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Abstract

This cross-sectional study was carried out to assess and compare Ankle Brachial Systolic Pressure Index (ABSPI) amongst 120 arsenic exposed and 120 non-exposed populations of Samta village in Bangladesh. Abnormal ABSPI was more prevalent in arsenic exposed (13.3%) than in non-exposed (2.5%) group. The prevalence of abnormal ABSPI for respondents when adjusted for age, sex, BMI, blood pressure status and diabetic status, the prevalence remain significantly different. The findings suggest that those exposed to arsenic have increased chance of having abnormal ABSP and hence increased chance of peripheral arterial disease in Bangladesh.

Introduction

Ankle brachial systolic pressure index (ABSPI) is a non-invasive, reliable test which can detect obstructive peripheral vascular disorder (PAD). Individuals with obstructive arterial disease are known to have abnormal ABSPI[1]. Gangrene is considered a result of compromised blood supply to the part, therefore, those having gangrene most likely had some obstructed disease of the artery/arteries of the lower limbs.

Prolonged consumption of water contains high concentration of arsenic effect on health. The effect is more serious with magnitude of the dose. Chronic arsenic poisoning affects many organs and system in the body including skin, nervous system, liver, peripheral vessels, endocrine system and respiratory organ[2-4]. Exposure to arsenic in occupational settings and environmental contexts similar to that in Bangladesh has been associated with the occurrence of obstructive peripheral arterial disease often culminating in gangrene or spontaneous or surgical amputation(s). Several studies in Bangladesh[5-7] have had reported the occurrence of gangrene of lower limbs amongst the arsenicosis patients. Arsenic exposed population, besides having traditional risk factors (age, sex, smoking, diabetes, hypertension etc) as in the non exposed population has additional risk factor which is arsenic itself. Arsenic has been found to cause endothelial damage, subsequently leading to atherosclerotic changes and varying degree of arterial obstruction[8]. Moreover, arsenic exposure has been related to development of DM and hypertension which in turn were risk factors for PAD. Based on above observation, it is most likely that arsenic exposed populations in Bangladesh are having high prevalence of PAD, i.e. atherosclerotic obstructive disease and hence ABSPI of ≤0.90, compared to those not exposed to arsenic.

Materials and Methods

This cross sectional comparative study was carried out during the period of March 2005 to June 2005. Participants of the study were selected into two separate groups which included a group with individuals having excess arsenic exposure (>50 µg/L) and arsenicosis, and a reference group comprising of individuals with background level arsenic exposure (<50 µg/L) and no dermatological signs of arsenicosis (melanosis, bilateral palmoplantar keratosis or leucomelanosis). Participants for the study group were selected from amongst previously diagnosed 192 (≥30 years of age) arsenicosis patients residing in Samta village of Sharsha Thana under Jessore District of Bangladesh. Participants for the reference group were also selected from same village, but from an area where most of the tube wells did not have arsenic contamination (<50 µg/L) and had been marked green following a previous arsenic screening activity and where no arsenicosis patients have been detected in a previous house to house arsenicosis patient identification activity.

Recruitment of participants for study group was done by household visits based on inclusion and

exclusion criteria. Inclusion criteria were individuals having evidence of consumed tubewell water whose arsenic content was >50 μg/L, presence of clinical signs of arsenicosis (bilateral palmoplantar keratosis ± melanosis on the trunk) and age between 30-60 years; exclusion criteria were individuals having evidence of consumed tubewell water whose arsenic content was <50 μg/L, individuals not having the clinical signs of arsenicosis, age <30 years or >60 years and those who were pregnant or had delivered a baby within the previous 4 months. Informed consent was taken from each individual before starting the study. During the household visits out of 192 previously identified arsenicosis patients contact with 125 patients could be made and ultimately 120 participated in the study. Equal number of participants for the reference group was subsequently selected, also based on inclusion and exclusion criteria [inclusion criteria: individuals who consumed tube well water whose arsenic content was <50 μg/L, individual not having sign of simulating the signs of arsenicosis and age between 30-60 years; exclusion criteria: individuals having evidence of consumed tube well water whose arsenic content was >50 μg/L, individual having sign of simulating the signs of arsenicosis: age <30 years or >60 years and those who were pregnant or had delivered a baby within the previous 4 months] and informed consent.

Data collection was carried out through face to face interview and examination of the participants using a pre-designed, pre-tested, household interview schedule and checklist. Urine sample of participants were collected for estimation of glucose content, the height and weight of the participant was measured.

Blood pressures were recorded over the right arm according to the protocol recommended by the World Heath Organization. Doppler assisted systolic pressure measurements were taken sequentially on all brachial, posterior tibial, dorsalis pedis arteries[10]. Weight to the respondent was taken by bathroom weighing scale. Height was measured in centimeter using a wooden device, in standing position without foot wear, shoulder blades in contact with the vertical scale[11]. For each participant ABSPI was calculated for each artery of both the lower limbs and the lowest of the 4 ABSPIs was taken as the ABSPI of the participant. Individuals on hypoglycemic agent or having glycosuria were considered as being diabetic.

Data obtained was entered in SPSSWIN 11.5 program and analyzed. Bi-variate and multivariate analyses were carried out using both descriptive and inferential statistics. Both crude and adjusted

rates were obtained for both groups, adjustments for the potential confounders (age, sex, smoking status, obesity, hypertension and diabetes) were undertaken. Adjustments were done by direct standardization where the composition of standard population was drawn up by pooling the population distribution in both the groups. The 95% confidence interval rates were also calculated. And subsequently differences between the rates were evaluated statistically.

Results

Most of the respondents were 30-49 years of age (80% in arsenicosis group and 81.7% in reference group (Table I). The mean age of the respondents of the groups found not to be significantly different (p<0.05). Among respondents in arsenicosis group 59.2% were male and 40.8% were female, whereas the reference group was dominated than by female (59.2%). The groups were significantly different (p<0.05) in gender. As regards to the type of household of the study participants only a single participant in group A lived in pucca house, while the vast majority both in arsenic exposed (60%) and non-exposed group (67.5%) lived in kachaa house. Moreover the groups were found to be dissimilar (p>0.05) in terms of their dwelling house.

Table I: Socio-demographic characteristics of study participants

Variable	Group	
	Arsenicosis	Reference
Age (years)	39.97 ± 9.30	39.34 ± 8.99
Gender		
Male	71	49
Female	49	71
Education		
Illiterate	53	63
Primary	55	45
Secondary & above	12	12
Annual income (Taka)	22871 ± 8112	23175 ± 6183
Possession of agricultural land (bigha)		
Landless	60	59
<3	52	32
3-25	8	29
Household type		
Kachaa	72	81
Semi pucca	47	39
Pucca	1	0
BMI (kg/m^2)	18.64 ± 3.0	20.02 ± 3.56
Smoking habit		
Non-smoker	96	112
Smoker	24	8

Table II: Diabetes mellitus, hypertension and ABSPI status amongst the respondents

Variables	Group		Significance
	Arsenicosis	Reference	
Skin manifestations of arsenicosis			
Melanosis on the trunk	120 (100%)	0	
Bilateral palmoplantar keratosis	50 (41.7%)	0	
Presence of urine glucose			
Yes	8	0	$\chi^2_{df=2}$ = 6.336, p value 0.012*
No	112	120	
Blood pressure (mmHg)			
Normotensive (SBP <120 & DBP < 80)	76	89	
Pre hypertensive (SBP 120-139 or DBP 80-89)	40	27	Fisher's Exact Test=3.590 p value 0.166
Hypertensive (SBP ≥140 or DBP ≥ 90)	4	4	
ABSPI status			
Normal (0.91-1.30)	104	117	$\chi^2_{df=1}$= 9.659 p value 0.002**
Abnormal (≤ 0.90)	16	3	

*Chi square with Yate's correction; **Significant at 1.96 critical level of significance

All respondents of arsenicosis group had melanosis on the trunk and only 41.7% had bilateral palmoplantar keratosis (Table II). Edema was present in only 3.3% of arsenicosis group and 0.8% in the reference group. None in any of the groups had been suffering from severe anemia, central cyanosis or dehydration and there was no palpable liver, spleen or intra-abdominal mass. None of the participants gave a family history of diabetes and none were being treated with hypoglycemic agents. Among the respondents of arsenicosis group 6.7% had reducing substance in their urine while none in the reference group had reducing substance in urine. And this observed difference was statistically significant (p<0.05). No participants in either of the groups gave a family history of hypertension and none were being treated with antihypertensive agents. About, 33.3% and 22.5% in arsenicosis and reference groups respectively were found to be pre-hypertensive; while 3.3% individual in both arsenicosis and reference groups was found to have hypertension. This difference in blood pressure status was found not to be statistically significant (p>0.05). The proportion of abnormal lower limb ABSPI (≤ 0.90) was higher in arsenicosis group (13.3%) than in the reference group (2.5%), and this observed difference was found to be statistically significant (p>0.05; Table III).

Discussion

ABSPI is considered is tool that allows for objectively assessing obstructive arterial disease of lower limb and ABSPI of ≤0.90 has been demonstrated to be both highly sensitive and specific for arteriographically demonstrable obstruction ≥50% of the arterial lumen more in a major leg artery[1,11,12].

Age, gender, obesity, DM, hypertension all are known risk factors for abnormal ABSPI[13]. Arsenic has been found to have a specific affinity for the vascular bed to be toxic to endothelial cells, subsequently leading to atherosclerotic changes and varying degree of arterial obstruction[9]. Arsenic exposure has also been related to development of DM[14,15] and hypertension[16,17] which in turn were risk factors for lower extremity obstructive arterial disease and thus low ABSPI. In absence of gangrene or symptoms low ABSPI indicates asymptomatic atherosclerotic disease or preclinical condition[11,12].

An increased risk of atherosclerotic disease of arteries of lower limbs as a result of drinking water containing excess arsenic has been observed in different parts of the globe[8,18-20]. Several studies in Bangladesh[6-8] have had reported the occurrence of gangrene of lower limbs amongst the arsenicosis patients. Moreover, as preclinical cases of peripheral vascular disease (LEAD) have been found to

Table III: ABSPI and adjusted factors

Abnormal ABI status	Group		Significance
	Arsenicosis	Reference	
Crude rate (%)	13.3	2.5	SE (p1-p2)= .0349, z value 2.92**
Rate (%) adjusted for age	13.2	2.6	SE (p1-p2)= .0246, z value 4.29**
Rate (%) adjusted for age & gender	13.4	2.5	SE (p1-p2)= .0247, z value 4.28**
Rate (%) adjusted for BP status	13.3	2.3	SE (p1-p2)= .0245, z value = 4.32**
Rate (%) adjusted for age, gender, smoking habit, BMI status, diabetes* & BP status	12.8	2.2	SE(p1-p2)= .0240, z value = 4.41**

*(reducing substances in urine); ** Significant at 1.96 critical level of significance

persist even after decline or cessation of exposure to arsenic[19,21] cardiovascular consequences could be expected to be persistently higher amongst the arsenic individuals in Bangladesh having LEAD even after provision of safe water options.

The study has revealed a significantly higher prevalence low ABSPI i.e., lower extremity arterial disease among individuals having high arsenic exposure compared to those having background level of exposure. Moreover, those having low ABSPI in addition to having lower extremity arterial disease, most commonly have concomitant atherosclerotic arterial disease in other parts of the arterial system. Thus low ABSPI which is found in lower extremity arterial diseases is a marker of an increased risk of fatal and nonfatal cardiovascular and cerebrovascular disease events and it also associated with a 2-fold increased risk of cardiovascular morbidity and mortality. Thus arsenic exposed population having low ABSPI were not only at risk of progression to gangrene and having amputation, but also to an increased risk of fatal and non-fatal cardiovascular and cerebrovascular disease events.

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