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Arsenic-Induced Keratosis and Bowen's Disease

Razia Sultana[*1], Md Rifat Al Mazid Bhuiyan[2], M Azizul Haq[3], Nigar Jahan Sonia[4], Shaila Akter Lata[5], Kazi Sadia Afrin[6], Hazera Sharmin[7]

Abstract

Introduction with objective: *Arsenicosis is a major public health problem in Bangladesh. The most common manifestation of arsenicosis is the development of keratosis in the palms and soles which affect the economic condition of the patients by reducing their working ability. In addition, it may cause Bowen's disease. The aim of the present study was to observe the keratoses and Bowens disease patients due to arsenicosis.* ***Materials and Methods:*** *This Observational study was carried out among 31 arsenic induced Bowen's disease and keratoses patients at the Pharmacology department, Bangladesh Medical University (BMU), Dhaka and two arsenic affected endemic areas [Bhanga Upazilla of Faridpur District (about 150 km from Dhaka) and Babutipara Union, Muradnagar Upazilla, Cumilla District (about 108 km from Dhaka)] from September 2017 to January 2019. Purposive sampling was done according to availability of the patients. All the data were compiled and sorted properly and the quantitative data was analyzed statistically by using Statistical Package for Social Science.* ***Result:*** *The mean (± SD) age of the arsenical keratosis patients was 41.3 ± 13 years. The mean amount of arsenic in the tube well water consumed by the arsenical keratosis patients was 222.4 ± 111.3 µg/L and in the nail sample of the patients was 8.8 ± 4.3 µg/g. The mean duration of exposure to arsenic contaminated water of the arsenical keratosis patients was 11.3 ± 1.7 years. The mean duration of the appearance of arsenical keratosis lesions was 6.5 ± 2.1 years. The mean (± SD) age of the Bowen's patients was 56.2 ± 4.4 years. The mean amount of arsenic in the tube well water consumed by the Bowen's patients was 222.4 ± 111.3 µg/L and in the nail sample of the Bowen's patients was 8.8 ± 4.3 µg/g. The mean duration of exposure to arsenic contaminated water of the Bowen's patients was 11.3 ± 1.7 years. The mean duration of the appearance of lesions was 6.5 ± 2.1 years.* ***Conclusion:*** *Chronic arsenicism may lead to both cutaneous and systemic neoplasms and patients should undergo regular long-term examination.*

Keywords: *Arsenicosis, Bowen's disease, Keratosis.*

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***1. Corresponding Author:**
Dr. Razia Sultana
Assistant Professor
Department of Pharmacology
Monowara Sikder Medical College
Shariyatpur, Bangladesh.
Phone: 01715995605
Email: dr.razia999@gmail.com

2. Dr. Md Rifat Al Mazid Bhuiyan
MPH Candidate
Department of Community Medicine
Rajshahi Medical College
Rajshahi, Bangladesh.

3. Dr. M Azizul Haq
Medical Officer
ENT Care Center
Gulshan, Dhaka, Bangladesh.

4. Dr. Nigar Jahan Sonia
Assistant Professor
Department of Biochemistry
Marks Medical College and Hospital
Dhaka, Bangladesh.

5. Dr. Shaila Akter Lata
Lecturer
Department of Pathology
MH Samorita Medical College, Dhaka, Bangladesh.

6. Dr. Kazi Sadia Afrin
Assistant Professor
Department of Pharmacology
Monowara Sikder Medical College
Shariyatpur, Bangladesh.

7. Dr. Hazera Sharmin
Assistant Professor
Department of Pharmacology,
Uttara Adhunik Medical College
Dhaka, Bangladesh.

Introduction:

Arsenic is a metalloid and a natural environmental contaminant to which humans are regularly exposed through air, water, food and soil. It is present in organic and inorganic form. Long-term ingestion of inorganic arsenic may affect several major organ systems including the skin[1,2]. The role of organic arsenic in human is not

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clear. A skin manifestation of prolonged arsenic exposure in humans includes altered pigmentation, keratosis and carcinoma[3]. Involvement in the skin is due to accumulation of arsenic. Arsenic accumulates in the keratin rich tissues like skin, hair or nail due to its affinity for sulfhydryl group. Arsenic-induced proliferation of keratinocyte in the outermost layer of skin is responsible for development of keratosis. This cellular event of arsenic-induced proliferation is reported to associate with regulations of two transcription factors, such as nuclear factor-kB and activator protein-1[4]. Arsenic can also enhance some growth-promoting cytokines such as, granulocyte-macrophage colony-stimulating factor, transforming growth factor-a and interleukin-8 in the epidermis of skin[5]. Arsenical keratosis mainly develops in the palm of the hand and the planter aspects of the foot. In mild keratosis, the skin becomes indurated with grit-like texture and minute papules less than 2 mm in size may appear which can be detected by palpation. However, in moderate keratosis, multiple wart-like lesions of 2-5 mm in diameter appear that are readily visible. In severe keratosis, horny or cauliflower like nodules, more than 5 mm in size appear which subsequently cause cracking or fissuring[3]. Arsenical keratosis has long been regarded as precancerous because cancer can develop from this lesion[6]. Arsenic-related Bowen's disease can appear 10 years after arsenic exposure, while other types of skin cancer can have a latency period of 20 or 30 years[7]. Bowen's disease usually appears as a slowly enlarging, erythematous, well-demarcated patch or plaque and has a scaling or crusted surface. It occurs as a solitary lesion, but the number may be several and has 3-5% risk to develop squamous cell carcinoma[8].

Materials & Methods:

This Observational study was carried out among 31 arsenic induced Bowen's disease and keratoses patients at the Pharmacology department, Bangladesh Medical University (BMU), Dhaka and two arsenic affected endemic areas Bhanga Upazilla of Faridpur District (about 150 km from Dhaka) and Babutipara Union, Muradnagar Upazilla, Cumilla District (about 108 km from Dhaka)] from September 2017 to January 2019. Purposive sampling was done according to availability of the patients. Ethical clearance for the study was obtained from the Institutional Review Board of Bangladesh Medical University. Written informed consent (Bangla version) was taken from every patient. All data were collected through a pre-structured questionnaire. After collection of data, they were checked for errors and then analyzed using the statistical software SPSS 25. The researcher took part in training in the Department of Dermatology, Bangladesh Medical University for two weeks. Identification of arsenical keratosis, Bowen's disease, psoriasis, eczema and atopic dermatitis were done by the researcher. The total amount of arsenic in the drinking water and nail samples were measured by silver diethyldithiocarbamate method. The size of the keratotic nodules and skin lesions were measured by the Vernier slide calipers (Tricle brand, China).

Results:

Patients with arsenical keratosis:

The mean (± SD) age of the patients was 41.3 ± 13 years. The mean amount of arsenic was 244.1 ± 177.5 µg/L and 8.2 ± 7.4 µg/g in the tube well water consumed by the patients and nail sample respectively. The mean duration of exposure to arsenic contaminated water of the patients was 9.3 ± 2.0 years. The mean duration of the appearance of keratosis was 4.6 ± 2.1 years (Table I).

Patients with Arsenic-induced Bowen's disease:

The mean (± SD) age of the patients was 56.2 ± 4.4 years. The mean amount of arsenic in the tube well water consumed by the patients was 222.4 ± 111.3 µg/L and in the nail sample of the patients was 8.8 ± 4.3 µg/g. The mean duration of exposure to arsenic contaminated water of the patients was 11.3 ± 1.7 years. The mean duration of the appearance of lesions was 6.5 ± 2.1 years (Table I).

Table I: Characteristics of the patients

Parameters	arsenical keratosis (n = 23)	Arsenic-induced Bowen's disease (n = 8)
Male patients (n)	8	6
Female patients (n)	15	2
Age (years)	41.3 ± 13.0	56.2 ± 4.4
Amount of arsenic in tube well water (µg/L)	244.1 ± 177.5	222.4 ± 111.3
Amount of arsenic in nail (µg/g)	8.2 ± 7.4	8.8 ± 4.3
Duration of arsenic exposure (years)	9.3 ± 2.0	11.3 ± 1.7
Duration of appearance of symptoms (years)	4.6 ± 2.1	6.5 ± 2.1

Data are presented as mean ± SD

In patients with palmar arsenical keratosis, 20 patients were exposed to arsenic for about six to ten years and three patients were exposed to arsenic for about 11 to 15 years. In patients with arsenic-induced Bowen's disease, three patients were exposed to arsenic for about six to ten years and five patients were exposed to arsenic for about 11 to 15 years (Table II).

Table II: Distribution of patients according to the duration of arsenic exposure

Duration of arsenic exposure (years)	arsenical keratosis (n = 23)	Arsenic-induced Bowen's disease (n = 8)
1 - 5	-	-
6 - 10	20	03
11-15	03	05

In patients with palmar arsenical keratosis, Sixteen patients had keratotic nodules for about five years. Remaining seven patients had keratotic nodules for about six to ten years. In patients with arsenic-induced Bowen's disease, two patients had skin lesions for about five years. Remaining six patients

had skin lesion for about six to ten years (Table III).

Table III: Distribution of patients according to the duration of appearance of the lesions

Duration of the lesions (years)	arsenical keratosis (n = 23)	Arsenic-induced Bowen's disease (n = 8)
1 - 5	16	02
6 - 10	07	06
11-15	-	-

In patients with arsenical keratosis, the amount of arsenic in water was within 200 µg/ L in 12 patients, 200 - 400 µg/ L in six patients and 400 – 600 µg/ L in remaining five patients.

In patients with arsenic-induced Bowen's disease, three patients had about 200 µg/ L arsenic in water, 200 - 400 µg/ L in remaining five patients (Table IV).

Table IV: Distribution of patients according to the concentration of arsenic in water

Concentration of arsenic in water (µg/ L)	arsenical keratosis (n = 23)	Arsenic-induced Bowen's disease (n = 8)
0 - 200	12	3
201 - 400	6	5
401 -600	5	-

Discussion:

The mean (± SD) age of the arsenical keratosis patients was 41.3 ± 13 years. The mean amount of arsenic in the tube well water consumed by the arsenical keratosis patients was 222.4 ± 111.3 µg/L and in the nail sample of the patients was 8.8 ± 4.3 µg/g. The mean duration of exposure to arsenic contaminated water of the arsenical keratosis patients was 11.3 ± 1.7 years. The mean duration of the appearance of arsenical keratosis lesions was 6.5 ± 2.1 years. Near to similar results were obtained in the study conducted by Nargis et. al (2025) in Bangladesh about palmar arsenical keratosis. In their study they stated that mean age of the arsenical keratosis patients was 43.1 ± 11.5 years. The average duration of arsenic exposure was 20.5 ± 7.7 years, with symptoms appearing after approximately 11.1 ± 5.3 years. Arsenic concentrations in drinking water were significantly elevated (mean: 293.1 ± 114.8 µg/l), far exceeding WHO standards. Correspondingly, arsenic levels in finger nails averaged 11.4 ± 2.4 µg/g, confirming prolonged internal exposure[9]. Mazumder et. al (2014) conducted a study in West Bengal about socio-demographic profile of arsenicosis patients. They observed that Mean peak arsenic level in drinking water was 259.53± 161.49 µg/l among arsenicosis cases[10].

Conclusion:

Based on our results, it is evident that prolonged exposure to arsenic-contaminated tube well water, averaging over 05 years, leads to significant health impacts, notably the development of arsenical keratosis and Bowen's disease. These findings highlight the urgent need for effective public health interventions, including safe water alternatives, early detection strategies, and community awareness programs, to prevent and manage arsenic-induced health conditions in affected regions.

Conflict of Interest: None.

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