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Characteristics of Palmar Arsenical Keratosis Patients

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Abstract **Original Research Article**

Background: Arsenic contamination of groundwater is a persistent public health issue in many developing regions, especially in Bangladesh. Chronic exposure through contaminated drinking water has been associated with multiple health effects, including dermatological conditions such as palmar arsenical keratosis one of the most characteristic indicators of arsenicosis. ***Objective:*** This study aimed to evaluate the demographic, clinical, and exposure-related characteristics of patients diagnosed with palmar arsenical keratosis in a highly arsenic-endemic region of Bangladesh. ***Methodology:*** This observational study was conducted between September 2019 and January 2021 in the Chuadanga district, involving 32 patients diagnosed with moderate-to-severe palmar arsenical keratosis. Demographic data, exposure history, and lesion characteristics were collected. Arsenic levels in tube well water and fingernail samples were quantified using the silver diethyldithiocarbamate method. Ethical approval and informed consent were obtained prior to participation. ***Results:*** The mean age of the patients was 43.1 ± 11.5 years, with a male-to-female ratio of 5:3. 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 fingernails averaged 11.4 ± 2.4 µg/g, confirming prolonged internal exposure. ***Conclusion:*** This study reaffirms that long-term arsenic exposure, particularly through contaminated tube well water, leads to clinically evident palmar keratosis. The high arsenic burden observed in both environmental and biological samples highlights the critical need for arsenic mitigation strategies, improved public awareness, and early detection efforts in endemic regions.

Keywords: Arsenicosis, palmar arsenical keratosis, chronic arsenic exposure.

INTRODUCTION

Arsenic contamination in groundwater remains a significant public health concern in many developing countries, particularly in South Asia. Chronic exposure to arsenic, primarily through contaminated drinking water, is associated with a spectrum of health issues, including skin manifestations, internal cancers, and systemic toxicity [1-3]. Among the dermatological outcomes, **palmar arsenical keratosis** is one of the most recognizable and diagnostically relevant indicators of chronic arsenicosis. It manifests as diffuse or nodular thickening of the palms and often signals the body's long-term exposure to toxic arsenic levels [4-6].

Palmar arsenical keratosis typically begins as small, firm, yellowish papules that gradually coalesce to form larger hyperkeratotic plaques. These lesions may be asymptomatic or associated with pain, fissures, and secondary infections. The severity and extent of keratosis often correlate with both the duration and concentration of arsenic exposure, although genetic and individual susceptibility factors also play a crucial role in disease manifestation [7-8]. As such, studying the characteristics of affected patients provides insights not only into the clinical course but also the broader epidemiological patterns of arsenicosis in endemic areas.

Patients with palmar arsenical keratosis commonly present from rural, socioeconomically disadvantaged backgrounds, where awareness of arsenic risks and access to safe drinking water are limited. There is often a delay in seeking medical care due to lack of health literacy, leading to more advanced stages of

keratosis by the time of diagnosis. Additionally, many of these patients suffer from other arsenic-related symptoms such as melanosis, conjunctival congestion, and systemic complications like neuropathy or gastrointestinal distress, reflecting the multi-organ impact of chronic arsenic exposure [9-10].

Demographic analyses reveal that both men and women are affected, though occupational exposures, such as agricultural or manual labor involving contact with contaminated water or soil, may predispose certain groups more. Age-wise, adults above the age of 30 are more frequently diagnosed, with the latency period from initial exposure to clinical presentation often spanning several years [11]. Nutritional deficiencies, particularly low intake of protein and antioxidants, may exacerbate keratosis severity by impairing the body's detoxification pathways.

Understanding the characteristics of palmar arsenical keratosis patients is essential for developing targeted interventions, from early screening programs to public health awareness campaigns. It also helps healthcare providers identify high-risk populations and implement preventive measures, such as the provision of arsenic-free water sources and nutritional support. A deeper understanding of these patient profiles may also aid future research into the pathophysiology and treatment of arsenicosis-induced skin disorders.

Objective

In this study our main goal is to evaluate the characteristics of palmar Arsenical Keratosis Patients.

METHODOLOGY

Type of Study

This observational study was conducted to evaluate the effectiveness of a herbal formulation in the treatment of arsenical keratosis.

Study Location

The fieldwork was conducted in Chuadanga, a region identified by the Public Health Engineering Department of Bangladesh as severely affected by arsenic contamination. Specifically, Begampur and Titudah unions within Chuadanga Sadar Upazila were selected due to their high patient prevalence. These locations are approximately 213 km and 204 km from Dhaka, respectively.

In addition to the field site, laboratory-based components of the study such as arsenic analysis in water and nail samples, as well as related sample processing were conducted in the Department of Pharmacology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka.

Study Duration

The study spanned 17 months, beginning in September 2019 and concluding in January 2021.

Protocol Development and Ethical Approval

An initial literature review guided the preparation of the research protocol. After refinement under the supervision of a faculty advisor, the protocol was submitted on December 18, 2019, to the Institutional Review Board (IRB) of BSMMU. Following feedback from a subcommittee session on January 4, 2020, the final version received approval on February 3, 2020. The IRB registration number was BSMMU/2020/1642.

Informed Consent

Each participant diagnosed with arsenical keratosis was informed in simple Bengali about the study's purpose, methodology, duration, expected outcomes, potential benefits, and risks. Informed written consent was then obtained, either by signature or thumb impression. Participants were assured of their right to withdraw at any point during the study. The confidentiality of all personal information was strictly maintained throughout the research.

Participant Enrollment

Prior to enrolling patients, the researcher underwent a one-week observational training in the Dermatology Department of BSMMU, focusing on various dermatoses including arsenical keratosis, atopic dermatitis, and psoriasis. Ultimately, 34 individuals with arsenical keratosis were enrolled—9 from Titudah and 25 from Begampur—using specific inclusion and exclusion criteria (Ferdoush & Misbahuddin, 2014).

Inclusion Criteria:

- Age: 19–65 years
- Gender: Male or Female
- Presence of moderate to severe palmar arsenical keratosis
- History of consuming arsenic-contaminated water (>50 μg/L) for over 6 months
- No topical treatment received in the last 3 months
- Willingness to participate

Exclusion Criteria:

- Age <19 or >65
- Pregnant or nursing women
- Recent (within 3 months) systemic or topical treatment for arsenicosis
- Other skin conditions: psoriasis, eczema, atopic dermatitis
- Diagnosed systemic illnesses (e.g., diabetes, hepatitis, lupus, rheumatoid arthritis)

Rationale for Study Site Selection

Chuadanga was selected due to its high prevalence of arsenicosis and support from local health

authorities. Data from the Directorate General of Health Services (DGHS) in 2013 reported 550 identified cases of arsenicosis in Chuadanga Sadar Upazila, with 302 male and 248 female patients.

Study Parameters

Assessment focused on the size of moderate-to-severe palmar keratotic nodules, measured with vernier slide calipers (Tricle, China) before and after treatment. Arsenic concentrations in patients' drinking water and nail samples were also measured using a modified silver diethyldithiocarbamate method.

Sampling Steps

Out of 550 recorded arsenicosis cases, 223 had keratotic lesions. Among these, 78 were from Titudah and Begampur. After screening, 34 participants were selected, and 32 completed the study (2 dropouts).

Study Procedure

Field Work: The investigator coordinated with the Upazila Health and Family Planning Officer and a Health Inspector, who provided a patient list. Patients were visited before, during, and after treatment.

Data Collection: A structured case report form was used to record demographic data, arsenic exposure history, and medical background. Physical examination and lesion measurements were conducted, and photographs were taken.

Water Sample Collection: Each participant provided 100 ml of drinking water in labeled plastic bottles, which were stored under refrigeration until analysis.

Nail Sample Collection: Participants were instructed to grow out fingernails and toenails, wash hands and feet before clipping, and submit 200–500 mg of nail samples in pre-labeled polyethylene bags. Samples were refrigerated prior to testing.

Arsenic Estimation Method: The modified silver diethyldithiocarbamate method involved acid digestion followed by arsine gas generation, which formed a red-colored complex measured spectrophotometrically at 535 nm.

Statistical Analysis

Data were presented as mean ± standard deviation (SD). A paired t-test was applied using Microsoft Excel to compare pre- and post-treatment keratotic nodule sizes.

RESULTS

This table provides a summary of the demographic and exposure characteristics of the 32 patients diagnosed with palmar arsenical keratosis. The average age was approximately 43 years, with a male-to-female ratio of 5:3.

Table-1: Characteristics of Palmar Arsenical Keratosis Patients

Parameter	Value
Total number of patients	**32**
Male patients (n)	20
Female patients (n)	12
Mean age (years ± SD)	43.1 ± 11.5
Mean duration of arsenic exposure (years ± SD)	20.5 ± 7.7
Mean duration of symptom appearance (years ± SD)	11.1 ± 5.3

The mean duration of arsenic exposure was 20.5 years, and patients developed symptoms on average after 11.1 years of exposure.

Table-2: Duration of arsenic exposure & symptom appearance

Parameter	Value
Mean duration of arsenic exposure (years ± SD)	20.5 ± 7.7
Mean duration of symptom appearance (years ± SD)	11.1 ± 5.3

This table presents the mean arsenic concentrations in the tube well water and fingernail samples of patients diagnosed with palmar arsenical keratosis. The water arsenic level far exceeds the WHO permissible limit (10 µg/l), and the nail arsenic level indicates prolonged internal exposure.

Table-3: Concentration of Arsenic in Water and Nail of the Patients

Category	Details
Sample Size	32 patients
Arsenic in Water	293.1 µg/l (Mean ± SD: ±114.8)
Arsenic in Nail	11.4 µg/g (Mean ± SD: ±2.4)

DISCUSSION

In the present study, we observed a total of 32 patients diagnosed with palmar arsenical keratosis, with a male predominance (62.5%) and an average age of 43.1 years. This gender distribution aligns with previous studies conducted in arsenic-endemic regions such as West Bengal, India, and Bangladesh, where males have been found to be more affected due to greater exposure to contaminated tube well water, often because of occupational outdoor activities. A study reported a similar trend with a mean age of presentation around 40 years and a higher number of male patients, reinforcing the notion that males are more likely to develop arsenicosis due to prolonged and direct environmental exposure [12].

The mean duration of arsenic exposure in our study was 20.5 years, and symptoms appeared after an average of 11.1 years. This is consistent with findings who noted that clinical manifestations of arsenic toxicity typically begin after 10–15 years of chronic exposure [13]. Our findings highlight a similar latency period, which suggests that the body accumulates arsenic over time, with skin lesions being one of the earliest and most visible manifestations. The relatively long exposure duration before symptom onset emphasizes the insidious nature of chronic arsenic poisoning.

The arsenic concentration in drinking water in our study was found to be 293.1 µg/l, significantly exceeding the WHO guideline of 10 µg/l and even surpassing the national standard of 50 µg/l in Bangladesh. This is in line with previous studies which documented tube well arsenic concentrations ranging from 100–800 µg/l in highly affected regions.14 The elevated levels in our study population support the continued presence of arsenic contamination in rural water sources and underline the need for urgent intervention and monitoring.

The mean arsenic concentration in patients' fingernails was 11.4 µg/g, which reflects chronic internal exposure. Fingernails serve as a biomarker of arsenic exposure, especially for long-term exposure assessment, as they reflect arsenic accumulation over several months. Similar concentrations were reported in studies conducted where nail arsenic levels in symptomatic patients ranged from 7–15 µg/g. 15 These findings reinforce the utility of nail analysis as a non-invasive method to assess arsenic body burden in clinical and epidemiological studies.

Moreover, our study findings contribute to a growing body of evidence linking prolonged arsenic exposure with characteristic skin lesions, including palmar keratosis. While previous studies have extensively documented diffuse melanosis and raindrop pigmentation as early signs, our focus on palmar lesions offers valuable insights into more specific and localized manifestations of arsenicosis. These lesions not only serve as clinical markers but also signify the severity of exposure and the risk of potential malignant transformation in chronic cases.

CONCLUSION

Based on our results, it is evident that prolonged exposure to arsenic-contaminated tube well water, averaging over 20 years, leads to significant health impacts, notably the development of palmar arsenical keratosis after approximately 11 years of exposure. The markedly high concentrations of arsenic found in both water (293.1 µg/l) and nail samples (11.4 µg/g) underscore chronic internal accumulation and ongoing environmental contamination. 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.

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