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Case report

A case series describing common radiographic and pathologic patterns of hard metal pneumoconiosis

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ABSTRACT

Introduction: Hard metal pneumoconiosis is a rare but serious disease of the lungs associated with inhalational exposure to tungsten or cobalt dust. Little is known about the radiologic and pathologic characteristics of this disease and the efficacy of treating with immunosuppression.
Objective: We describe the largest cohort of patients with hard metal pneumoconiosis in the literature, including radiographic and pathologic patterns as well as treatment options.
Methods: We retrospectively identified patients from the University of Pittsburgh pathology registry between the years of 1985 and 2016. Experts in chest radiology and pulmonary pathology reviewed the cases for radiologic and pathologic patterns.
Results: We identified 23 patients with a pathologic pattern of hard metal pneumoconiosis. The most common radiographic findings were ground glass opacities (93%) and small nodules (64%). Of 20 surgical biopsies, 17 (85%) showed features of giant cell interstitial pneumonia. Most patients received systemic corticosteroids and/or steroid-sparing immunosuppression.
Conclusions: Hard metal pneumoconiosis is characterized predominately by radiographic ground glass opacities and giant cell interstitial pneumonia on histopathology. Systemic corticosteroids and steroid-sparing immunosuppression are common treatment options.

1. Introduction

Hard metal pneumoconiosis is a rare and serious occupational lung disease that occurs after inhalational exposure to the hard metals tungsten carbide and cobalt. The greatest exposures occur in mining processes, cemented tungsten-carbide industry, alloy production, and also the grinding and sharpening of steel tools with these hard metal abrasives. Individuals with more chronic inhalational exposure may develop interstitial lung disease and often present with worsening dyspnea, exercise intolerance, and a non-productive, bronchospastic cough [1,2].

Little is known about the spectrum of radiographic and pathologic characteristics of hard metal pneumoconiosis. Prior literature is limited to case reports and very small case-series. The presence of giant cell interstitial pneumonia on histopathology is described as almost pathognomonic [3]. The most commonly reported radiographic findings include a reticulonodular pattern of opacities with ground glass mosaicism and traction bronchiectasis without radiographic honeycombing.

Furthermore, little is known about the prognosis and the effects of treatment. Previous case studies have suggested improvement with corticosteroids, but there is no clear, evidence-based treatment strategy. Long-term steroid use is not an ideal treatment strategy because of many dose-dependent side effects. To our knowledge, there are no prior

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studies that have examined the use of steroid-sparing immunosuppressive agents.

Here, we report the largest cohort of patients with hard metal pneumoconiosis. We describe the radiographic and histopathologic findings in these cases and describe our center's experience with systemic corticosteroids and steroid-sparing immunosuppression.

2. Methods

2.1. Patients

We retrospectively identified patients with a diagnosis of hard metal pneumoconiosis as described in the pathology registry cared for at the University of Pittsburgh between the years of 1985 and 2016. Patients were identified by searching the pathology database for the terms “giant interstitial pneumonia” or “hard metal pneumoconiosis” located in either the final pathology diagnosis or the pathology diagnosis comment section. Members of the study team (JC and LRT) reviewed the medical records of the patients identified through this search to confirm the diagnosis. This study was approved by the University of Pittsburgh Institutional Review Board with a waiver of informed consent (PRO16070398).

2.2. Data collected

For each case, we collected available basic demographic data including age at diagnosis, gender, and race as well as data on date of diagnosis, profession and occupational history, exposure, type of biopsy, steroid use and duration, and use and type of steroid-sparing immunosuppression. We collected data on comorbidities including chronic lung disease, chronic heart disease, gastroesophageal reflux disease, and cancer. We collected mortality data including time from diagnosis to death. We collected data on reported symptoms including dyspnea, cough with or without sputum production, and wheezing as well as prescriptions for inhaled corticosteroid. We collected pulmonary function test (PFT) data starting at the time of diagnosis and then at yearly follow-up for 2 years. PFT data includes the raw value and percent predicted forced vital capacity (FVC), forced expiratory volume over 1 second (FEV1), total lung capacity (TLC), diffusing capacity for carbon monoxide (DLCO). A study team expert in chest radiology (CRF) reviewed computed tomography (CT) scans for radiologic trends based on definitions in existing literature [4]. All but two CT scans were with sharp algorithm processing consistent with high resolution CT imaging. All scans were of good quality as determined by an expert in chest radiology (CRF). A study team expert in thoracic pathology (SAY) reviewed all biopsies for histologic trends. CT images do not correspond to the exact pathology sampling sites.

3. Results

3.1. Cohort description

We identified 23 patients with a pathologic pattern on lung biopsy described in pathology reports as consistent with hard metal pneumoconiosis. The characteristics of each of these patients are detailed in Tables 1–3. Patients’ median age at the time of diagnosis was 42 years. The vast majority were male (87%) and caucasian (100%). Tungsten carbide comprised 87% of the known exposures. Of the 17 patients with medical records available for review, all patients reported dyspnea, 13 reported cough 4 of which with sputum production, and 3 reported wheezing. The most prevalent comorbidity was gastroesophageal reflux disease, present in 8 patients. Of the 21 patients that have treatment data, 6 (29%) were prescribed inhaled corticosteroid and 18 (85%) received systemic immunosuppression. Sixteen patients (89%) received systemic corticosteroid or steroid-sparing immunosuppression. Fourteen of these sixteen patients (78%) received systemic corticosteroids.

Table 1
Cohort demographics.

	N	Result
Age, median (range)	23	42 (23–73)
Male	23	20 (87%)
White	22	22 (100%)
Related exposure	13	
Carbide/tungsten		11 (85%)
Cobalt		2 (15%)
Prescribed inhaled corticosteroid	21	6 (29%)
Steroid	18	
No		4 (22%)
Less than 6 months		7 (39%)
More than 6 months		7 (39%)
Immunosuppression	18	
No		8 (44%)
Cyclophosphamide		2 (11%)
Azathioprine		6 (33%)
Other		2 (11%)
Asthma	17	0
COPD	17	1 (6%)
Chronic heart disease	17	0
GERD	17	8 (47%)
Cancer	17	0
Death	23	5 (22%)
Age at death, median (range)	5	45 (37–74)
Years from diagnosis, median (range)	5	4.6 (1.0–5.4)

COPD – chronic obstructive pulmonary disease.
GERD – gastroesophageal reflux disease.

Ten of these patients received steroid-sparing immunosuppression, including 6 (38%) who received azathioprine and 2 (13%) who received cyclophosphamide. Mortality was 19% in this cohort and the median time from diagnosis to death was 4.6 years.

3.2. Pulmonary function testing

Of the 19 patients who had pulmonary function testing, 16 had a restrictive pattern, 2 were normal, and 1 was obstructed at the time of diagnosis. For the cohort as a whole, severely restrictive physiology with decreased DLCO was observed at baseline (Table 4). We also show individual patient trajectories for FVC and FEV1 (Fig. 1) over 2 years of follow up.

3.3. Radiology

Of the 23 cases, 14 CT chest studies were available for review. Radiographic honeycombing was present in 6/14 (43%) and traction bronchiectasis was seen in 8/14 (57%) (Fig. 2A). Ground glass opacities was the most frequently observed radiographic finding, present in 13/14 (93%) (Fig. 2B). Small nodules were common, found in 9/14 (64%) (Fig. 2C). Small cysts were uncommon and found in only 3/14 (21%) (Fig. 2D). None of our cohort exhibited perihilar conglomerate fibrosis, which is typical of other pneumoconioses. All images had more than one finding. The most common combination was small nodules and ground glass opacities, present in 50%.

3.4. Pathology

Of the 23 cases described as consistent with hard metal pneumoconiosis in biopsy reports, twenty surgical biopsy specimens were physically available for review. Seventeen biopsies showed features of giant cell interstitial pneumonia. Of the remaining three cases, two were consistent with usual interstitial pneumonia and one case was consistent with hypersensitivity pneumonitis. Injury was typically bronchiolocentric (15/20) with a lymphocytic bronchiolitis and with centrilobular airspace giant cells with leukoerythrophagocytosis (“cellular cannibalism”) in 17/20 cases. We identified prominent lymphoid