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Research Article

THE ROLE OF COMPUTED TOMOGRAPHY IN THE DIAGNOSIS OF CHOBLE (LITERATURE REVIEW)

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ABSTRACT

Chronic obstructive pulmonary disease (COPD) is a common human disease. Further increase of morbidity rate is predicted in the nearest years. Early diagnosis of COPD is of topical importance, and computed tomography (CT) is generally accepted as the "gold" standard for its diagnosis. Therefore, this publication presents a literature review on CT diagnostics of COPD.

KEYWORDS

Computed tomography, chronic obstructive pulmonary disease.

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a chronic inflammatory disease with predominant involvement of the distal airways, lung parenchyma and emphysema, characterised by initially partially reversible and eventually irreversible bronchial obstruction. According to the American Thoracic Society, COPD is a preventable and treatable disease that restricts airflow in the airways.

One of the problems with the term 'chronic obstructive pulmonary disease' is that it is interpreted in two ways. Firstly, COPD is a term describing a group of diseases in which the leading clinical syndrome is airway obstruction (chronic obstructive pulmonary disease). Secondly, the term "chronic obstructive pulmonary disease" corresponds to an independent nosological form. The term "COPD" is preferable to "chronic bronchitis", because the disease does not involve the pathological. The pathological process involves not only the bronchi, but also without exception all the functional and structural elements of the lung tissue (alveolar tissue, vascular system, pleura, respiratory muscles). Understanding and knowing the features of this pathology makes "COPD" a term that describes the disease more fully and profoundly.

COPD is one of the most common human diseases. The incidence of the disease is predicted to increase further in the coming years. Epidemiological data on morbidity and mortality often underestimate the significance and prevalence of COPD, as it is usually not diagnosed until clinically significant and relatively severe stages of the disease develop. About 600 million people in the world currently suffer from chronic obstructive pulmonary disease. According to epidemiological studies, the global prevalence of COPD is ~ 10.1% (11.8% men and 8.5% women). Specifically, the cumulative prevalence of COPD is 4.6% in the USA, 7.4% in Europe and 11.4% in South-East Asia.

A large-scale international PLATINO study conducted in 5 Latin American countries showed a prevalence of COPD ranging from 7.8% (men 11%, women 5.6%) in Mexico to 19.7% (men 27.1%, women 14.5%) in Uruguay (MenezesA.M. etal. 2005). The prevalence in Kazakhstan was 64.4 per 100,000 population; in 2014, it was 73.5. - 73.5, an increase of 9.1 over the previous year. By regions, the highest rate of COPD morbidity is registered in South Kazakhstan Oblast - 145.5 per 100 thousand population, the lowest rate of COPD morbidity is registered in Aktobe oblast - 19.4 per 100 thousand population [13, 14]. Mortality from COPD is constantly increasing, and according to the World Health Organization (WHO) forecasts, by 2020, COPD will occupy the fifth place in the world's population. COPD will rank fifth among all causes of death. A study published in TheLancetRespiratoryMedicine 2017 found that 3.2 million people died of COPD worldwide in 2015, an increase of 11.9% since 1990. At the same time, the standardised age-specific mortality rate decreased by 41.9%, (from 37.7 to 45.1), due to population growth and an ageing world population. The main purpose of radiological examination of patients with COPD is usually to rule out other diseases or pathological conditions that may have similar clinical manifestations or be combined with obstructive disease. These include tuberculosis and lung cancer in particular. The radiological examination of COPD patients can be divided into two stages. The first is aimed at the initial assessment of the thoracic organs and usually involves the use of traditional radiography - chest radiography in 2 projections (straight and right lateral) with the patient upright, or fluoroscopy. Any of these examinations are performed in almost all

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patients with COPD at the stage of primary diagnosis or during an acute episode of the disease. The second stage consists of an in-depth study of the morphology and function of the lung tissue and is aimed primarily at detecting emphysema and bronchiectasis and determining the type and extent of pathological changes. Chest radiography is currently the routine method of assessing the macrostructure and anatomico-topographic condition of the pulmonary tissue. However, the main manifestations of COPD, such as pneumofibrosis and pulmonary emphysema, can only be diagnosed by this method if they are sufficiently widespread and pronounced. Other imaging techniques such as ultrasound, radionuclide and MRI are of limited value in the diagnosis of COPD. However, the use of ventilatory perfusion scintigraphy in static lung scintigraphy provides additional scintigraphic criteria not only for limited, but also for diffuse respiratory disease.

When considering a surgical procedure such as lung volume reduction surgery, a chest CT scan is essential, as the distribution of emphysema is one of the most important factors in determining the indication for surgery.

Early diagnosis of COPD is relevant, as it is not yet known that there is a period in the development of COPD, the timely diagnosis of which can radically affect the course of the disease, i.e. to halt its progression . Structural changes in the lung tissue far outstrip the irreversible airway obstruction detected by external respiratory function tests and estimated by statistical averages of less than 80% of the proper values. In mild COPD, no significant radiological changes are usually detected on conventional chest film radiographs. However, spirometry and clinical findings are not considered to be abnormal in clinical stage zero chronic obstructive pulmonary disease and therefore radiology is more sensitive in detecting bronchial obstruction than functional tests.

When patients in stage zero COPD are examined using CT scanning, gross changes in the lung tissue are detected. This raises the question of starting treatment as early as possible. Computed tomography also helps to rule out the presence of lung tumours, which are much more likely to occur in chronically smokers than in non-smokers. Computed tomography can detect common congenital malformations in adults: cystic lung, lung hypoplasia, congenital collateral emphysema, bronchogenic cysts, bronchiectasias and structural changes in lung tissue associated with other lung diseases that may significantly affect the course of COPD. COPD exacerbations are not to be forgotten. It often requires not only additional therapy, but also hospitalisation. The consequences of COPD exacerbations are extremely unfavourable: acceleration of disease progression, deterioration of patients' quality of life, and significant economic losses. In exacerbations of COPD, radiological examination is performed to rule out pneumonia or lung abscess, as well as venous stasis and pulmonary edema in left ventricular insufficiency. Currently, high-resolution computed tomography (HRT) and its modifications are considered the accepted gold standard for the diagnosis of COPD, as confirmed by numerous literature sources, which, unlike ICGG and radiography, can detect pathognomonic symptoms of COPD such as 'air traps', sabral tracheal deformity and 'tree in the kidney'.

The frequency of detection of these symptoms, according to different sources, ranges from 25% to 75%. However, the role of CT in the radiological diagnosis of chronic obstructive pulmonary disease is still unclear and is debated by many scientists. The clinical

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indications for CTPR in chronic obstructive pulmonary disease are:

1. Detection and staging of COPD, taking into account the history of the disease (smoking history, occupational inhalation exposures to the lungs, frequent pneumonia in childhood).
2. Diagnosis of possible lung complications, in particular pneumonia, spontaneous pneumothorax, various lung tumours, etc.
3. When planning surgery on thoracic organs, including lung transplantation.

Computed tomography in patients with COPD allows the structure of the lung tissue and the condition of the small bronchi to be assessed. For this purpose, CTBT is used, which can be a variant of stepwise scanning or performed in spiral mode on MSCT machines [15, 38]. CTVR can serve as a non-invasive method of detecting morphological changes in the lungs in the early stages of COPD, which enables to prescribe adequate treatment in time and to judge the effectiveness of the therapy. According to the results, almost half of the examined patients with COPD (43.8%) showed no lung changes, while CTVR revealed these changes.

According to M.V. Khrupenkova-Piven's data on COPD, sensitivity, specificity, and prognostic predictive indices of CTBP significantly exceed those of conventional chest radiography, which suggests that CTBP is a more informative technique for detection and differential diagnosis of COPD, especially in the early stages of the disease The sensitivity of CTBP method is 88.7% and specificity 95.4% that is significantly higher than that of conventional radiography (11.3% and 65.5%, respectively) [37]. According to Trishina N.N. (2009) CT sensitivity in diagnostics of COPD is 90.3%, and for CTVR 95.2%. Specificity is 84.3% and 89.5%, and accuracy is 87.5% and 94.9% respectively. However, a number of authors have noted disadvantages of CTVR in the diagnosis of COPD. For example, a study by K. Kurashima et al. (2005) showed that CTVR has a rather high sensitivity and low specificity in the diagnosis of COPD. Pulmonary emphysema was not detected by CTVR in 18.6% of patients with COPD .

CTVR clarifies the localisation of the most airy areas in the lungs. The densitometric density of normal lung tissue ranges from -600 to -900 Ni. In emphysema, this figure rises to -900l-1000 Ni. In addition, comparison of the densitometric values of adjacent lung areas during inspiration and exhalation helps to identify not only overinflated but also poorly ventilated areas. Aspiratory-expiratory CTVR is. Aspiratory-exhalation CTVR combined with spirometry can determine the extent of emphysema, while expiratory CTVR can reflect airflow limitation and pulmonary hyperinflation. Pulmonary hyperinflation is an increase in lung volume at the end of spontaneous exhalation. Expiratory CTVR allows a better assessment of airway conduction to areas of the lung containing air traps.

Sections obtained during full exhalation are more functionally informative than those obtained during full exhalation. The most informative for density estimation are lung areas at the level of tracheal bifurcation (95%) and aortic arch (93%), to a lesser extent - in the basal areas (83%). According to M.V. Khrupenkova-Pivenvramkova, COPD develops at least 2 parallel pathological processes (emphysema and obliterating bronchiolitis) having different symptoms at CTBP. In COPD, obliterating bronchiolitis is combined with infectious bronchitis and/or bronchiolitis, often with emphysema, creating a characteristic, often pathognomonic CT picture. In addition, she believes that CTBP should be the method of choice in the diagnosis of chronic obstructive pulmonary disease, as compensated forms of COPD can have normal functional test values and at the same

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time have CT signs of chronic obstructive pulmonary disease. The clinical significance of the changes detected may vary. This is due to the fact that COPD patients have a combination of functional changes in external respiration resulting from bronchial obstruction, morphological changes typical of emphysema, and pathological changes in the bronchial tree characteristic of chronic bronchitis.

An aspiration-expiratory CT scan provides important diagnostic information. It allows the quantification of emphysema. Sections taken during full exhalation are more functionally informative than those taken during full exhalation. Equally importantly, the CT scan allows the degree of ballooning of any part of the lung to be judged. The changes between inspiration and exhalation serve as an index of regional ventilation. A series of slices determines the condition of all parts of the bronchial tree, reveals peri-ribronchial infiltrates, presence of broncho- and bronchioloectasis, vasoconstriction in oligemic areas. Peripheral parts of the lung fields deserve special attention. In case of pathological changes of small bronchi and transition of process to bronchioles, small striations and branching structures, tubular shadows, small foci are detected here. In some cases an expiratory obstruction syndrome (so-called "air traps") is detected, when the area of the swollen lung does not disappear or diminish in density on exhalation. In the preclinical stage (risk of disease onset), CTBG reveals thickening of bronchial walls and bronchioles, sometimes widening of their lumen (broncho- and bronchioloectases), often local, not sharply expressed signs of expiratory trapping (mainly during exhalation examination) CT allows to assess functional features not only of lobes and segments, but also separate lobules of lung CTBG allows to differentiate degrees of COPD severity, but not initial manifestations of disease. In areas of impaired bronchial patency, equal in volume to individual lobules, sometimes segments and even lobes, the study reveals areas of increased airiness - "air traps" - on exhalation. "An 'air trap' is a retention of stored gas in any part of the lungs during the exhalation phase.

On high-resolution CT, air-trap regions appear as areas of lower density than normal parenchyma and are usually localised within a secondary lobule, segment, lobe or the whole lung, being more clearly visualised on exhalation. The 'air trap' symptom is seen on an expiratory CT scan in cases where the patency of the small bronchi is compromised. This is more characteristic of obstructive changes in general, and is not specific for COPD. Emphysema is characterised by an abnormal increase in air-containing spaces distal to the terminal bronchioles in the absence of overt fibrosis in the lung tissue. Emphysema is usually classified into three main types according to the predominant localisation of areas of destruction: centrilobular, panlobular and paraseptal. In the early stages of development, these forms of emphysema can be distinguished with confidence by CTVR. In the final stages of the disease, they are difficult or impossible to distinguish, not only on CT scan, but also on morphological examination.

The detection of signs of emphysema on CTVR and the exclusion of symptoms of interstitial lung disease complete the diagnostic process. Crucially, it is not necessary to perform a lung biopsy in these cases. Appearance of small foci inside secondary lobules on the background of some intra lobular interstitial pattern enhancement is called in scientific literature as symptoms of "tree with swollen kidneys" or "toy men" and morphologically correspond to manifestations of obliterating bronchiolitis of various etiology.

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CONCLUSIONS

Thus, among current methods of radiological diagnosis of COPD, CTBP has a special place, especially when using its functional (inspiratory-expiratory) modification

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