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Research Article

A STUDY OF THE CLINICAL PROFILE IN PATIENTS OF ILD WITH EMPHASIS ON EXPOSURE TO CEMENT DUST: CEMENT WORKER'S PNEUMOCONIOSIS

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ABSTRACT

Background and Objectives: India accounts for 17 percent of the 11 million occupational disease cases and also 17 percent of the 0.12 million global deaths. The pattern of occupational morbidity in India differs from the global scenario, occupational lung diseases form the majority of the work-related morbidity in India. Short term exposure to cement dust leads to irritation of the mucosa leading to increased bronchial muscle tone i.e. hyper-reactiveness and broncho-constriction. Chronic exposure leads to impaired gaseous exchange. The cement dust or constituents of cement causes pathogenesis of various lung diseases including chronic bronchitis, asthma, lung cancer, pneumonia and tuberculosis. This study also highlights the need for awareness so that preventive measures (in the form of gloves, boots, eye goggles and face masks) can be advised early on to the at-risk workers to prevent or halt the disease progression at an early stage.

Materials and Methods: A prospective observational study was conducted at MVJ MC & RH over a span of 2 years where 51 cases so far presenting to the hospital, diagnosed radiologically to have Interstitial Lung disease were included.

Results: Of the 51 patients evaluated so far, 29 (56.8%) were males and 22 (43.13%) females. And majority of them were above 61 years i.e. 28 patients (54.90%) majority of the patients 40 (78.43%) had been chronically exposed to the inhalational irritants for >20 yrs

Occupationally, 32 (62%) of the patients had a history of chronic exposure to cement dust. most common presenting feature was breathlessness was most common symptom noted in all patients (100%) on examination tachypnea, reduced chest expansion in 38 (74%). chest x-ray, HRCT and spirometry was used in our study .

Conclusion: Long term cement dust exposure and inhalation causes respiratory complications due to epithelial damage Long term exposure to cement dust cause interstitial lung disease, pleural thickening and chronic bronchitis. Due to disproportionate urbanization and boom in construction more cases of cement workers pneumoconiosis is being reported. The main idea of this study is enhance the awareness among high risk workers so that preventive measures (in the form of gloves, boots, eye goggles and face masks) can be taken early to prevent or halt the disease progression at an early stage.

INTRODUCTION

Occupational diseases are caused by work-environmental interface that vary depending on the geographic, socio-cultural, economic and job-related factors. The occupational risks are estimated to be the tenth leading cause of morbidity and mortality among the global risk factors. India accounts for 17 percent of the 11 million occupational disease cases and also 17 percent of the 0.12 million global deaths. [1-2]

The pattern of occupational morbidity in India differs from the global scenario. In contrast to musculoskeletal diseases being at the top on the global burden, occupational lung diseases form the majority of the work-related morbidity in India.

India is the world's second largest cement producer after China. The recent decadal urbanization of rural areas, development in the housing sector, industrial expansion, highways and road development and increased infrastructure has increased the number of workers subjected to overwork schedules, long work hours of exposure to high concentrations of cement dust (including raw material, clinker and finished cement) with other socioeconomic inequities. In India, the cement manufacturing sectors has about 140 major and 360 smaller plants, most of which are concentrated in south India with Karnataka being 3rd largest producer among all states Respiratory tract disorders are the most important group of occupational diseases in the cement industry and are the result of inhalation of airborne dust and the effects of macroclimatic and microclimatic conditions in the workplace environment. [3-6].

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In the construction industry, the major exposure is cement dust. Cements used in construction are usually inorganic, often lime or calcium silicate based. The cement industry, the backbone of the construction sector employs over 200,000 formal labour force and a vastly more number in the form of non-contractual labour who have no access to basic protective gear or devices to avoid skin contact / inhalational exposure to cement dust and have received no formal training of sorts to protect themselves from harm caused by inhalational or contact exposure to the same [7].

The population most exposed to cement pollution includes workers and managers in cement plants and factories [8]. Portland cement dust as a whole has been considered as a chemical hazard by the National Institute of Occupational Safety and Health (US) [9-13]. The cement Particles that have a diameter ranging from 0.05 to 5.0 µm have been implicated as a potential cause of interstitial lung disease.

Short term exposure to cement dust leads to irritation of the mucosa leading to increased bronchial muscle tone i.e. hyper-reactiveness and broncho-constriction. Chronic exposure leads to impaired gaseous exchange. Persistent alveolitis leads to obliteration of alveolar capillaries and reorganization of the lung parenchyma, accompanied by irreversible fibrosis. This may be associated with the resultant weakness of the respiratory [intercostal] muscles witnessed by poor ventilatory findings on a spirometer [14, 15].

Arising as a direct sequalae to inhalation of cement dust as a whole with free silica forming only a small proportion of the offending mixture, the name CEMENT WORKERS' PNEUMOCONIOSIS is suggested as the most appropriate for this spectrum of disease.

The population most exposed to cement dust pollution includes workers and managers in cement factories and construction site. The externalities of the cement industry to the environment as a whole with pollution of the environment and adverse health outcomes to the surrounding communities has been the focus of studies by and large, but studies looking at morbidities to the workforce in the cement producing units or on site workers in India have not been done [8,14,15].

In a country like ours, in the backdrop of various socio-economic conditions, it is imperative to study the morbidities among the Indian Cement industry workers. Hence, this study has been taken up.

We conducted a study with the aim to assess the clinical profile of patients presenting with ILD, specially correlating the same to exposure to cement dust to evaluate the effects of long-term inhalational exposure to cement dust at the workplace.

MATERIAL AND METHODS

A prospective observational study was conducted at MVJ MC & RH over a span of 2 years where 51 cases so far presenting to the hospital, diagnosed radiologically to have Interstitial Lung disease were included. After collecting their demographic data, details pertaining to their symptom onset, duration and progression were taken. Details of occupational history, years of exposure to inhalational irritants and duration of exposure following which symptom onset occurred were noted. They were thoroughly assessed clinically, at presentation and investigated during their hospital stay. Collagen vascular workup was done in all the patients to rule out other causes of interstitial lung diseases and one of them was found to be positive for RA factor and hence excluded from the study.

Breathlessness was graded according to the MMRC grading for respiratory illnesses. Cough or rhino-sinusitis lasting for more than 8weeks and more than three consecutive years were defined to be chronic. Cough when associated with an expectoration > 60 ml per day was considered productive.

Chest measurements were taken at the level of the nipple using a non-elastic measuring tape.

Patient's resting oxygen saturation was measured in supine position in all the four limbs using a hand held pulse oximeter. Pulmonary function tests were done for all the patients using A Spirometer Helios 401. The procedure was demonstrated to the patients and after closing nose with a nose clip, they were asked to perform the same under supervision.

Chest X-Ray findings were inconclusive for a definitive diagnosis and hence HRCT were done on all the patients.

RESULTS

Of the 51 patients evaluated so far, 29 (56.8%) were males and 22 (43.13%) females. the age distribution among the subjects showed that 4 patients (7.8 %) were in the age group between 20-40 years, 19 patients (37.25%) were in the age group between 41-60 years, and 28 patients (54.90%) were in the age group above 60 years.[Fig 1]

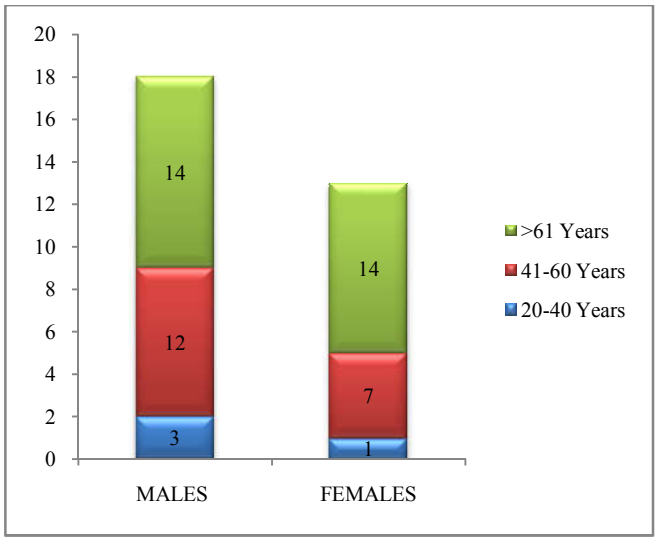

Figure 1 Age distribution of patients

Occupationally, 32 (62.74%) of the patients had a history of chronic exposure to cement dust with 28 working as manual construction workers and 4 working in a cement processing unit/factory. 14 patients were farmers, 3 worked in a glass factory involved with the grinding process and 2 worked in a garment mill. [Fig 2]

A large majority of the patients; 34 of the 51 (66.66%) had been chronically exposed to the inhalational irritants for >20 yrs. [Table1] [Fig 3]

Table 1 Years of Exposure among subjects

Years of Exposure	<10 Yrs	10-15 Yrs	15-20 Yrs	>20Yrs
Construction workers	1	2	5	20
Farmers	2	1	1	10
Cement factory workers	1	1	1	1
Glass factory workers	-	-	2	1
Garment factory worker	-	-	-	2

The most common presenting feature was breathlessness seen in all patients (100%). None of the patients had grade IV breathlessness. The next most common symptom was dry cough which was present in 42 (82.35%) of the patients while 9(17.65%) patients who had associated co-infection, presented with expectoration. Also noted were acute rhino-sinusitis in 31(60.78%) of the patients while chronically present in 8 (15.68%). [Table 2].

Table 2 Symptomatology of subjects

Symptoms	*Males*	*Females*	*Total*	
	No.	No.	No.	%
Breathlessness	29	22	51	100
Chronic Cough	15	19	34	66.67
Acute Cough	7	10	17	33.33
Dry Cough	23	19	42	82.35
Cough with expectoration	3	6	9	17.64
Chronic Rhino-Sinusitis	5	3	8	15.68
Acute Rhino-Sinusitis	20	11	31	60.78

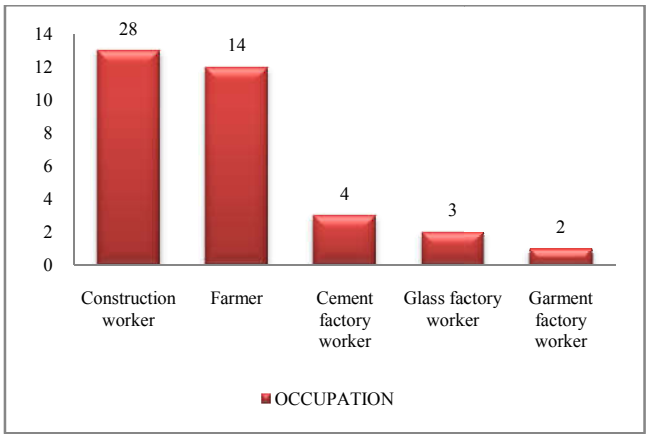

Figure 2 Occupation of Subjects

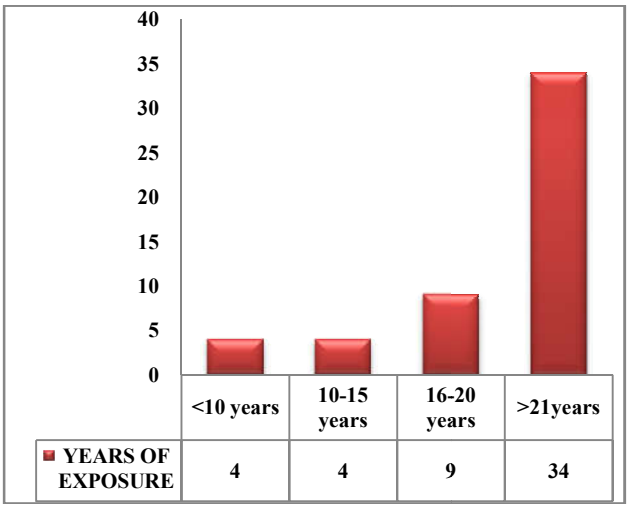

Figure 3 Years of exposure among subjects

34(66.66%) patients claimed to have developed breathlessness after more than 20 years of exposure at the workplace, 9(17.66%) patients were breathless after 16-20years, 4(7.84%) developed same in 11-15years of exposure and 4(7.84%) patients claimed to have grade II breathlessness within 10years at work [Fig 4]. Chronic cough was reported by 23(45.09%) of the patients within 10 years of exposure. 31 (60.78%) patients complained of acute sinusitis which was of recent onset, after >20 years of work related exposure.

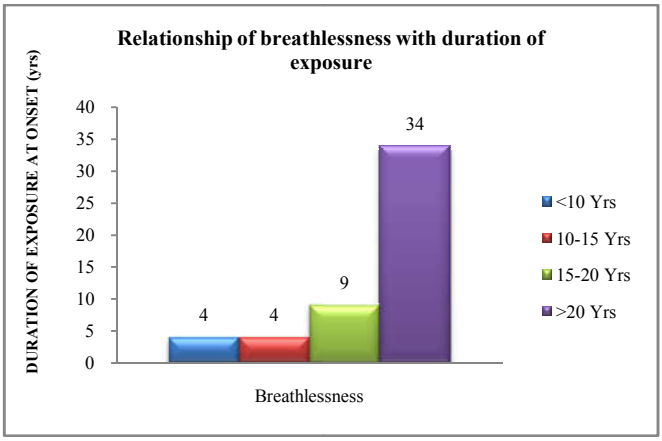

Figure 4 Relationship of breathlessness with duration of exposure

Of the 32 patients working in construction site or at the cement factory with chronic exposure to high levels of cement dust; chronic cough was noted in 26(81.25%) while 6 complained of a more recent onset of cough. 23(71.87%) of these workers complained of dry cough while only one had associated expectoration. 22(68.75%) of the cement exposed workers had chronic rhino-sinusitis. Most of them complained of having the episodes only during the prolonged exposure shifts at work lasting >36 hours. An equal number of farmers had chronic and acute cough though it was predominantly dry cough (24%). [Fig 5]

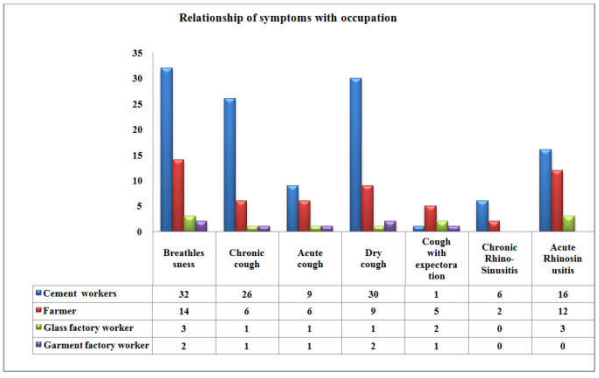

Figure 5 Relationship of symptoms with occupation

While breathlessness was a late onset feature in most of the patients, 11(21.56%) of the workers exposed to cement dust had complaints of exertional breathlessness in less than 20 years of exposure while 4 (7.84%) of the farmers complained of the same. (Table 2) The onset of cough was a relatively earlier feature with 23(71.87%) workers who were exposed to cement dust and 9 of the farmers developed cough within 20 years of exposure. Majority of patients were exposed for 8 hours per day to cement dust as seen in 24 patients (47.05%).

On examination, all the patients had Tachypnoea (RR ranging from 20-25 cycles per minute). Velcro crepitations were noted in both the lung fields in 43(84.31%) patients while 2(3.92%) of them had coarse crepitations 6(11.76%) of them had fine crepitations. Restricted chest expansion <3cm was noted in 38(74.0%) of patients. Signs of emphysema were noted in 24(47.05%) patients, loud S2 was heard in 22 (43.31%) patients, Pulse oximetry showed moderately low oxygen saturation amongst all the patients with SpO2 ranging from 88-92% at room air.

A blood workup revealed an elevated ESR (ranging from 30-50mm/h), leucocytosis (10,000-14,000) while the collagen vascular workup revealed one patient to be positive for RA factor, who was excluded from the study On PFT, the pattern

noted was predominantly restrictive, seen in 38(74.50%), obstructive in 10 (19.60%) and mixed in 3 (5.88%) of the patients. Of the patients with a restrictive lung disease, 26(50.98%) were employed with chronic exposure to inhalational cement dust, 8(15.68%) were farmers, 3 were employed in a glass factory and 1 in a garment factory. [Table 3] [Fig 6]

Table 3 PFT patterns among subjects

	Restrictive	Obstructive	Mixed
Cement industry workers	26	6	-
Farmers	8	3	3
Glass factory workers	3	-	-
Garment factory worker	1	1	-

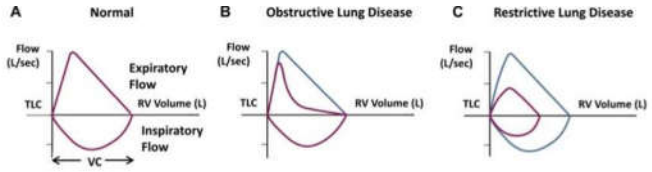

Figure 6 Patterns of Pulmonary Functions on Spirometry

On Chest X-Ray: Various degrees of abnormalities were noted which included predominantly reticular opacities in the lung fields in 32 (62.7%), altered attenuation was seen in 6 (11.76%), old calcified granulomas was seen in 2 (3.921%), emphysematous changes associated with inflammatory processes and infiltrative changes was seen in 24 (47.05%) patients, cardiomegaly was noted in 6(11.76%) patients [Fig 7] HRCT: Reticulo-nodular opacities in B/L lung fields predominantly in the lower zones in 26(50.98%). Perilymphatic lung nodules were seen in 4 (12.5%) cement workers**.** Diffuse calcified pulmonary nodules were seen in 2(7.84%), Ground glass opacities noted in 32 (62.7%) of cement workers pneumoconiosis cases. [Fig 8]

Figure 7 Chest X-Ray showing Reticulo-Nodular Pattern in Subjects suggestive of ILD

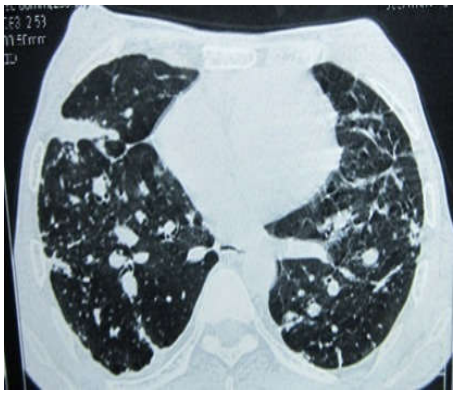

Figure 8 CT Scan showing Honey-combing pattern suggestive of ILD

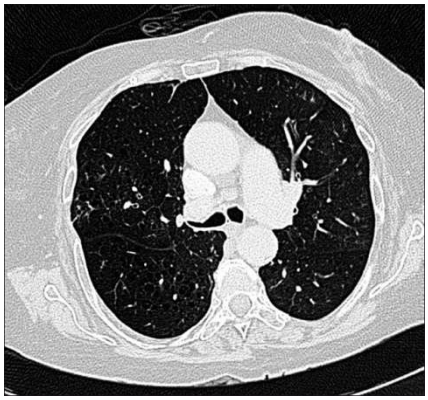

Figure 9 CT Scan of a subject with ILD showing Interstitial thickening

Figure 10 CT- Scan of patient with ILD showing secondary infection and traction bronchiectasis

DISCUSSION

Respiratory diseases associated with inhalation of airborne dust are the most vital group of occupational diseases. Previous study subjects with chronic obstructive pulmonary disease advocate that workplace exposures are powerfully linked with an increased risk of chronic obstructive pulmonary disease. Chronic respiratory diseases account for a public health challenge in both industrialized as well as developing countries because of their health and economic impacts. Cement is one of the most important building materials in the world. Moreover, cement dust constitutes numerous materials including calcium oxide, silicon oxide, aluminium trioxide, ferric oxide, magnesium oxide, sand and other impurities. The cement dust or constituents of cement causes pathogenesis of various lung diseases including chronic bronchitis, asthma, lung cancer, pneumonia and tuberculosis.

In our current study a large majority of the patients; 34 of the 51 (66.66%) had been chronically exposed to the inhalational irritants for more than 20 years.

Most patients belonged to age group 41-60 years (37%), whereas in study conducted by Shrivastava A *et al* most

patients belonged to age group of 21-40 years (67%).[16] Study done by Arshad H Rahmani *et al* also showed that majority of the patients belonged to age group 20-40 years seen in 74% of study subjects. [17] In study done by AN Nwibo *et al* most subjects (75%) were of age group 21-40 years. [18]

In our current study mean age group were 43.5±8.2 years. Study done by A N Nwibo showed mean age group of study population was 30.1±9.3 years[18], whereas in study done by Alphonsus *et al* showed that mean age group of study population was 36.2±10.9 years[19]

In our study males and females were 56.8% and 43.2% respectively which was similar to study done by Shrivastava A *et al* males and females were 87% and 13% respectively. [16] In a study done by A N Nwibo in which males and females were 51.6% and 48.4% respectively. [18]

In our current study all the patients (100%) presented with breathlessness, Grade 2 breathlessness was noted in 12(23.52%) patients and grade 3 was seen in 39(76.47%) patients, none of them had grade 4 breathlessness. 34(66.66%) patients in our study had breathlessness after more than 20 years of work exposure. Next common symptom was dry cough seen in 84.31% of patients and 17.64% of patients had associated co infections. In study done by Shrivastava A *et al* shortness of breath was noted in 26% of patients followed by cough seen in 19% of patients.[16]

In study done by Arshad H Rahmani *et al* 10% of study population had dry cough, 14% of them had associated lung infection[17]. In study done by Alphonsus *et al* Chest tightness was seen in 35.5%, cough in 23.7% and breathlessness in 7.9% of study population.[19]

In our study Velcro crepitations were noted in both the lung fields in 43(84.31%) patients while 2(3.92%) of them had coarse crepitations 6(11.76%) of them had fine crepitations. Restricted chest expansion <3cm was noted in 38(74.0%) of patients. Signs of emphysema were noted in 24(47.05%) patients, loud S2 was heard in 22 (43.31%) patients. Elevated ESR and leucocytosis was seen in significant number of patients.

Various degrees of abnormalities were noted on chest x ray commonest finding being predominant reticular opacities in the lung fields in 32 (62.7%) patients, cardiomegaly was noted in 6(11.76%) patients, emphysematous changes associated with inflammatory processes and infiltrative changes was seen in 24 (47.05%) patients. Most patients had Reticulo-nodular opacities in B/L lung fields predominantly in the lower zones in 26(50.98%) on HRCT. Ground glass opacities were seen in 62.7% of the patients. Few patients also showed Perilymphatic lung nodules (12.5%) and calcified pulmonary nodules (6.25%) on HRCT .In a study done by Fatih Alper *et al* showed that 23 (46%) patients had pleural involvement with progressive massive fibrosis and calcification was seen in 24% of patients [20]

Most common pattern noted on PFT was restrictive pattern which was seen in 74.5% of patients, obstructive pattern in 19.6 and mixed patterns in 5.88%. In a study done by AN Nwibo *et al* a significant decline was noted in mean FEV1 and FVC values and a negative correlation was noted with duration of work. [18]

CONCLUSION

Cement dust can produce mixed pneumoconiosis characterized by both irregular (caused by silicates) and rounded opacities (influenced by the free silica). Long term cement dust exposure and inhalation causes respiratory complications due to epithelial damage leading to interstitial lung disease, pleural thickening and chronic bronchitis, eventually causing impairment in lung function.

Workplace exposures to cement are associated with increased risk of ILD. With decrease in coal workers pneumoconiosis and disproportionate urbanization and the boom of construction industry in both urban and rural areas, more and more cases of cement pneumoconiosis are being diagnosed.

This study emphasizes on the effects of cement dust exposure on the basis of clinical study, spirometry and radiology. There appears to be a direct relation between the amount and duration for the evolution of cement pneumoconiosis. This study also highlights the need for awareness so that preventive measures (in the form of gloves, boots, eye goggles and face masks) can be advised early on to the at-risk workers to prevent or halt the disease progression at an early stage.

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