Original article

Silicosis in Stone Crushing Workers-A Retrospective Analysis

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ABSTRACT

Introduction: Silicosis is a progressive, fibrotic and preventable occupational lung disease. Occupational exposure in stone crushing units to silica particles of size 0.5 to 5µm poses a hazard to the workers.

Methods: Our study is a passive surveillance study of silicosis in the symptomatic workers referred from Occupational Disease Centre to Department of Radiodiagnosis for chest X-Ray and High Resolution Computerized Tomography on suspicion of occupational lung disease. Period of study was 1 year from 01 January 2016 to 31 December 2016.

Results: 8 out of 99 referred patients sent for X-Ray Chest and HRCT Chest werediagnosed as silicosis. These 8 patients worked in stone crushing unit and were male with average age of 42.5 years. 75% showed exposure of 18 to 22 years. Chest X-ray and HRCT Chest were evaluated using the International Labour Organization classification system. Small, rounded opacities were found in 87.5% and 50% of cases showed "t" which are small irregular opacities. Large opacities were 25%. Profusion-1/1 was 50%. There was 12.5% of silicotuberculosis and 12.5% of progressive massive fibrosis. calcified hilar lymph nodes was seen in 50%, emphysema in 25 %, mediastinal lymphatic nodule enlargement in 25%, pleural thickening in 62%.

Conclusions: Silicosis is a preventable disease and workers of stone crushing units are at risk of developing silicosis. This study was a passive surveillance study and the actual numbers will be more. Active health screening of the workers needs to be formulated.

Key Words: Silicosis, Stone crushing units, lung parenchymal lesions

Introduction

Silicosis is an occupational lung disease caused by inhalation of respirable crystalline silica and pulmonary reaction to it. [1]. Its true prevalence is underestimated as during its initial phase the patient is symptom free. In India the prevalence of silicosis varies from 3.5% to 54.6%. [2] No effective treatment is available, so prevention and early diagnosis is essential if this disease is to be controlled Inhaled silica dust are deposited in the lungs and stimulate fibroblasts to proliferate and produce collagen around the silica particles, thus resulting in fibrosis and the formation of the nodular lesions [3]. Silicosis is the commonest occupational lung disease all over the world. But it is more frequent in developing countries where safe work practice among the workers is poor. Countries like USA, have shown a remarkable control of cases and the mortality rate from silicosis has decreased from 1,065 (1968) to 165 (2004) [4] In India, 3 million workers are exposed to silica dust daily.[5] Freshly crushed rock in stone crushing unit releases a burst of fresh silica.[6] Inhalation of freshly released crystalline silica is more harmful than aged silica Fresh silica dust produces greater effect on integrity of alveolar cellular membrane .[7]Development of silicosis depends upon duration of exposure to silica particles as well as its intensity. . Patients are apparently

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asymptomatic in initial stage even though the X-Ray Chest may show lesions. Patients develop symptoms after 15 or more years of exposure to silicosis. High exposure can cause symptoms in one year. Chronic mild or short exposure cause development of nodules in lungs but initially patient is asymptomatic and the lung functioning is normal. If exposure continues, the fibrosis sets and the lung capacity is decreased. Some cases may progress to progressive massive fibrosis with lung fields showing large conglomerate masses.

Chest X-ray findings along with positive occupational history is important for diagnosis of silicosis. International Classification of Radiographs of Pneumoconiosis wasformulated by International Labour Organization to have a uniformity in reporting of the cases and their comparison. It is based on the size and shape of opacities, their concentrations and the accompanying pleural changes visible on the X-ray chest. Quality of films is also taken into consideration. Appropriate coding is given after careful evaluation of X-ray Films. The appearance of radiological category 1/1 or greater with round opacities in lung fields indicated silicosis. [8] HR CT scan shows cross-sectional lung with clearly outlined pathology hence it is more sensitive than X-Ray Chest to confirm silicosis. But HRCT standards for reading has not yet been formulated due to chances of false positive readings hence X-Ray film reading supported by HRCT findings continue to be used in diagnosis of silicosis. [9,10,11] There are three forms of silicosis. In acute type of silicosis, chest X-ray shows ill-defined diffuse opacities in both lung bases. HRCT shows centrilobular and ground-glass opacities involving both lung fields [12]. Chronic silicosis is the most common type and shows round opacities or nodules with upper lung fields preponderance on both chest X-Ray and CT. Nodules and lymph nodes in hila and mediastinum may show egg shell calcification [13,14].

Progressive massive fibrosis on X-ray shows bilateral upper lobe masses formed by coalescence of the nodules. Due to fibrosis, these masses are pulled towards the hilum causing the lower lobes to look increased in size. Hilar calcification may also be seen. Bullae may be seen around the conglomerate masses.Studying specific radiographic features of silicosis is important for approaching its diagnosis to the international standard, early detection and prevention from complications. Prevention is the only safeguard; there is no cure for silicosis.

Aim and Objectives

To determine the number of silicosis cases diagnosed in a one-year period in patients referred to Radiology department with suspicion of occupational lung disease. This study would also evaluate radiographic patterns in silicosis by using the International radiological classification of pneumoconiosis.

Method and Material

This is a retrospective cohort analysis. All cases suspected of occupational lung disease who were referred from Occupational Disease Centre to Department of Diagnosis for Chest X-Ray and HRCT Chest during 01 January to 31 December and diagnosed as silicosis were included in the study. Silicosis was diagnosed on basis of occupational history, clinical examination, pulmonary function tests and radiological investigation.

X-Ray Chest and HRCT Chest of the diagnosed cases of silicosis was examined and classified. according to the ILO International radiological classification of pneumoconiosis. The radiographic abnormalities are coded according to size, shape and profusion of the lesions. [8]. Quality of the Chest radiograph was first evaluated. Small opacities were

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categorized according to shape and size. Categories are **p** (up to 1.5 mm), **q** (1.5 mm to 3 mm), or **r** (exceeding 3mm and up to 10 mm). Small, irregular opacities are classified by width as ***s***, (up to 1.5 mm)**t**, (1.5 mm to 3 mm) and **u** (exceeding 3mm and up to 10 mm). Above symbols of small opacities are coded in 2 letters. In case opacities are of one shape and size the symbol is coded twice example q/q. If there are opacities of different shape or size the most predominant is recorded first followed by next code second letter example q/t.Large opacities greater than 1 cm are classified as category A (one or more large opacities whose combined longest dimension does not exceed about 50 mm), category B (for one or more large opacities whose combined longest dimension exceeds 50 mm but does not exceed the equivalent area of the right upper lung zone), and category C (for one or more large opacities whose combined longest dimension exceed the equivalent area of the right upper lung zone).For recording profusion each lung field from apex to the diaphragm is divided into 3 evenly spaced zones: upper, middle, and lower resulting in 6 zones: right upper, right middle, right lower and left upper, left middle, left lower. The zones in which the small parenchymal opacities appear are noted and profusion was recorded by using 12-point scale as 0/-, 0/0, 0/1, 1/0, 1/1, 1/2, 2/1, 2/2, 2/3, 3/2, 3/3, 3/+. Category 0 refers to the absence of small opacity and category 3 represents the most profuse. The first number represents the predominant category and the second number represents the profusion which is the next alternative, if there is no alternative the first number is repeated .Pleural abnormalities and location were noted. Other associated findings were also recorded.

Results and Analysis

99 Patients were referred to Department of Radiodiagnosis with suspicion of occupational lung disease and 8 patients were diagnosed as silicosis. An average age at which silicosis diagnosed was 42.5 years. Youngest patient was 35 years old and oldest patient was 49 years old. Average age of entry into the employment was 18 years. 75% of the workers diagnosed as silicosis had been working in stone crushing unit for 18-30 years.[Table 1]

Radiological pattern of lung parenchymal opacities on the chest X-ray were

1) small, rounded opacities (87.5%), rounded opacities of less than 1.5mm in diameter or “p” opacities occurred in 0 % (n=0) and round opacities of 3-100mm or “r” opacities were revealed in 12.5% (n=1). "q" or round opacities of 1.5-3mm in diameter composed 75 % (n=6). [figure 1]

2)"t" or small, irregular opacities of 1.5-3mm in width composed 50 % (n=4). Thin irregular opacities of 1.5 mm or “s” opacities 12.5% (n=1) and thick irregular of 3-10mm or “u” opacities occurred in 12.5 (n=1) %.

3) Profusion-1/1 was 50% ,1/2 ,2/1,2/2,2/2,2/3 was 12.5%. No cases recorded in 0/1 and 3/3.

4) Large opacities of “A, B and C” occurred in 25% (n=2) of the cases.

5) Additional Features noted were calcified hilar lymph nodes (n=4) 50%, emphysema (n=2) 25 %, mediastinal lymphatic nodule enlargement in (n=2) 25%, pleural thickening 62%(n=5) and emphysema in 25%(n=2). Tuberculosis was associated in 12.5%(n=1) of cases

Discussion

Term Silicosis was coined by Visconti in 1870.[15] . Incidence of silicosis has decreased in developed countries, but it still is one of the most common

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occupational diseases in many developing countries of the world. In 1995 the WHO/ILO Joint Committee on Occupational Health launched "Global program on Elimination of Silicosis" aiming to eliminate Silicosis from the world by the 2030 [16].In India, silicosis is common and is the cause of morbidity and mortality in workers [17]. Clinical symptoms of Silicosis develop after a period of exposure to silica and the patient remains unsymptomic even though a chest X-Ray will reveal lesions. [18]. Our study was based on passive surveillance and the patients were symptomic. It is stressed that active health screening of the workers who are at risk should be done so that the disease may be detected early. Routine Chest X-Ray will detect lesions early. All Chest X-Ray films of our patients showed late features of silicosis. HRCT Chest was also done for determining the extent of lung involvement and additional findings. The HRCT Chest is not recommended as a diagnostic tool in diagnosis of silicosis, as it also detects insignificant pulmonary nodules which would create problems in definitive diagnosis and lead to reporting of false positive cases. Use of HRCT Chest should be only used for certain cases which requires further characterization. [9,10,11] Hence X-Ray Chest still remains the main diagnostic tool. our study HRCT Chest was done in all cases. In our study small rounded opacities of criteria p,q,r was predominant 87.5%[figure 1 and 2] followed by irregular small opacities 50% [figure 3].Large opacities were seen in 25% of cases. This is close to the study of Janet M. Hughes and Robert N. Jones of the Washington University, USA and the University of British Columbia, Canada where small opacities were 95%, large opacities were 5% [19]. By our study of silicosis, small opacities were more common but large opacities were also significant. Study of S.M Jain et al showed small round opacities (p; q; r) were 67%, small irregular dash-formed opacities (s; t; u) - 35%, and large opacities (A; B; C) - 20% [20] these figures is similar to our study. Present study showed calcified hilar lymph nodes (n=4) 50%, emphysema in(n=2) 25%, mediastinal lymphatic nodule enlargement in (n=2) 25%, pleural thickening 62%(n=5) were slightly more than study by S.M Jain and K.C Khare which showed that in emphysema in 9% of cases and enlargement of hilar lymph nodes in 11% of cases [21]. Pleural thickening in our study were apical. Profusion of the small opacities were-1/1 was 50% and more consistent with restrictive disease silicosis. HRCT Chest delineated the soft lesions of lung and mediastinal lymph nodes better than X-Ray Chest. HRCT findings delineated small nodules which were centrilobular ,sub pleural with upper lobes preponderance. Some of the nodules showed calcification. Soft rounded and irregular lesions coalesce to form larger masses. One case showed features of progressive massive fibrosis which was characterized by large masses with bullous emphysematous changes.

Patients suffering from silicosis are at a higher risk of developing other lung complications and infections like tuberculosis. Tuberculosis commonly develop in silicotic patients.[21]Silico tuberculosis was seen in 12.5% (n=1) case[figure 4] which is lower than the study of the National Occupational Health Center of India in 2003, in 23.9% of silicosis suffered from silicotuberculosis[22] . The radiological features were soft opacities in upper lobes and cavitation. CECT Chest showed necrotic enlarged lymph nodes in addition to lung parenchymal findings. These findings are similar to the findings of other researchers. Pleural and pericardial effusion was not present. [23,24]

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Conclusion

Chronic Silicosis is still prevalent in stone crusher unit. Active health screening and education of the workers for safe work practice is essential to reduce mortality and morbidity in workers and pick up the cases early. In India silicosis presents in late stages. Among the lesions in silicosis small round opacities were predominant. This study is limited due to less number of cases who were passively screened in symptomatic patients.

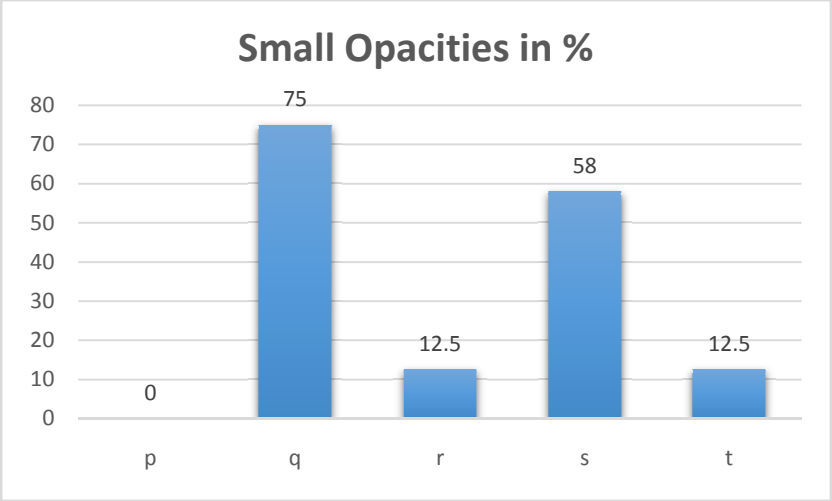

Figure 1 : Small Opacities in %

Table 1 Exposure to silica in stone crushing unit in years

S.No	Worked Years	Case No.	%
1	18-20	3	37.5
2	21-23	2	25
3	24-26	1	12.5
4	27-30	1	12.5

Figure 2 : X-Ray Chest showing multiple nodular opacities both lung fields

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Figure 3 : CT Chest showing multiple soft and calcified nodular opacities both lung fields

Figure 4: Ct Chest showing thick walled cavity left lung as well as multiple nodular opacities both lung fields in silicotuberculosis.

Acknowledgements: Dr U.C.Ojha, Director Occupational Disease Centre ESIH Basaidarapur

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