Letter to the Editor

An Epistaxis Emergency Associated with Multiple Pollutants in Elementary Students*

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Emergencies of epistaxis in students caused by environmental pollution have rarely been reported to date. This study aimed to explore the cause of an emergency of epistaxis in elementary students by using a field epidemiological investigation. Twenty-two epistaxis cases from a single school with differences in gender, age, and classroom, were diagnosed within a period of 7 days. The air concentration of chromic acid mist (Cr^{6+}) in the electroplating factory area, new campus, and residential area exceeded the limit of uncontrolled emissions. The emission of HCL and H_2SO_4 was also observed. Formaldehyde levels in the classrooms exceeded the limits of indoor air quality. Abnormal nasal mucosa was significantly more frequent in the case group (93.3%) and control group 1 (of the same school) (66.7%) than in control group 2 (from a mountainous area with no industrial zone) (34.8%; $P < 0.05$ and $P < 0.01$, respectively). On the basis of the pre-existing local nasal mucosal lesions, excessive chromic acid mist in the school's surrounding areas and formaldehyde in the classrooms were considered to have acutely irritated the nasal mucosa, causing epistaxis. Several lessons regarding factory site selection, eradication of chemical emissions, and indoor air quality in newly decorated classrooms, should be learned from this emergency.

Epistaxis is defined as an acute hemorrhage from the nostril, nasal cavity, or nasopharynx. Although the vast majority of patients who present to the emergency department (ED) with epistaxis may be successfully treated, it often causes significant anxiety in patients and their family members[1]. An emergent event of epistaxis among many students may draw wide public attention, which presents a challenge for local government to deal with the public events appropriately.

In addition to trauma, infections, and tumors, which are the most common known factors, chemical irritants in indoor or outdoor air pollution may be a factor in the differential diagnosis of epistaxis[2]. A study by Szyszkowicz et al. suggested that an association exists between air pollution exposure and ED visits for epistaxis[3]. In terms of indoor air pollution, a study by Wantke et al. indicated that exposure to gaseous formaldehyde could induce IgE-mediated sensitization to formaldehyde in school-age children at the age of 8 years[4]. The report also suggested that many clinical symptoms among affected children, such as epistaxis, headache, and rhinitis, were associated with the formaldehyde concentrations in classrooms. In the occupational setting, nasal septum lesions induced by chromium exposure area type of occupational disease. Chromium electroplating workers usually suffer from epistaxis during work due to nasal septum perforation[5-6].

Epistaxis is common among children and young adults. A retrospective review of 101 patients seen with epistaxis in hospitals showed that modal age presentations for epistaxis were recorded among 1-20-years-old (40.6%, with 1-10 years accounting for over 20%)[7]. The predilection site of epistaxis in children usually locates at the anterior part of the nasal septum. The most common cause of epistaxis in adolescents is angiectasis or erosion of the nasal mucosa in Little's region of the nasal septum[8].

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Although children are susceptible to epistaxis, an outbreak of many epistaxis cases among school students, which might be associated with environmental pollution, has rarely been reported. In this report, multiple methods, including field epidemiological investigation, air monitoring, and a case-control study, were used to explore the cause of the event, to provide a scientific basis for the local government to deal with the emergency.

On September 3, 2013, an elementary school in a town of Zhejiang Province, East China, moved to a new location. Within the first week of classes, 22 students suffered different degrees of epistaxis. The event drew wide public attention because of the large number of epistaxis cases and the fact that epistaxis was observed immediately after the move to a new campus. The elementary school was located in a rural community with developed township enterprises. There were 27 classes and 1211 students from Grade 1 to Grade 6. The classrooms of the new campus were newly decorated with various materials.

Thirty-one factories were located within a 1-km radius around the school. Among them, 27 factories were involved in potential emission of air pollutants. Their layout is illustrated in Supplemental Figure 1 (see the website: www.besjournal.com). These included two electroplating factories, one chemical factory, three heat-treatment processing enterprises, and two aluminum die-casting enterprises. The production processes in the two electroplating factories included degreasing, pickling, and plating (chromium, copper, and nickel) processes. The main hazardous chemicals from the production processes were sulfuric acid, hydrogen chloride, and hexavalent chromium. The prevailing wind direction of the local area was northeasterly. The new campuses may have been affected by noxious gases throughout the year.

On September 6, the local environmental department conducted tests for sulfuric acid, chromic acid mist, hydrogen chloride, benzene, toluene, and xylene around one of the electroplating factories (the one located closest to the school), as well as at sites around the school. These environmental pollutants were determined on the basis of their corresponding criteria in China. Of the 16 classrooms in which students experienced epistaxis, 8 classrooms were randomly selected as sampling locations for formaldehyde, benzene, toluene, and xylene. These chemicals were determined on the basis of the standard in China (GB/T 18883-2002 'Indoor Air Quality Standard').

Fifteen students who had experienced epistaxis were selected as the case group, and another 18 students from the same school who did not experience epistaxis were selected as control group 1. Sixty-six students from a school located in a mountainous area with no industrial zone were selected as control group 2. The average ages and gender compositions of the two control groups were not significantly different from those of the case group ($P > 0.05$). All study participants provided informed consent. All subjects underwent nasoscopy and nasal endoscopy. Abnormal nasal mucosa was defined by the presence of Little's region angiectasis, nasal mucosa erosions, and rhinitis.

One-way analysis of variance with the least significant difference post-hoc test (equal variances) was used to analyze the differences in average age among the three groups. A chi-square test was applied to analyze the differences in the percentages of abnormal nasal mucosa and other confounding factors in the three groups.

Detailed epidemiological characteristics of the 22 students with epistaxis are as follows: (1) population distribution: 15 male and 7 female students aged 7 to 12 years; (2) time distribution: from September 3 to 9 (4 cases on September 3, 3 cases on September 4, 10 cases on September 5, 1 case on September 6, and 4 cases on September 9); (3) class distribution: 16 classes from Grade 1 to Grade 6; (4) clinical manifestations: one student experienced epistaxis ≥ 4 times, 2 experienced it 3 times, 6 experienced it twice, and 13 experienced it once. Nine students had a history of rhinitis, and 13 were aware of an abnormal smell in the classroom. In addition to epistaxis, subjects showed different degrees of accompanying symptoms, such as dizziness, headache, cough, or a sore throat. Epistaxis was not observed after the students left school and returned home to rest.

Table 1 shows that the levels of chromic acid mist around the electroplating factory area, the area of painted steel frame piles on the new campus, and the local community area were beyond the concentration limits of uncontrolled emissions as specified in China's GB16297-1996 'Integrated emission standard of air pollutants.' Hydrogen chloride and sulfuric acid were also detected, but these levels were not very high. Benzene, toluene, and xylene were not detected at the above sampling locations around the electroplating factory, new campus, or residential area. Table 2 shows that formaldehyde