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The role of computed tomography in the diagnosis of lung cancer - a case report

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Abstract:

Introduction: Lung cancer has been the main oncological problem in the world for years. It is extremely important to use appropriate diagnostic methods that enable its detection and implementation of appropriate treatment.

Aim: The presented case shows the advantage of computed tomography over chest X-ray (X-ray) in visualizing neoplastic changes in the lungs.

Case Study: The paper presents a description of a patient diagnosed with centrally located advanced lung adenocarcinoma with a strong expression of PD-L1 qualified for treatment with pembrolizumab.

Results and Discussion: Presented case confirms that X-ray is less sensitive, especially in the case of centrally located tumors. Therefore, the emergence of a new cough in a smoker or ex-smoker should raise concerns related to lung cancer despite a normal X-ray image. The central

location of the tumor may cause dramatic course of the symptoms. In the presented case, a sudden significant deterioration of the condition was observed due to atelectasis of the entire lung. Haemoptysis observed during hospitalization was another symptom of centraly located tumor mass.

Conclusions: In conclusion, the history of cigarette smoking, presence of typical symptoms should provide an in-depth diagnosis of lung cancer, despite normal X-ray. Diagnostic procedures include computed tomography in the first place. The course of centrally localized disease may change rapidly during on first cycle of treatment. Due to the possibility of serious complications of the ongoing neoplastic disease, the patient should be under constant medical supervision.

Key words: computed tomography, diagnosis of lung cancer, a case report

1. Introduction

Lung cancer is the main oncological problem in the world. The use of effective diagnostic methods, enabling the subsequent implementation of appropriate therapy, largely contributes to the improvement of the prognosis of patients with lung cancer [1].

Accurate staging, expressed as TNM (T-tumor, N-Nodes, M-metastasis) grade, is important for the proper management of patients with non-small cell lung cancer (NSCLC). The optimal imaging technique to determine the stage of lung cancer requires a thorough characterisation of the primary tumor (T) and a careful assessment of the presence of lymph node metastases (N) and distant metastases (M) [2].

Unfortunately, NSCLC is still diagnosed in late stage of the disease.[3]. Current diagnostic methods include: chest x-ray (X-ray), computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET). Histopathological diagnosis is compulsory and can be obtained by sputum analysis, bornochoschopy or transthoracic lung biopsy. Despite the technological progress and ongoing research on neoplastic diseases, the diagnosis of lung cancer in as many as 57% of patients is made when the tumor has already metastasized to distant organs. This may be primarily due to the lack of symptoms in the early stage of lung cancer and their non-specificity. The most common symptoms include: persistent cough, dyspnoea, chest pain, wheezing and hemoptysis [4].

2. Aim

The main aim of the publication is to present the advantages of computed tomography over chest X-ray (X-ray) in visualizing neoplastic changes in the lungs.

3. Case report

In May 2021, a 71-year-old cigarette smoker presented with chronic dry cough and general weakness. Medical history of comorbidities included persistent atrial fibrillation. An X-ray

examination revealed no pathological changes. I [Fig. 1]. Despite the correct X-ray image, due to the history of cigarette smoking, diagnostic vigilance was maintained and computed tomography was performed. CT examination revealed the presence of a pathological tissue mass of approx. 45x29 mm in the tracheal bifurcation. Moreover, enlarged lymph nodes were visualized: right pre-tracheal, at the level of the aorto-pulmonary window (approx. 28-20 mm), in the aorto-pulmonary window (approx. 19 x 11 mm), in the right hilum, at the level of the pulmonary trunk division (approx. 14x24 mm). The visible nodules in both adrenal glands aroused anxiety, undergoing heterogeneous strengthening: approx. 25 x 40 mm on the right and approx. 15-30 mm on the left, which may suggest metastatic changes [Fig. 2]. For further diagnostics, bronchoscopy was performed [Fig. 3, 4], during which material was collected for histopathological examination. As a result, lung adenocarcinoma with PD-L1 (programmed death-ligand 1) expression in 98% of neoplastic cells was diagnosed. Molecular tests to evaluate mutations in the EGRF gene, ROS1 rearrangement and ALK protein expression were negative. On the basis of the performed tests, the stage of the disease was determined as T1bN3M1b. The level of functioning was grade 1 according to the ECOG (ECOG Performance Status developed by the Eastern Cooperative Oncology Group) scale (presence of disease symptoms, possibility of walking and light work). The laboratory test results were acceptable. In order to qualify for treatment, a CT scan was repeated showing the progression of neoplastic lesions in the bifurcation of the trachea, and the additionally shaded density of adrenal lesions confirmed the previously suggested metastatic nature of the lesion.

The patient was qualified for treatment with pembrolizumab. On the day following the first infusion of pembrolizumab, her health deteriorated. The patient complained of severe chest pain. An ECG was performed with no evidence of fresh myocardial ischemia and myocardial damage enzymes were not elevated. Chest X-ray revealed shading of the entire right pulmonary field with a partial displacement of the mediastinal shadow in this direction - atelectasis, suggesting closure of the main bronchus, with fluid in the right pleural cavity [Fig. 5]. Symptomatic treatment was given (glicocorycosteroids i.v) - improvement in health was achieved. In the control X-ray, re-aeration of the lung occurred. Furthermore, a significant reduction in the amount of fluid in the right pleural cavity was found compared to the previous examination. In further course of hospitalization episode of haemoptysis was observed. Effective embolization of the bronchial arteries was performed. After the procedure, haemoptysis was not observed and the pain diminished. The patient continues pembrolizumab treatment with partial response according to RECIST criteria. Atelectasias and hemoptysis did not occur again. Immunotherapy treatment is well tolerated.

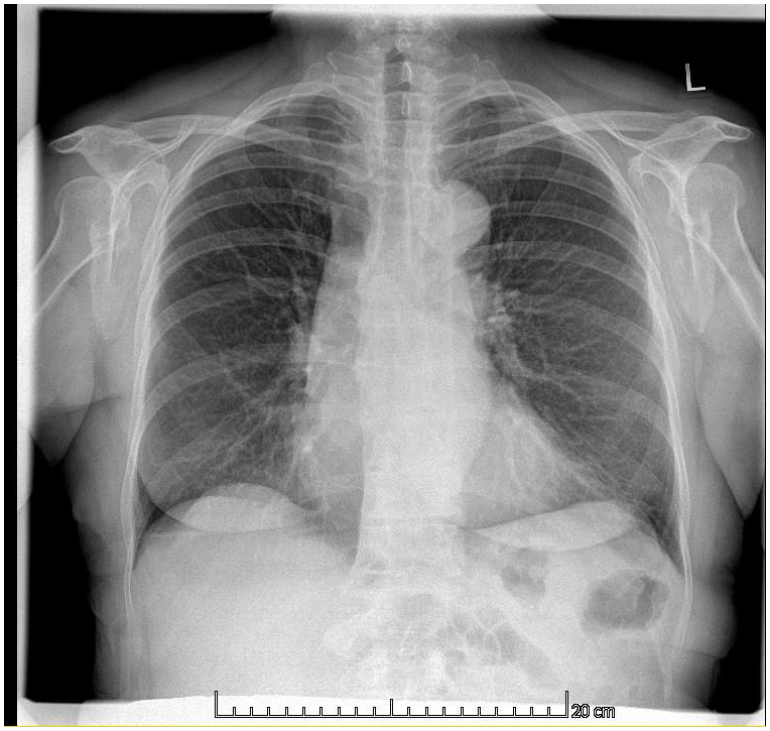

Figure 1: Chest X-ray: no pathological changes.

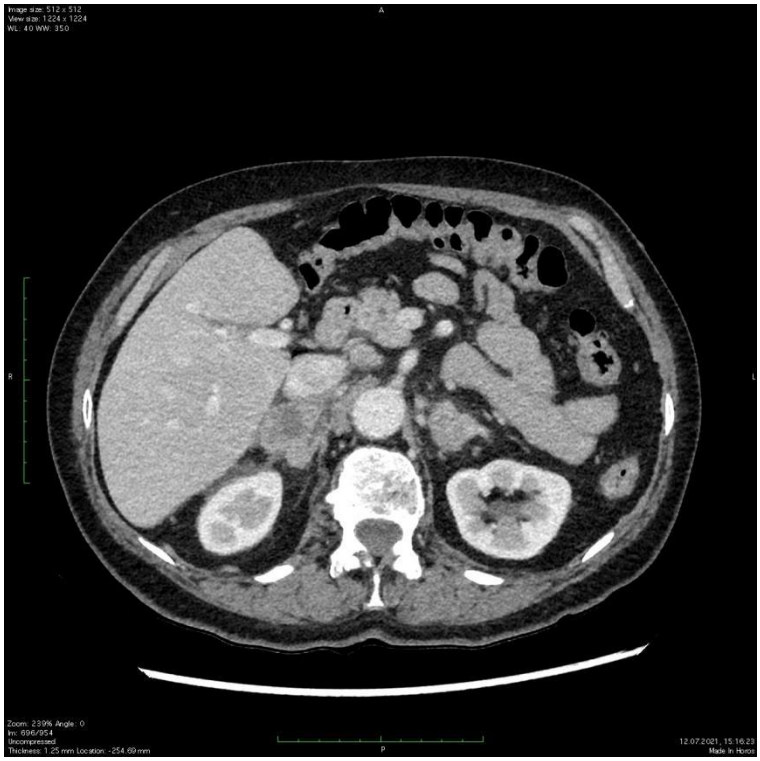

Figure 2: Abdominal CT scan: lesions in the adrenal glands suggesting metastatic changes.

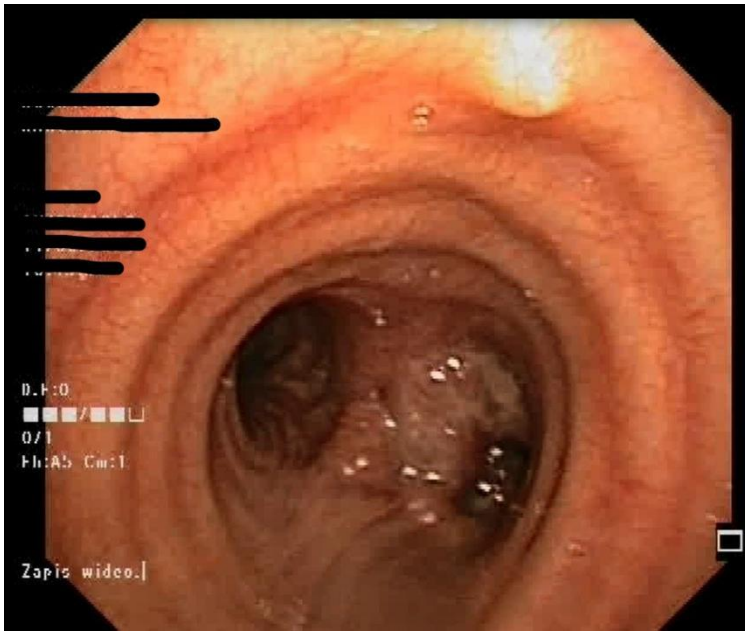

Figure 3: Bronchoscopy image: tracheal bifurcation.

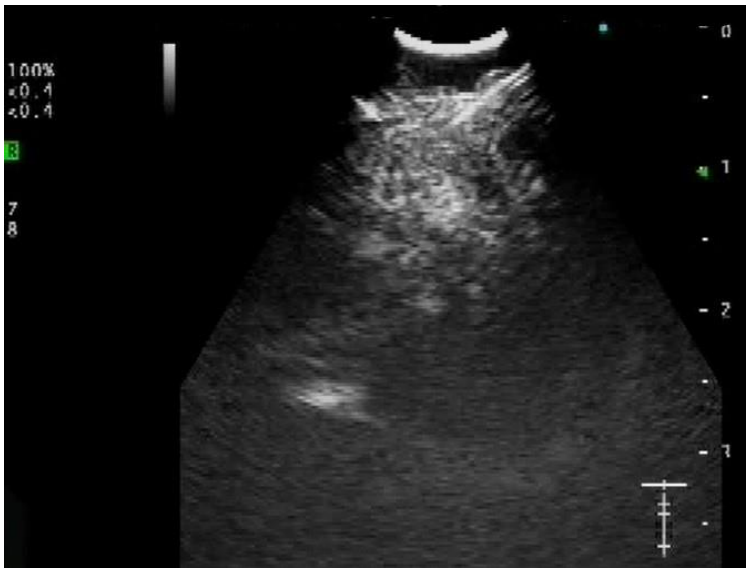

Figure 4: Bronchoscopy with ultrasound.

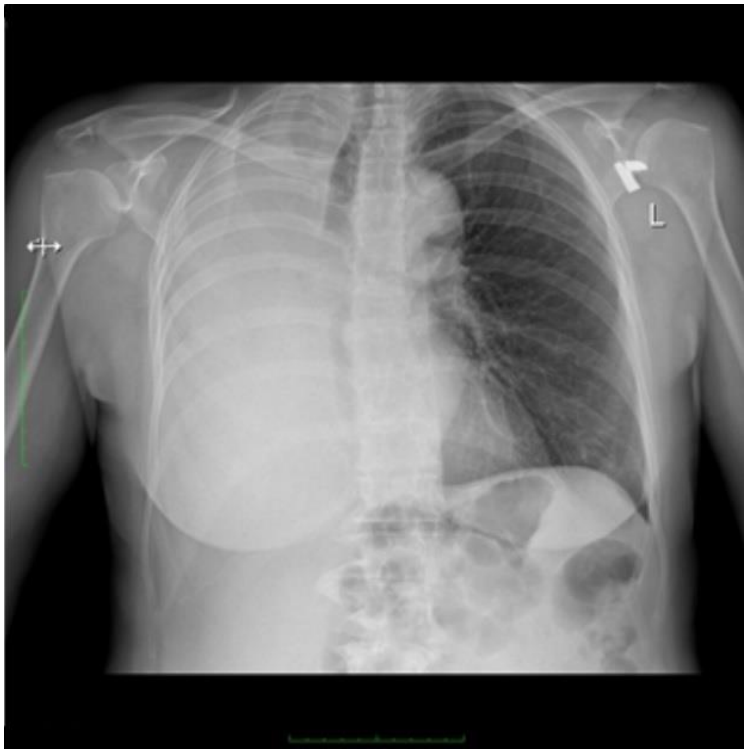

Figure 5: Chest X-ray: right lung atelectasis.

4. Discussion

It is extremely important that each patient suspected of having lung cancer undergoes a careful history and a thorough physical examination. Imaging tests are used both in the initial diagnosis and in the assessment of the stage of advancement and monitoring the response to treatment, possible complications. X-ray is not sensitive in detecting central chest infiltration and mediastinal involvement [5], which was also confirmed in the presented case report. Haemoptysis, which appeared in a patient, is a common symptom in NSCLC, especially in tumors with a central location [6]. This location is associated with a more turbulent course of the disease.

On the other hand, the appearance of atelectasis of the right lung in the patient could be caused by occlusion of the main bronchus by infiltration with activated lymphocytes in the area of the tumor as a result of a response to pembrolizumab.

The most widely used method of lung cancer diagnosis, staging and monitoring is computed tomography, which is unquestionably more sensitive compared to X-ray [5]. Observational studies have shown that the detection of lung cancer increases up to three to four times with the use of CT in relation to the chest X-ray [7,8].

Chest X-ray in the P-A (posterior-anterior) position and in the lateral position is the first imaging examination performed when lung cancer is suspected. Its widespread use is primarily due to the wide availability and low cost of the test. However, once a suspicious change is detected, more detailed diagnostics are required. Then, a computed tomography with contrast

should be performed. Most asymptomatic lung tumors are radiographed as single, peripheral nodules. In the absence of rib destruction, X-ray examination does not determine the malignancy of the lesion. In the case of centrally located neoplasms, the X-ray image shows the enlargement of the mediastinal profile, but it is impossible to assess the infiltration of individual structures such as the phrenic nerve or the superior vena cava [9].

Although multi-slice computed tomography remains the gold standard in lung imaging, advances in magnetic resonance (MR) technology have led to its greater is of some clinical importance in lung cancer assessment [10].

MRI has some limitations in lung imaging. While in other places of the body MR provides excellent soft tissue contrast, unattainable by CT, the low tissue density and high air content in the lungs, mean that MRI does not work so well [10].

Magnetic resonance imaging is currently recommended by NICE (National Institute for Clinical Excellence) and NCCN (National Comprehensive Cancer Network) for the initial assessment of tumors at the apex of the lung, especially when assessing the relationship between the tumor and adjacent vascular and nervous structures [11]. A Pancoast tumor often invades the parietal pleura, the chest fascia and its lymphatic vessels, brachial plexus, intercostal nerves, stellate ganglia, ribs and vertebral bodies. Assessing the integrity of these structures is crucial for making therapeutic decisions. It is MRI, which is characterised by high resolution of soft tissues, that is used to assess local tumor growth. In turn, computed tomography is considered a sensitive imaging technique, especially in the assessment of lymph node involvement and distant metastases [12].

Positron Emission Tomography with 18F-Fluorodeoxyglucose (18F-FDG) - Computed Tomography (PET / CT) was developed to characterise undefined pulmonary nodules and staging lung cancer. In some cases, FDG PET / CT may be preferable to CT, for example in differentiating tumors associated with extensive atelectasis. In contrast, false negative results can be seen in small nodules, usually less than 8-10 mm in diameter, mucinous adenocarcinoma with relatively few cells, and low-grade tumors such as carcinoma in situ and minimally invasive adenocarcinoma. PET is characterised by greater accuracy in the assessment of lymph nodes. However, the main advantage of FDG PET / CT is higher sensitivity in detecting latent metastases to the adrenal glands, liver and skeleton. The main limitation of FDG PET / CT in detecting distant metastases is the identification of lesions within the central nervous system due to the high physiological uptake of FDG in the brain. Therefore, in patients with diagnosed NSCLC, brain MRI is performed in order to fully assess the advancement of the neoplastic disease. It should also be mentioned that the presence of inflammation may mimic distant metastases through intensive FDG uptake [2, 13].

Recently, attempts have been made to develop new radiopharmaceuticals to improve the sensitivity and specificity of PET imaging in lung cancer. Many other tracers, besides 18-F-FDG, are available for studying various aspects of the biology of lung cancer. These include markers of proliferation, amino acid metabolism, hypoxia, and angiogenesis. However, they have so far only been used in clinical trials [14].

5. Conclusions

The emergence of hemoptysis, a new cough, a change in the nature of a chronic cough in a smoker or ex-smoker should raise concerns about lung cancer. Any patient suspected of having lung cancer should receive careful clinical evaluation. It is necessary to perform computed tomography of the chest with contrast infusion [8]. MRI is an auxiliary method in diagnosing changes located at the top of the lung or infiltrating the chest wall. PET CT is a key method in patients undergoing radical treatment in order to exclude distant metastases or to plan radiotherapy. The main advantage of FDG PET / CT over conventional imaging methods is its higher sensitivity in detecting metastases beyond the thorax, especially bone lesions and those located in the adrenal glands [15].

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