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Metastatic pulmonary calcification – a case report and review of the literature

Przerzutowe zwapnienia płucne – opis przypadku i przegląd piśmiennictwa

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Abstract

We present a case report of a 66-year-old woman with multiple lung nodules up to 1 cm in diameter observed for 2 years. The patient was dialyzed for many years due to end-stage renal failure. No signs of respiratory distress and normal levels of calcium serum were observed. Several individual lung nodules were resected through minithoracotomy and metastatic pulmonary calcification (MPC) was diagnosed. We describe the clinical, morphological and physiological characteristics of MPC and its diagnosis with reference to the present case.

Key words: renal failure, lung tumor, metastatic pulmonary calcification.

Streszczenie

Przedstawiono przypadek 66-letniej chorej z guzkami płuc o średnicy do 1 cm obserwowanymi od 2 lat. Chora była dializowana od wielu lat z powodu przewlekłej niewydolności nerek, jednakże bez cech niewydolności oddechowej, z prawidłowymi stężeniami wapnia w surowicy. Drogą otwartej biopsji płuca pobrano kilka pojedynczych guzków, a wynik histopatologiczny oceniono jako przerzutowe zwapnienia płucne (*metastatic pulmonary calcification* – MPC). Na podstawie przeglądu piśmiennictwa opisano kliniczne, morfologiczne i patofizjologiczne cechy MPC wraz z ich diagnostyką, z odniesieniem do prezentowanego przypadku.

Słowa kluczowe: niewydolność nerek, guz płuca, zwapnienia przerzutowe.

Pulmonary calcification foci are the result of the dystrophic and/or metastatic process in the injured and/or healthy tissue, if a calcium metabolism disorder occurs. The dystrophic type of calcification focus is present in the inflammatory tissue coexisting with tuberculosis, sarcoidosis, amyloidosis, rheumatic diseases, some forms of pulmonary hemosiderosis, neoplastic metastases, i.e. osteo- and chondrosarcoma, adenocarcinoma and benign neoplasm, i.e. hamartoma [1-4]. Metastatic etiology of calcification foci in the lung tissue is a rarity in thoracic surgery. The available medical literature describes casuistic cases or short series only [1-4].

Case report

A 66-year-old woman was admitted to our institution due to multiple pulmonary nodules observed in a two-year period (Fig. 1, 2). Chronic renal insufficiency was diagnosed and treated for 15 years. The patient underwent kidney transplantation in 1999, but the graft was explanted 7 years later and she had been dialyzed ever since. The several times repeated abdominal sonography, chest and abdomen computed tomography (CT), bronchofibroscopy, spirometry and gastrointestinal endoscopy did not reveal the disease etiology. Lung as well as bone scintigraphy and PET-CT were not performed. Due to the small size and localization of the lung nodules, fine needle aspiration biopsy was decided against and surgical biopsy planned [5]. Using right minithoracotomy, multiple hard subpleural and intrapulmonary nodules up to 1 cm in diameter were visualized and assessed with resection of part of segment VI. The postoperative course was uneventful and the histological diagnosis – metastatic pulmonary calcification (MPC) – was established.

Discussion

Metastatic pulmonary calcification (MPC) is calcium deposition in previously healthy pulmonary tissue due to

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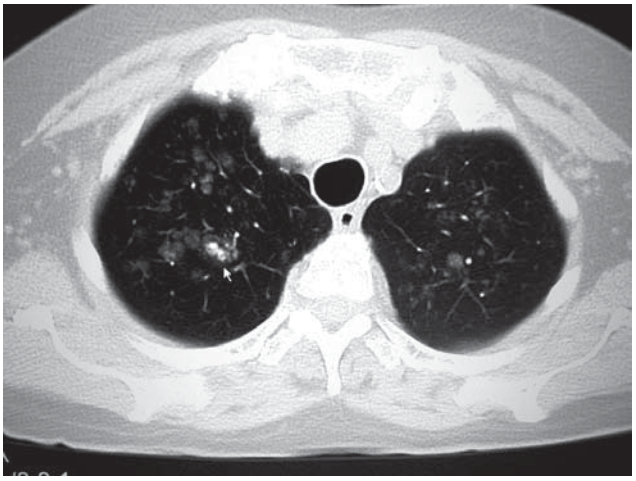

Fig. 1. Numerous nodules in the upper lung areas. Several of them are calcified (arrow)

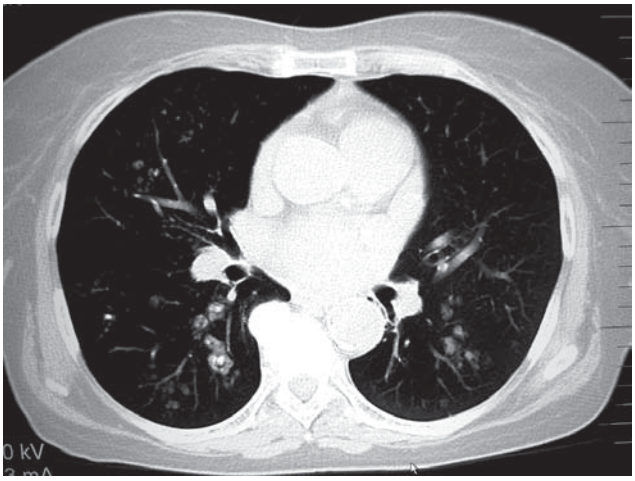

Fig. 2. Numerous nodules in the middle lung areas with different intensity

metabolic and electrolytic disorder in the course of chronic renal insufficiency treated by long-lasting dialysis [2-4, 6]. The deposition foci in the form of tumors of size 2-12 mm can be localized or bilaterally disseminated, accompanied by infiltration areas, mimicking pneumonitis with fibroproliferation and lymphadenopathy. Calcification may be present in the wall of alveoli, trachea, bronchial tree, arterioles and pulmonary capillaries, causing intraluminal embolism and thrombus (Fig. 3). Other organs such as the kidney, stomach and thoracic wall, heart and even muscles or subcutaneous tissue can be involved in this pathology. The calcification pattern can be patchy and heterogenic as well, mostly concentrated in the central part of the nodule. Ground glass opacity (GGO) is often the concomitant radiologic sign and it is usually less intense than post-inflammatory or tuberculotic depositions in the lung parenchyma and parietal pleura [4, 6-13]. Metastatic pulmonary calcification is particularly capable of localizing in the pulmonary upper fields and it is due to lung circulation specificity and increased pH value in comparison to the lower pulmonary areas. There are four cardinal causes of MPC development. First, there is bone calcium leaching in the course of chronic acidosis. Then there is hyperparathyroidism and low glomerular filtration rate (GFR) with elevation of calcium and phosphorus blood serum concentration. Lastly, tissue alkalosis enables development of MPC, and that is why the upper parts of the lungs are involved. Metastatic pulmonary calcification may also be triggered by vitamin D hypervitaminosis, orthotopic liver transplantation, immunosuppression, milk alkali syndrome, some neoplastic syndromes and ARDS (adult respiratory distress syndrome) [2, 4, 6, 14, 15]. Metastatic pulmonary calcification is often undiagnosed due to low sensitivity of classic radiography and benign, symptomless course at the beginning, though it is present in 60-70% of autopsies of dialysis-dependent patients. Metastatic pulmonary calcification usually occurs after several years of dialysis, though sometimes it occurs after just a few months of this therapy [2, 6, 12, 16]. The clinical progress of the disease is unpredictable. The course of MPC can be stable for many years or can develop rapidly, causing death [9, 12, 13, 17]. Occasionally, the disease causes lung restriction, vital capacity decrease, hypoxemia and lung tissue necrosis with cavern formation [12]. Sometimes the process can be reversible, especially by causative treatment of neoplastic syndromes [2, 6, 14]. Computed tomography using the mediastinal window and Technetium 99mTc scintigraphy are the key evaluation tools for MPC in contrast to chest X-ray due to their lower sensitivity (Fig. 4) [3, 6, 11, 14, 15, 18]. Magnetic resonance (MRI) was also described as useful for MPC diagnosis [19, 20]. MRI and scintigraphy are similarly useful for this purpose as thoracic splenosis diagnostics, though isotope examination is used differently [21-23]. According to this rule diagnosis of MPC was established only by computed tomography or by CT accompanied by 99mTc scintigraphy [2, 3, 6, 14]. The histological diagnosis can be obtained by transthoracic fine-needle aspiration biopsy and/or transbronchial biopsy.

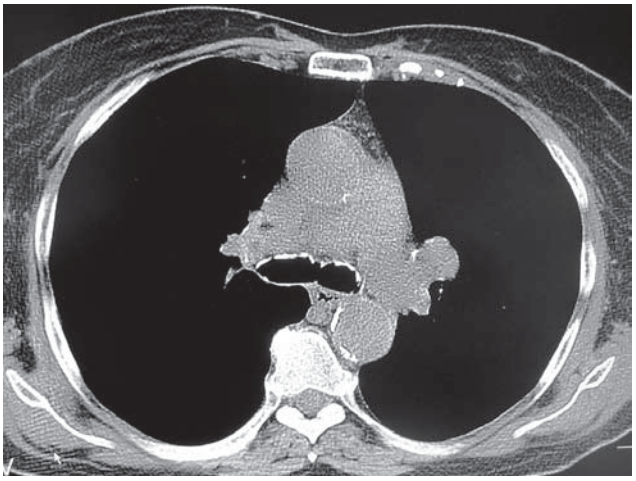

Fig. 3. Intensive calcium concentration in the main left and right bronchus wall (mediastinal window of the chest CT)

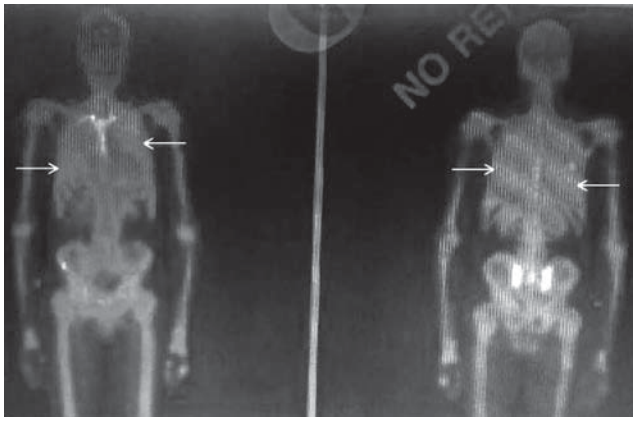

Fig. 4. Technetium 99mTc-scintigraphy of the MPC case presented by Rastogi *et al.* [18]. High level of calcium concentration in lung areas marked by arrows

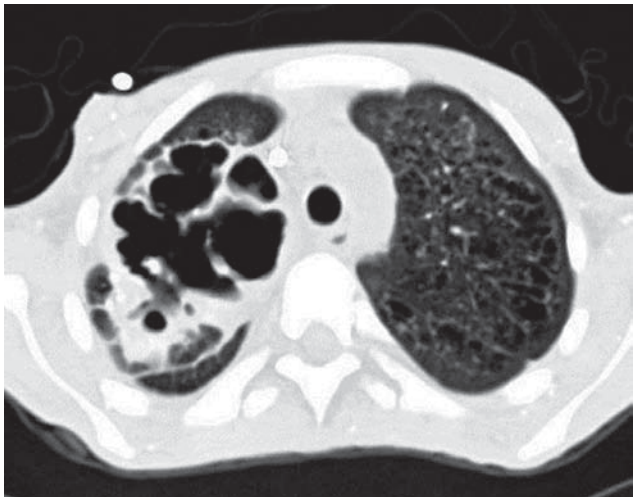

Fig. 5. Bilateral intensive MPC lesions in the chest-CT scan presented by Alkan *et al.* [9]

In some cases video-assisted thoracoscopy and open lung biopsy was applied [1-3, 6-8, 13-16, 18, 24, 25]. It depends on the character, shape and localization of lesions. The presented patient had all the radiologic and clinical criteria of MPC, but oncologic etiology was also considered due to the solid and semi-solid character of GGO lesions. Some of them can be slow growing forms of adenocarcinoma, which are difficult to interpret on PET-CT if their size is smaller than 10 mm, as in the present case. They looked different from the radiologically advanced forms of MPC (Fig. 5, 6) [24]. Fibrosis, rheumatologic coins, tuberculosis and sarcoidosis were also considered in the differential diagnosis, with the plan of histological confirmation. Small size of nodules and anatomic long distance were contraindications for biopsy technique. Open lung biopsy was performed to control the lung tissue directly and to rule out the oncologic origin of the disease. Intraoperatively the nodules resembled rheumatologic rather than isolated calcium deposits probably due to coexisting fibroproliferation [2, 14, 25]. Therefore MPC looks different from the other calcium deposits seen during common thoracic procedures. The patient showed no symptoms of pulmonary insufficiency. The lung function test and heart ultrasonography were within the normal range as well as the serum calcium concentration, similarly to the other cases [2]. These facts underline the complexity of MPC. Lung scintigraphy could make the diagnosis of MPC easier and could replace surgical biopsy, but it could not rule out the coexistence of other benign or malignant tumors. In summary, the differential diagnosis of lung tumors in patients with chronic kidney insufficiency should consider MPC followed by implementation of precise diagnostic means which allow us to avoid unnecessary surgical intervention due to the typical course.

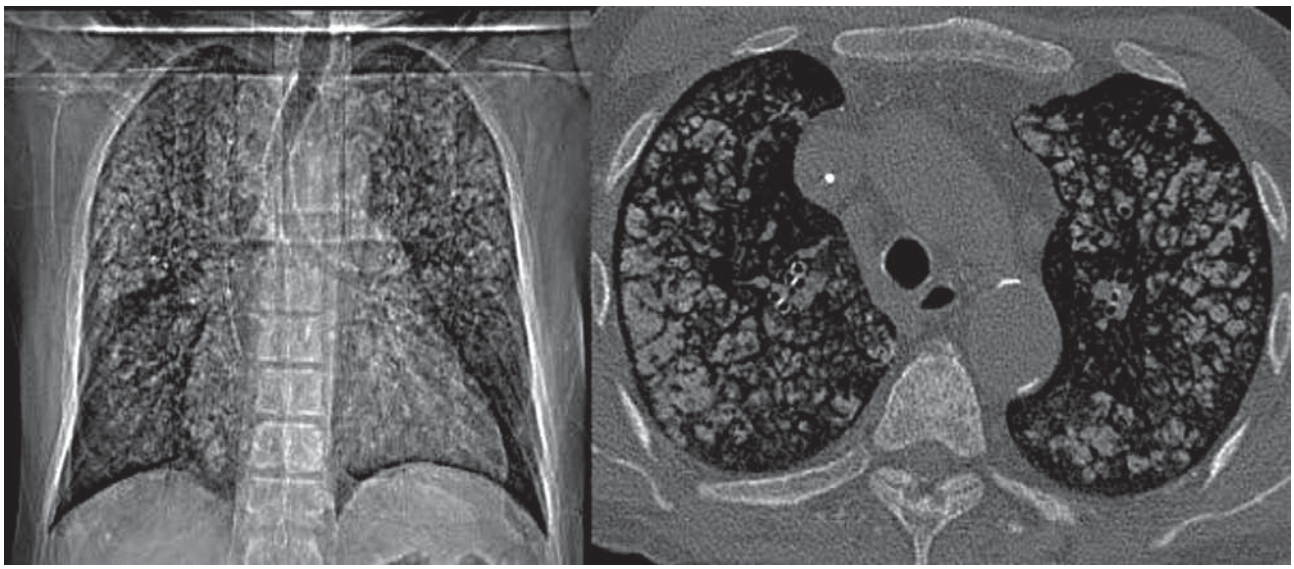

Fig. 6. Lung destruction due to MPC in the chest-CT scan presented by Beyzaei *et al.* [12]

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