Massive melanoptysis: a serious unrecognized complication of coal worker's pneumoconiosis

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ABSTRACT: Black sputum is produced when cavitation of progressive massive fibrosis occurs due to mycobacterial and anaerobic bacterial infections (67%) or ischaemic necrosis. The blackish or greyish sputum suggests cavitation of conglomerated masses; the acinar shadows in gravity dependent areas together with cavitary pneumoconiosis, make us suspect an insufficiency of bronchial clearing. Bronchoscopy confirms the diagnosis by showing the airway blocked by dark material. During melanoptysis the patient suffers respiratory failure which can be fatal. Close vigilance of the arterial blood gases is essential. Measures must be taken to maintain clear airways. Melanoptysis should be listed with the other complications of coal worker's pneumoconiosis.

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Patients and methods

Patients were considered to have progressive massive fibrosis of coal miner's pneumoconiosis if the following criteria were present: abnormal shadows exceeding one centimetre in width, diffuse micronodular infiltration, and a history of exposure to industrial dust. Radiological explorations were carried out according to ILO (International Classification of Radiographs of Pneumoconiosis, 1971 [2]). A Combianalysor (Eschweiler, Kiel, West Germany) was used to analyse the blood gases in the brachial artery: the arterial oxygen tension ($PaO_2$) was measured using a polarographic electrode (Clark's type) and the arterial carbon dioxide tension ($PaCO_2$), according to the Severinghaus principle.

Bronchoscopy examination was carried out using an Olympus BSF-51 fibreoptic bronchoscope in accordance with established methods [3].

Clinical features

Black sputum, typical of coal miners, is present in two significantly different conditions. In the case of

miners without progressive massive pneumoconiosis it indicates the expulsion of inhaled dust with the sputum, and the amount of dust is small. It can appear several years after the individual has stopped working in the mines.

Patients with large amounts of black expectoration practically always have cavitating pneumoconiosis. This type has a pathological repercussion and is the one to which we shall make reference.

The main clinical feature is dark grey sputum in variable quantities, sometimes copious. Dyspnoea, coughing, high fever, thoracic pain and generally poor clinical status complete the medical picture.

Case one

A 63 year old coal miner with complicated pneumoconiosis (category C) was admitted to hospital suffering from malaise and increased coughing, with blackish expectoration, for the previous two weeks. His arterial blood gases, breathing room air, were: $PaO_2$ 9.6 kPa, $PaCO_2$ 4.3 kPa, pH 7.38. The thorax X-ray confirmed the cavitation of progressive massive fibrosis. The bronchoscopy examination showed blackish secretions which flooded the bronchial branches. The bacteriological examination of sputum, bronchial secretions obtained by bronchoscopy, and blood cultures were negative for fungi, mycobacteria and bacteria. The patient continued expectorating blackish sputum with an increase of dyspnoea and became very sick despite postural drainage and use of bronchodilators.

Arterial blood gases on 40% oxygen were: pH 7.27; $PaO_2$ 6.1 kPa; $PaCO_2$ 7.7 kPa. The patient was intubated and mechanically ventilated. Four days later he was
stable enough to be discharged without symptoms and arterial blood gas determination showed: pH 7.44; Pao$_2$ 10.5 kPa; Paco$_2$ 5.4 kPa.

Case two

The patient, a 61 year old coal miner, was diagnosed as having complicated pneumoconiosis, and chronic obstructive pulmonary disease with a forced expiratory volume in one second (FEV$_1$) of 1.70 l (normal value 3.15 l). He was admitted to hospital because of his daily expectoration of 100 cm$^3$ of blackish sputum, dyspnoea and high temperature. Comparing X-rays on admission with those of two months earlier, an acinar pattern in the middle left field and a decrease of the level in the upper left lobe masses "hour glass sign" could be seen (figs 1 and 2) [4].

Arterial blood gases on 40% oxygen showed pH 7.32; Pao$_2$ 5.9 kPa; Paco$_2$ 2.8 kPa. Bronchoscopy was impossible to carry out due to severe respiratory failure. Sputum and blood cultures for bacteria, fungi and mycobacteria were negative. During his stay in hospital the blackish expectoration persisted and his arterial blood gas analysis levels deteriorated, making mechanical ventilation necessary.

Subsequent evolution was good. The patient was discharged two months later.

Case three

A 51 year old coal miner, with progressive massive fibrosis (category C) was hospitalized because of coughing abundant blackish expectoration and increased dyspnoea. His previous FEV$_1$ was 2.60 l (normal value 2.50 l). The chest X-ray taken on admittance showed large masses of progressive massive fibrosis with an air-water level in the left mass. During bronchoscopy, one could see reddening of the bronchial mucosa with anthracotic plaques, and 200 cm$^3$ of blackish liquid was aspirated from the bronchial tree; six bacilloscopies, three cultures for mycobacteria in sputum and the analysis of transtracheal puncture were negative. Arterial blood gas determination whilst breathing room air, showed: pH 7.18; Pao$_2$ 4.6 kPa; Paco$_2$ 9.3 kPa. The patient recovered on treatment with oxygen, bronchodilators and drainage.

Case four

A 54 year old coal miner, with progressive massive fibrosis (category C), was hospitalized suffering from a dark expectoration and the "hour glass sign" on X-ray due to emptying of the mass into the right upper lobe. Bacteriological studies were negative. Blood gas analysis levels were: pH 7.30; Pao$_2$ 4.9 kPa; Paco$_2$ 7.7 kPa. His general state of health improved with postural drainage, use of bronchodilators and oxygen treatment and he was discharged in a stable condition with no trace of blackish expectoration.

Case five

A 62 year old coal miner was first hospitalized on November 8, 1979 expectorating dark grey sputum, and with dyspnoea and cavitation of the right mass. *Streptococcus pneumoniae* grew on transtracheal aspiration. The patient was treated with Penicillin G Sodium (4 MU/day), bronchodilators and postural drainage. The clinical situation improved and he was discharged. His FEV$_1$ was 1.45 l (normal value 3.20 l). Arterial blood gas determination whilst breathing room air showed: pH 7.41; Pao$_2$ 6.7 kPa; Paco$_2$ 3.9 kPa. The same patient was again hospitalized on March 14, 1980 suffering from coughing with whitish expectoration. The radiographs and tomographs of the thorax did not show any change, nor was any cavitation observed. On the seventh day after admission he showed abundant melanophysis, a high temperature and increased fatigue. On renewed radiography a suspicious cavitation of the right mass was observed with a consolidation pattern immediately below it. Deterioration of the arterial blood gases (pH 7.26; Pao$_2$ 4.7 kPa; Paco$_2$ 7.7 kPa) and clinical condition were rapid, resulting in the death of
the patient despite transfer to the intensive care unit.

The autopsy showed cavitation of the right mass. The trachea and bronchial branches were completely filled with dark material. The bacteriological studies of autopsy material were sterile.

Discussion

In the English medical literature, black sputum is referred to as melanoptysis. The aetiological aspect of this syndrome is the same as that which causes cavitary pneumoconiosis. During 1983, 42 cases of pneumoconiosis cavities were observed in our hospital [5]. Twenty four cases were diagnosed as secondary to Mycobacterium tuberculosis (57%) and four cases were due to anaerobic bacterial infection (10%). This new clinical aspect has previously been described by us [6]. In twelve cases, no aetiology was found. Ischaemic necrosis or collagen disease were possible causes [7].

Melanoptysis is the main finding of the clinical picture and signifies cavitating pneumoconiosis. The quantity of expectorated gives an idea of severity but although copious sputum is dangerous, a decrease in volume may sometimes indicate retention in the airway and a more serious prognosis.

Chest radiography (and on occasions tomography) will show the cavitation, but one has to look for the consolidation shadows in the gravity dependent areas ("hour glass sign"), as this indicates insufficient clearing of the secretions. In addition to being a diagnostic criteria for this syndrome, it is a warning of medical complications in the near future [4]. The dyspnoea, pleuritic pain, high temperature and crepitations are less useful in diagnosis as they may depend on the aetiological agent or accompanying illnesses. Bronchoscopy examination is the most positive method of diagnosis. Visualization of the airways blocked with the black material, will undoubtedly disclose its origins. Bronchoscopy is also useful for removing secretions, thus solving the medical problem; but it is occasionally impossible to perform due to extreme respiratory failure.

The major indicator of the severity of this aspiration is the measurement of arterial blood gases. Such measurement is essential as it clearly indicates the variable evolution of the melanoptysis, which in turn depends on various factors, lung function, aetiological agent, mechanical efficiency of bronchial clearance and in particular the amount of expectorated, which depends on the category of the massive fibrosis. In category A small masses, softening causes only a small amount of melanoptysis and, moreover, is known for its minimal or small variations of the functional respiratory parameters. The opposite occurs in category B and C masses, with which there is a greater risk of respiratory failure and death.

It is of primary importance that measures are taken to maintain clear airways using methods varying from simple postural drainage to endotracheal intubation.

The seriousness of this syndrome does not explicitly appear in the consulted monographs of pneumoconiosis [8-11]. In our experience, melanophasis constitutes a danger to the patient’s life and should be listed as another complication of coal worker’s pneumoconiosis.

References


RÉSUMÉ: Le crachat noir apparaît lorsqu’une excavation de la fibrose progressive massive survient à la suite soit d’infections mycobacteriennes et anaérobiques (67%), soit d’une nécrose ischémique. La couleur noire ou grisâtre du crachat suggère une excavation dans les masses agglomérées; les ombres acineuses dans les aires dépendantes de la gravité en même temps que la pneumoconiose cavitaire, sugèrent une insuffisance de la clairance bronchique. La bronchoscopy confirme la diagnostique en montrant que la voie aérienne est bloquée par une matière noirâtre. Au cours de la melanophyse, le patient est la victime d’une insuffisance respiratoire qui peut être mortelle. Une surveillance attentive des gaz sanguins artériel est essentielle. Des mesures pour libérer la voie aérienne sont impératives. La melanophyse doit figurer parmi les autres complications de la pneumoconiose du travailleur du charbon.