Hematological changes in cement mill workers

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ABSTRACT

Objectives: Considering the hazards of exposure to cement dust, this study incorporated basic hematological parameters, erythrocyte sedimentation rate and the total leukocyte count. The idea was to identify a simple, readily available and cost effective screening test that could help in identifying the presence of disease, its severity, or both in cement mill workers potentially related to their work place.

Methods: This study was carried out in the Department of Physiology, Faculty of Health and Medical Sciences, Hamdard University, Karachi and the University of Karachi, Pakistan, during the time frame 1999-2000. In this study a group of 50, apparently healthy volunteers male cement mill workers were randomly selected with ages ranging from 20-60 years. They were matched with another group of 50, control healthy male subjects in terms of age, height, weight and socioeconomic status. Both groups met with exclusion criteria as per standard. The total leukocyte count was performed on an auto analyzer, (Symex-K-1000 CP-Analyzer, Japan) and the erythrocyte sedimentation rate was measured by Westergren tube method. Results were compared in a mean, and on the basis of, period of exposure in a cement mill.

Results: In the present study, the mean values of erythrocyte sedimentation rate ($p<0.05$) and total leukocyte count ($p<0.02$) significantly increased, but the parameters do not revealing statistically significant differences between 2 groups on the basis of duration of exposure in a cement mill.

Conclusion: This study has shown that exposure to cement dust causes increased mean values of total leukocyte count and erythrocyte sedimentation rate. However, this change is not related to the duration of exposure in a cement mill.

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The erythrocyte sedimentation rate (ESR) was adopted by modern medicine in 1918 when, the Swedish physician Fahraeus published his observations on the ESR in pregnancy.[1] Since the ESR has maintained a time-honored position in hematological analysis as a screening test for various non-hematological disease states.[2] Being a simple, inexpensive side room test, the ESR is especially valuable for diagnostic and prognostic purposes in silent illness including chronic diseases.[3] The ESR remains fairly constant in healthy persons and is affected by properties of the erythrocytes and plasma and by mechanical or technical factors.[1] High ESR even in healthy looking subjects leads to suspicion of a severe disease.[4]

In general, the ESR is high when there is an infectious disease or a significant amount of tissue necrosis. It may also be increased in localized infections, tuberculosis, and malignant tumors with necrosis.[5] The pathological process in which ESR is

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increased may be immunological, infective, ischemic, malignant or traumatic.[6] In addition, alteration in the normal leukocyte blood picture may also provide a diagnostic clue in certain specific diseases, both benign and malignant. An increase in the number of total leukocyte count (TLC) may be physiological or pathological. Pathological leukocytosis is caused by a disease.[7] The peripheral blood leukocyte count is a cellular marker of inflammation.[8] Changes in the number of circulating leukocytes can represent a primary disorder of leukocyte production or may reflect a secondary response to some disease process or toxin.[9] Raised leukocyte count also suggests the presence of infection.[10] These basic hematological parameters (ESR and TLC) are increased in pneumoconiosis, hypersensitivity pneumonias, bacterial pneumonia, pulmonary tuberculosis, bronchiectasis, chronic bronchitis, lung abscess, bronchiogenic carcinoma[11] and also in occupational diseases. Almost all industrial sectors generate agents that are considered health hazard. Cement industry is large industry and it produces dust during cement production. Cement is adhesive mineral dust containing mixture of calcium oxide, silicon oxide, aluminum tri oxide, ferric oxide, magnesium oxide and also clay, shale, sand and other impurities.[12] High concentration or prolonged inhalation of cement dust, or both can provoke clinical symptoms and inflammatory response that may result in functional, structural as well as other abnormalities.[13] Chronic exposure to cement dust has been reported to lead a greater prevalence of chronic respiratory symptoms and a reduction of ventilatory capacity. Effects of cement dust are due to its irritating and sensitizing properties. Cement dust induces chronic bronchitis and tissue fibrosis. The most frequently reported symptoms in cement mill workers were cough and phlegm production, dyspnea, chest tightness, impairment of lung function, sinusitis, and bronchial asthma.[14] Other health symptoms reported in the cement mill workers include headache and fatigue.[15] Inhaled cement dust is suspected of causing bronchial asthma and cancer of the lungs and the stomach.[16,17] According to the literature provided, it is clear that alternating studies are available on the hazards of cement dust without considering a basic hematological parameters namely TLC and ESR that can help further in the evaluation of the effect of cement dust. Thus, the present study has been carried out to achieve the hematological findings in workers exposed to cement dust by comparing with their matched controls.

Methods. This study was conducted in the Department of Physiology, Faculty of Health and Medical Sciences, Hamdard University Karachi and University of Karachi, Karachi, Pakistan. In this study 2 groups 50 volunteers each were recruited. The first group was formed of healthy male cement mill workers age 20-60 years, and were selected randomly from a cement mill located in Karachi, Pakistan. They were matched with a 2nd group of 50 healthy male control subjects selected from the local population of Karachi, in terms of age, height, weight and socioeconomic status. All subjects completed a questionnaire, which also included anthropometric data and a consent form. The Ethics Committee, Hamdard University, approved the study.

Exclusion criteria. Subjects with gross anemia, diabetes mellitus, cardiopulmonary diseases, malignancy, drug addicts, cigarette smokers and subject with any history of acute or chronic infections or recent hospitalization and prior history of employment in textile other than cement industry were excluded from the study.

Collection of blood sample. Five ml of blood was collected from each subject by a venipuncture and a disposable syringe. Three ml of blood was transferred to a bottle containing ethylenediaminetetraacetic acid, in a concentration of 1.5 mg/ml to be used for TLC count and 1.6 ml of blood was collected in another bottle containing 0.4 ml of 3.8% of sodium citrate for ESR. Each bottle was labeled with the subject identification code number. Total leukocyte count was performed on an electronic cell counter (auto-analyzer) Symex-K-1000 CP, Japan. Erythrocyte sedimentation rate was measured by Westergren tube method. The results were computed on computer in Excel program. The difference in the mean values of the 2 groups was regarded statistically significant if the p-value was less than 0.05.

Results. ***Physical characteristics.*** The basic physical characteristics for the total number of cement mill workers and control group is shown in **Table 1**. There were no significant differences between the means in physical characteristics of age, height or weight, in both groups. The mean duration of exposure in the cement mill workers was 12.94 ± 1.0 years (mean ± standard error of mean, range 2-28 years).

Hematological studies. The mean values of hematological (ESR and TLC) parameters for 50 cases of cement mill workers and controls are presented in **Table 2**. According to results, cement mill workers show a statistically significant increase in the mean values of ESR ($p<0.05$) and TLC ($p<0.02$).

Effects of duration of exposure (<5, 5-10 and >10 years) on erythrocyte sedimentation rate and total leukocyte count. **Table 3**, summarizes the comparison of ESR and TLC parameters in cement mill workers on the basis of duration of exposure <5, 5-10 and >10-years, compared with their matched control. There were no significant differences between the means of ESR and TLC in both groups.

Table 1 - Comparison of the physical characteristics between cement mill workers and controls (n=50).

Parameters	Control subjects (mean + SEM)	Cement mill workers (mean +SEM)	Significance Level
Age (years)	37.80 ± 1.66	36.86 ± 1.50	NS
Height (cm)	165.24 ± 0.89	165.64 ± 0.85	NS
Weight (kg)	63.72 ± 1.10	63.70 ± 1.39	NS

SEM - standard error of mean, NS - non significant

Table 2 - Comparison of erythrocyte sedimentation rate and total leukocyte count between cement mill workers and control (n=50).

Parameters	Control subjects (mean + SEM)	Cement mill workers (mean +SEM)	Significance Level
ESR (mm/first hour)	10.03 ± 1.21	15.4 ± 230	p<0.05
TLC/micro litre	6586.66 ± 235.02	7526.66 ± 264.75	p<0.02

SEM - standard error of mean, ESR - erythrocyte sedimentation rate
TLC - total leukocyte count

Table 3 - Erythrocyte sedimentation rate and total leukocyte count for cement mill workers on the basis of duration of exposure compared with their matched controls (n=50).

Parameters	Control subjects (mean + SEM)	Cement mill workers (mean +SEM)	Significance Level
	Duration of exposure < 5 years (n=10)		
ESR (mm/ first hour)	10.87 ± 2.45	14.2 ± 2.8	NS
TLC/micro litre	5950.00 ± 352.54	6920.00 ± 556.23	NS
	Duration of exposure 5-10 years (n=10)		
ESR (mm/ first hour)	8.42 ± 2.19	21.5 ± 9.42	NS
TLC/micro litre	6900.00 ± 582.68	8666.66 ± 947.15	NS
	Duration of exposure >10 years (n=30)		
ESR (mm/ first hour)	10.33 ± 1.85	13.78 ± 2.11	NS
TLC/micro litre	6780.00 ± 326.19	7326.31 ± 226.18	NS

SEM - standard error of mean, ESR - erythrocyte sedimentation rate
TLC - total leukocyte count, NS - non significant

Discussion. Considering the effects of exposure to cement dust, this study incorporated 2 basic hematology parameters, ESR and the TLC. The idea was to recognize a simple, readily available and cost effective screening test that could help in identifying the presence of disease or its severity in cement mill workers, or both. Estimation of the ESR is used in clinical practice and is a useful screening test in routine medical check-up. A normal ESR is reassuring but, a high ESR even in a healthy-looking subject leads to the suspicion of disease and it should prompt further investigations.[18] Although ESR is a non-specific phenomenon, the fact remains that the vast majority of acute or chronic inflammation/ infection and most neoplastic and degenerative diseases are associated with acceleration of sedimentation.[19] In this study we found a significant increase in the mean values of ESR ($p<0.05$) and TLC ($p<0.02$). However, the parameters are not illuminating a significant difference between 2 groups on the basis of duration of exposure in the cement mill. This may indicate an inflammatory change in the lungs of cement mill workers as described earlier.[12,15-17] A medline search revealed no such study that could describe the ESR in cement mill workers. To the best of our knowledge, this the first report on ESR findings in cement mill workers. However, ESR has been found to be faster in patients with respiratory diseases[6,11] MacieJewska and Bielichowska-Cybula[20] found that cement dust induces chronic exfoliative bronchitis, tissue fibrosis and emphysema. In addition, Oleru[12] and Abou-Taleb et al[15] reported that, the most frequent symptoms in cement mill workers were cough and phlegm production, chronic bronchitis, impairment of lung function, chest tightness, restrictive lung disease, skin irritation, conjunctivitis, stomach ache and boils. On the basis of such relation, our results suggest that cement dust effecting different systems including respiratory systems and thus, involving blood parameters to deviate from their normal values. In addition to ESR, another hemotological parameter studied in the present work to confirm the involvement of cement dust in changing the blood picture. High TLC count represents a primary disorder of leukocyte production or may reflect a secondary response to some disease process or toxins.[9] The peripheral blood leukocyte count is a marker of inflammatory activity and ongoing tissue inflammation from whatever underlying cause. It thus might be viewed as a bio-marker of inflammatory response. Longitudinal studies have linked elevations of the peripheral blood leukocyte count to increased mortality from decreased pulmonary function,[21] ischemic heart disease[22] and cancer.[23]

In the present study TLC like ESR, was found to be significantly higher in cement mill workers compared to healthy controls (**Table 2**). However, a non-significant rise was observed on the basis of duration

of exposure (**Table 3**). Redlich[24] reported that, various occupational exposures cause lung injury and initiate a chronic inflammatory process that may either progress to initiate fibrosis or result in repair. Alternatively, it is also possible that chronic exposure to irritating material might lead to adaptation process, which resist inflammation and leukocytosis. On the basis of suggestion given by Hauser et al[25] the similar adaptation to a certain extent may be responsible for non-significant rise in TLC with regard to period of exposure in this study.

In the present study, a rise in the mean values of ESR and TLC has been demonstrated and it has been suggested that, the rise in the above hematological parameters is most likely due to ongoing effect of cement dust but the parameters did not reveal significant difference between 2 groups on the basis of period of exposure. It probably reflects the low degree of severity of disease expressed in terms of hematologically changes. Although as per obtained hematological result, the above values of ESR and TLC cannot be reliably translated into clinical benefit for the cement mill worker. However, a study involving >30-years of exposure in cement industry might bring out significant hematological changes. We recommended that cement mill workers should regularly use appropriate personal protective equipments at their work site namely apparel, mask, goggles, and should get periodic medical surveillance including hematological profile. These measures would help to decrease the effects of occupational hazards of cement dust and detect the disease in initial stage when treatment is achievable in cement industrial workers.

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