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Research Article

The Role of Artificial Intelligence (AI) in Assessing of Fibrosing Interstitial Lung Diseases Progression

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Abstract

Estimate AI's ability to assess the fibrosing interstitial lung diseases progression using lung volume counting programs used for COVID-19.

Keywords: COVID-19; Artificial Intelligence; CT Scans

Introduction

The widespread use of artificial intelligence programs during the COVID-19 pandemic to assess the exact volume of lung tissue damage has allowed it to train a large number of radiologists. The simplicity of the program for determining the affected lung tissue in acute interstitial pneumonia, which has density indicators in the range from - 200 HU to - 730 HU, which includes the density indicators of "ground glass opacity" and reticulation (the main radiation patterns in COVID-19) allows you to accurately determine the extent of the process (CT-1 - up to 25%, CT-2 - 25-50%, CT-3 - 50-75%, CT-4 - more than 75%) [1]. However, the characteristics of chronic interstitial pneumonia of progressive nature fit into the same density framework. The extent to which progression is assessed is very important because it determines the tactics of managing these patients. Signs of the fibrosing interstitial lung diseases progression are a decrease in FVC ≥5-10%, a decrease in DLCO ≥ 10–15%, and a decrease in the 6-min test walking> 50 m, an increase in shortness of breath or objective criteria for the quality of life and, an increase in signs of fibrosis in HRCT [2,3]. To assess the degree of fibrosis progression on CT, visual multiparametric control was previously used (comparison of identical CT scans), manual calculation of the lesion volume in 3 main sections (upper sections, tracheal bifurcation level, basal sections), and a program for accurate quantitative calculation of different types of interstitial lesions "CALIPER" [4]. All these options had disadvantages (inaccuracy in visual assessment and the use of only 3 levels, laboriousness in the separate calculation of different types of interstitial lesions). Application of the density range used for COVID-19 will reveal the volume of all interstitial changes characteristic of progressive fibrosing interstitial lung diseases, both capable of regression ("ground glass opacity", reticulation) and the final ones ("honeycomb lung"). Conducting a multidisciplinary consultation with an assessment of clinical and functional data will allow us to understand what the increase in interstitial changes is connected with exacerbation or progression of fibrosis and, therefore, to determine the tactics of treatment.

Materials and Methods

A retrospective analysis of computed tomography data was carried out during follow-up of 54 patients with idiopathic pulmonary fibrosis (IPF).

Results

Radiological studies results analysis revealed that the use of programs for calculating the volume of lung tissue lesions with the

isolation of the density range used for COVID-19 pulmonary lesions made it possible to accurately assess the prevalence of interstitial changes in IPF and correlated with the most important parameter - the diffusion capacity of the lungs (Figure 1).

Figure 1: Patient M., 69 years old. IPF. CT with an assessment of the extent of the lesion from 03/03/2020 - the volume of the affected lung tissue - 18.07%, which is 0.98 liters out of 5.45 liters (total lung capacity) (a, b, c). Control CT from 13/07/2020 - an increase in clinical symptoms, an increase in the volume of the affected lung tissue - 19.62%, 1.05 liters out of 5.35 liters (d, e, f). Control CT from 22/12/2020 - an increase in the volume of the affected lung tissue - 21.92%, 1.08 liters out of 4.92 liters (g, h, i). Control CT from 06/05/2021 - stabilization of the process against the background of therapy - 20.97%, 1.12 liters out of 5.37 liters (j, k, i). In the period from 03/2020 to 05/2021, there is a decrease in DLCO by 16.3% (from 69,4% from D to 53,1% from D).

Discussion

The idea of using an artificial intelligence program to assess the volume of lung injury used in acute interstitial pneumonia COVID-19 for progressive pulmonary fibrosis lies on the surface:

- More radiologists have been trained to use the COVID-19 interstitial lesion counting program as many have worked in hospitals treating the new coronavirus infection.
- The program is characterized by simplicity of calculation and speed of execution.
- The use of one range of density indicators (from - 200 HU to - 730 HU) enables data standardization.
- If DICOM data is available, retrospective comparison is possible.
- The program is feasible in patients with progressive interstitial pulmonary fibrosis in severe condition and during an infectious exacerbation (when it is not possible to assess the diffusion capacity of the lungs).
- Radiation changes are the same type both in acute interstitial pneumonia (exacerbation) and fibrosis progression: appearance/growth of "ground glass", reticulation (patterns that can reflect both a reversible process - acute interstitial pneumonia, and an irreversible process - fibrosis variants of interstitial pneumonia) and require conducting a multidisciplinary consultation to determine the tactics of patient management.
- The graphic image of life has been used at all times: Pushkin's graphic self-portraits - aging and the appearance of traits of wisdom (Figure 2).

Figure 2: Pushkin's graphic self-portraits.

Conclusions

The experience of using artificial intelligence programs to assess acute interstitial pneumonia in COVID-19 can be applied to chronic interstitial pneumonia.

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