

MEDICAL GRAND ROUNDS

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AIR POLLUTION AND INHALATIONAL RESPIRATORY DISEASES

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Case 1. [REDACTED], a 54-year-old [REDACTED], who gave a history of at least 35 years of exposure to multiple organic solvents for mixing with various kinds of paints. He also acknowledges a heavy exposure to spray paint without the use of a mask, and in addition, heavy exposure to very dusty environments on other occasions. For the same period of time he smoked two to three packages of cigarettes per day, inhaling deeply, often in the presence of his contaminated environment. He acknowledged a cigarette cough for many years prior to his first serious episode of respiratory symptoms. This occurred in 1935 when he developed acute bronchitis and pneumonia necessitating hospitalization and producing an illness lasting more than two weeks. From that time until the present, the patient has had variable amounts of cough, periodically productive of mucopurulent expectoration which was occasionally blood-streaked. For the last year he has experienced, for the first time, exertional dyspnea, which he acknowledged was worse when his cigarette consumption was heavier. He gave a history of intolerance to cold weather which necessitated his giving up very lucrative job in Canada. The cold weather increased his shortness of breath, his coughing and sputum production. Six months prior to his admission he had reduced his cigarettes to several cigarettes per day and this had been accompanied by a marked diminution in his cough and sputum production with a significant improvement in his shortness of breath. He also gave a history of having had nocturia and hematuria on several occasions following unusually heavy exposure to paint solvents. He was told that he had high blood pressure on one of those occasions, but his blood pressure has since always been normal.

Physical examination revealed a well-developed, well-nourished, plethoric middle-aged man with normal vital signs who exhibited many spider angiomas over his face, trunk and arms. He was noted also to have palmar erythema. At this time, the examination of the chest revealed only a slight increase in A.P. diameter with fixation of the thoracic cage predominantly in an inspiratory position and the lungs were essentially clear except for crackling rales heard in several scattered areas on deep breathing. Fluoroscopic examination of the chest revealed diminished diaphragmatic and chest cage excursion. The motion of the diaphragm with cough was impaired. The density change of the lungs on deep breathing was poor bilaterally although there was no evidence of unilateral obstruction. There is prominence of the pulmonary outflow tract but no definite evidence of right heart enlargement.

The ventilatory function studies revealed a forced expiratory volume, 0.5 seconds, of 750 ml. or 27 per cent of the F.V.C. The F.E.V., 0.1 second was 1170 ml. or 38 per cent of the F.V.C. The F.V.C. was 2880 ml. or 63 per cent of predicted. The patient was found to be polycythemic, dusky in appearance, his hemoglobin was 18 gm., hematocrit 55 per cent and oxygen saturation on room air breathing was 90 per cent. The alveolar to arterial oxygen tension gradient was 23 mm. of mercury and the arterial PCO₂ was 46 mm. Hg. Studies on 100 per cent oxygen breathing revealed a more than 10 per cent shunt.

Complete abstinence from smoking and intensive aerosol therapy were advised with an admonition to the patient to avoid all forms of atmospheric exposure that would cause further respiratory tract irritation. Marked improvement in his symptoms was observed as well as marked improvement in his ventilatory function. When last seen the patient was virtually asymptomatic.

Case 2. [REDACTED], 19-year-old [REDACTED] [REDACTED] [REDACTED]. This girl was first seen by her referring physician at age 13 because of an itching eruption of her skin, felt to be due to a milk allergy. This responded promptly to symptomatic measures. She was noted, at that time, to have a slight systolic murmur which was not felt to be of significance. This was not heard on

a subsequent examination one year later. At age 15 she complained of exertional dizziness and blurring of vision. At that time she weighed 157 pounds and had a blood pressure 170/100, on exercise, which dropped immediately to 130/90 with rest. An electrocardiogram, at that time, was said to be normal. On a dietary regimen with Obedrin tablets, some weight reduction was accomplished. In [REDACTED] of 1958 at age 16, she experienced a brief uncomplicated respiratory infection. A year later she was seen in a follow-up examination. At this time, she was thought to have thyroid enlargement. A series of PBI studies were done over the period of the next several months and values progressively decreased from a high of 17.1 MCG per cent to 4.3 MCG per cent in a progressive manner under the impact of propylthiouracil therapy. The girl's mother gave a history of having had thyroid surgery for recurrent thyroid hyperplasia. In [REDACTED] 1960 the patient first experienced hemoptysis in association with a moderate cough and slight sputum production which had been grossly minimized by the patient. Two sputum cultures revealed a heavy growth of *Candida albicans*. For this, she was given intravenous Fungizone therapy, which resulted in clearing of the sputum. The patient was referred to a consultant in San Angelo, Texas, at that time and an opinion of cyanotic heart disease with pulmonary complications was considered after a detailed evaluation including bronchoscopies, pulmonary angiogram, cardiac catheterization. The pulmonary artery pressure was found to be 111/72 with a mean pressure of 100 mm. Hg. The right ventricular pressure was 111/3 with an end-diastolic pressure of 14 mm. Hg. Right atrial pressure was 9.5 mm. Hg. and pulmonary wedge pressure varied between 4 and 8 mm. Hg., depending on the phase of respiration. The opinion rendered as a result of these studies was hyperplastic pulmonary vascular disease, etiology undetermined, with primary pulmonary hypertension. Because the patient's dyspnea became progressive and the incidence of hemoptysis was recurrent, the patient was referred to this hospital for further study and possible treatment.

On admission here, a re-evaluation of the history was made and it was learned that this girl had lived all of her life on a farm. As a child, she made a habit of playing in silage ditches unaware of the possible danger involved. It is acknowledged that she had frequent respiratory reactions thought to be colds but it was felt that she had no more than most children. However, there are no siblings to make comparisons more clear-cut. Her studies in this hospital are as follows: All of her sputum examinations were negative for acidfast routine pathogens and fungi. Her L.E. preps were negative and her electrophoretic pattern revealed 67% albumin, 3% alpha 1, 7% alpha 2, 12% beta globulin and 11% gamma globulin. All of her electrocardiograms revealed a first degree A.V. block with prominent P waves in lead 2, 3 and A.V.F., with definite pattern of right ventricular preponderance. The following tests were negative, both on the patient's blood and on the mother's blood. The latex fixation, L. E. preps, S.S.C.A., anti-nuclear and thyroid A.B. In addition, the patient's Kline and cryoglobulin tests were negative. Bleeding and clotting times were normal; complete chemistries including BUN, creatinine, fasting blood sugar, chlorides, sodium, potassium, total protein, albumin and globulin, phosphorus, CO₂ content, total cholesterol, serum bilirubin, cephalin flocculation, and thymol turbidity tests were all well within normal limits. Alkaline phosphatase was 7.4 Bodansky units prothrombin time was 100%. Her hemoglobins averaged 13 gm. and her sed rates 25 to 30, although it should be noted she was menstruating at the time. White blood counts were all less than 10,000. Urinalysis was entirely normal with specific gravity of 1.018 and a pH of 6.5. The chest x-rays revealed evidence of increased reticular markings with evidence of generalized increase in radiolucency suggestive of emphysema. There was also evidence of early radiologic manifestations of pulmonary hypertension; otherwise the x-rays were not remarkable.

Physiological studies are listed below.

	Room air <u>I</u>	100%-O ₂ <u>II</u>	<u>Brachial Vein</u>		<u>Predicted</u>
			Room T ^o <u>III</u>	Ice <u>IV</u>	
O ₂ % saturation	76	90	73	56	more than 96%
pCO ₂ mm. Hg.	25	26	27	29	40 mm.
pH at 37.5 ^o	7.50	7.47	7.46	7.46	7.35-7.46
Alveolar pO ₂ mm.Hg.	120	667			More than 90 mm.
Aeration gradient (Amb.pO ₂ -Alv.pO ₂)	-	-			Less than 65 mm.
Transfer gradient (Alv. PO ₂ -Art.pO ₂)	83	596			Less than 15 mm. on room air
Hemoglobin gm%	12.9				
Hematocrit%	38.4	38.5			
Ventilation L/min.	11.5				
Tidal Volume, cc.	819				

			<u>Predicted</u>
Forced vital capacity	3.85 L		
Forced expiratory volume 0.5 est.	2.50 L	60% FVC	2.5 L
Total lung capacity	5.80 L		4.80 L
Residual volume	1.95 L		1.16 L
RV x 100/TLC	33%		20%
Single breath N ₂ mixing index	0.95%		1%
Diffusing capacity	21.7 ml. (min x mmHg.)	(41.5%)	52.4
Pulmonary capillary volume	107.2 ml.	(157%)	68

Case 3. [REDACTED], a 46-year-old [REDACTED], admitted with a history of exertional dyspnea since 1953. Except for a bout of pneumonia in 1945 there is no other history of significant respiratory difficulty. From 1943 until 1949 he worked in the hold of a number of ships while a great deal of welding was taking place in the same area. He was not protected by any mask. From 1950 until 1953 he worked as a construction worker on a dam project and was continually exposed to an atmosphere laden with limestone dust as a result of a rock crushing procedure. He was provided with a mask but rarely wore it. In addition, the patient smoked one and a half packages of cigarettes per day and often smoked in the polluted environments. Later in 1953, after having changed his location of work and at a time when the patient was not in a polluted atmosphere, he first began to note exertional dyspnea. This has been mildly but relentlessly progressive until the present time. In [REDACTED] of 1960 he was said to have had the flu and when a chest x-ray was taken at the time of that illness, he was discovered to have extensive fibrosis of the lungs. ACTH therapy was begun at that time, but not because of the pulmonary symptoms. Over the preceding year the patient had developed migratory polyarthritis that had also been progressive in nature and was characterized by considerable joint discomfort and weakness as well as easy fatigability. Whereas the ACTH did alleviate his arthritic symptoms, it had little or no effect on his pulmonary symptoms. For a month or two prior to admission, the patient began to experience post-prandial epigastric distress relieved by milk or alkali. A G.I. series performed prior to admission was normal.

Physical examination: The vital signs are normal. His height is 69 inches. He is a thin, slightly plethoric, dusky man, not otherwise appearing ill. He reveals moderate clubbing and moderate changes of rheumatoid arthritis in multiple joints of both extremities. The chest was symmetrical; there was no deformity. There was good excursion of the rib cage. Respiration was quiet with no evidence of accessory muscle activity. Percussion and auscultation were essentially normal except for slight increase in breath sounds and a few fine end-expiratory crackling rales on forced breathing. The remainder of the physical examination, including the heart, was not revealing. All tuberculin and chromagen skin tests were negative. Histo and coccidio skin test were both moderately positive. BUN 20, CO₂ 31, Chlorides 106, total protein 6.4, albumin 4.1. Other serum chemistries: L.E. preparation, stool examinations, urine examination, and serology, as well as complement fixation tests for fungi, were all negative. Hemoglobin was 15.2 gm., hematocrit 48 per cent, white blood count 14,000 with 52 per cent neutrophils. Ventilatory function studies revealed a normal vital capacity with a mild central type obstructive ventilatory defect. All routine sputum cultures and cultures for AFB were negative. The electrocardiogram revealed non-specific T wave changes with an otherwise normal tracing. Chest x-rays revealed extensive pulmonary fibrosis with bilaterally equal overdistention.

The only treatment this patient has had has been ACTH therapy. He returns again for complete pulmonary function and immunological investigation as a diagnostic problem which is most likely some form of pneumoconiosis with extensive pulmonary fibrosis. Since he also has rheumatoid arthritis, this may well represent an example of Caplan's syndrome or pneumoconiosis with rheumatoid disease.

NOTABLE QUOTES

"And what is all this, but the Hellish and Dismall Cloud of Sea Coole? which is not only perpetually imminent overhead---but so universally mixed with her otherwise wholesome and excellent Aer, that her inhabitants breathe nothing but an impure and thick mist, accompanied by a fuliginous and filthy vapor---corrupting the Lungs and disordering the entire habit of their bodies; so that Catarrhs, Phthisicks, Coughs and Consumptions rage more in this one City than in the whole Earth besides."

- John Evelyn (about London) 1661

"---why do we not at this moment of history rid ourselves of the problem of air pollution which, in many urban areas, is no less a problem of filth than the old-fashioned open sewers? ---the era in which we live may come to be known as the Era of Sanitary Reawakening."

- R. Prindle 1960

"If there is enough money to develop seven thousand new products each year there is money enough in the richest nation in the world to control their by-product wastes. If there is money enough for motivational research to find out why people buy a product, there is money enough to make sure they are not injured by its existence."

- Porterfield 1959

"It is the tragedy of today that man is so indifferent to the life of man. Yes, we surround the babe unborn with premonitory protection, deal wisely and gently with infancy and childhood, and then hurl the product of a reasonably healthy youth into a maelstrom of blind changes of dust, fumes and fatigue which wear down the stoutest body and cripple the most willing worker."

- Emerson

"The approximate amounts of benzpyrene inhaled by town dwellers can now be estimated. If a person smokes 40 cigarettes a day for a year the smoke will contain about 150 mg. benzpyrene and in a large town the air inspired during the same time might contain 200 mg."

- British Empire Cancer Campaign Report 1959

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