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Diagnostic significance of CT quantitative detection in chronic lung disease

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Abstract

Objective To explore the diagnostic value of CT quantitative detection in chronic obstructive pulmonary disease (COPD). Methods A total of 113 patients with suspected COPD who were hospitalized in an outpatient department of a hospital from January 2018 to December 2020 were selected as the subjects of study. All patients underwent CT quantitative examination, lung function and other related examinations. The results of lung function examination were used as the gold standard to detect COPD, and the application of CT quantitative examination in the diagnosis of COPD was analyzed. Results Among 157 suspected patients with C0PD, 112 (71.34%) were COPD and 20 (12.74%) were bronchial asthma; The forced expiratory volume (FEV,), forced vital capacity (FVC) and FEV,/FVC value, mean lung density (MLD) and lumen area (LA) in the first second of COPD group were lower than those in the non-COPD group. The respiratory biphasic voxel index<- 950HU lung volume accounted for the percentage of total lung volume [VI-950 (%)] and the percentage of wall area (WA%) in the COPD group were higher than those in the non-COPD group, and the difference was statistically significant (P<0.05); The results of bivariate Spearson correlation test showed that FEV,/FVC were negatively correlated with VI-950 and WA% (r<0, P<0.05), and positively correlated with MLD and LA (r>0, P<0.05); The ROC curve results show that the AUC of quantitative detection of VI-950, MLD, LA, WA% for COPD by rCT is more than 0.7, which has high predictive value. When the best threshold is obtained, the best predictive value can be obtained. Conclusion CT quantitative detection has high diagnostic efficiency in the differential diagnosis of COPD, and can provide objective reference for clinical early examination.

Keywords

chronic obstructive pulmonary disease; CT quantitative detection; Diagnostic effectiveness

1. overview

Chronic obstructive pulmonary disease (COPD), as a preventable and treatable lung disease characterized by progressive development of airflow restriction, has a high incidence rate and mortality. Therefore, early diagnosis, prevention and treatment of COPD is a hot topic that is widely concerned by clinical doctors and patients. At present, clinical diagnosis of COPD is mainly based on lung function detection and clinical signs. However, lung function detection is

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easily affected by many factors, resulting in low sensitivity of lung function detection and poor tolerance of patients. It is impossible to identify a series of obstructive ventilation disorders caused by C0PD in time, so there is a certain deviation in the diagnosis of COPD solely relying on lung function detection. The literature reports that in the early stage of COPD, although the clinical manifestation is not obvious, the pathological changes have occurred in the patients with COPD from the perspective of morphology, which provides a new idea for clinical early diagnosis. Multi-slice spiral CT has the characteristics of non-invasive, repeatable, and high resolution. It can scan the whole lung to locate and determine the location of the lesion, and the quantitative detection of CT can carry out accurate parameter quantitative analysis, which can objectively reflect the morphological changes of the lesion, and provide objective basis for the differential diagnosis of severe stage. 5. It is beneficial to consider the application of CT quantitative detection in the diagnosis of COPD. In view of this, this study advances in the analysis of the diagnostic significance of CT quantitative detection in chronic obstructive pulmonary disease, which is reported as follows.

2. Data and methods

2.1. Research object

This research protocol has been approved by the Medical Ethics Committee (Approval No.: LL092). 123 patients with suspected C0PD who were hospitalized in the outpatient department of our hospital from January 2021 to March ~2022 were selected as the study subjects. The inclusion criteria were as follows: (1) All patients had respiratory dysfunction symptoms such as chronic cough, shortness of breath, chest tightness and dyspnea; (2) All patients received chest CT quantitative detection; (3) Cardiac function grade II and ~III; (4) All patients signed the exclusion criteria of informed consent form (1) patients with severe heart, liver, kidney and other organ dysfunction before operation, (2) patients with mental disease and central nervous disease before operation, 3) patients with heart, surgical history, history of malignant tumor, history of thrombosis, abnormal coagulation function and blood system disease, (4) patients who had taken psychotropic drugs 2 weeks before operation, (5) scores of preoperative mini mental state examination (MMSE) were less than 23 points, People with cognitive impairment.

2.2. Method

The diagnosis criteria of COPD refer to the relevant diagnosis criteria of COPD in the Guideline for Primary Diagnosis and Treatment of Chronic Obstructive Pulmonary Disease (Practical Version · 2018): (1) There are risk factors such as exposure to smoking and harmful particles and symptoms such as chronic cough and dyspnea; (2) Chest X-ray examination showed emphysema; (3) Physical examination found that the expiratory phase was prolonged, the breath sound was low, and the rale could be heard; (4) Persistent airflow restriction occurred. The lung function test results after inhaling bronchodilator showed that FEV1/FVC was less than 70%; (5) Except for chronic lung diseases such as bronchiectasis, pulmonary tuberculosis and congestive heart failure. According to the contact history of the above risk factors, clinical manifestations and physical signs, laboratory tests and other relevant data, the lung function test results are used as the gold standard.

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CT quantitative detection is carried out by Philips Brilliance 64-slice spiral CT scanner (Philips Medical Co., Ltd., Netherlands). The patient is instructed to take supine position and then check from the lung tip to the lung bottom with breath holding after deep exhalation and deep inspiration. Parameter settings: tube current 200mAs, tube voltage 120kVp, matrix 512 × 512, line tube rotation speed 0.33s/cycle, collimation 64 × 0.5mm, field of vision 32cm, layer thickness 1mm, interval 0.625mm, rotation time 0.5s, after the detection, the detection data will be uploaded to the workstation, and quantified by CT image analysis software. (1) Import the two-way original respiratory detection data into the system software, record the lung volume and emphysema index at the time of inspiration and expiration, mainly the percentage of respiratory biphasic voxel index<- 950HU lung volume in total lung volume [VI-950%]; Mean lung density (MLD) in respiratory phase. (2) The target bronchus was selected from the right upper lobe apical segment, the right lower lobe posterior basal segment and the left lower lobe posterior basal segment bronchus in the inspiratory phase, and the lumen area (LA), wall area (wall: area) and the ratio of wall area to total vascular area (WA%) of the above target bronchus were recorded. All quantitative CT airway parameters were the mean of the above three target organs.

Pulmonary function test Pulmonary function test and CT scan time are less than 1 week. The VS229 pulmonary function tester provided by the American company Centries is used for pulmonary function test, and the patient's forced expiratory volume in one second (FEV), forced vital capacity (FVC) and FEV/FVC values are collected.

2.3. Software analysis

The statistical method is SPSS23.0 statistical analysis software, and the measurement data conforming to the normal distribution is $\bar{x} \pm s$ expressed in, and the independent sample t-test is used for comparison between the two groups; The counting data was expressed by rate, and the comparison between the two groups was performed by X test; Two-variable spearson correlation was used to detect the correlation between the relevant indexes of CT quantitative detection and lung function in patients with COPD; Draw the ROC curve to get the area under the curve (AUC), and test the predictive value of CT quantitative detection on C0PD: AUC<0.5 is worthless, 0.5~0.7 is low diagnostic value, 0.7~0.9 is medium diagnostic value>0.9 is high diagnostic value, P<0.05 is statistically significant.

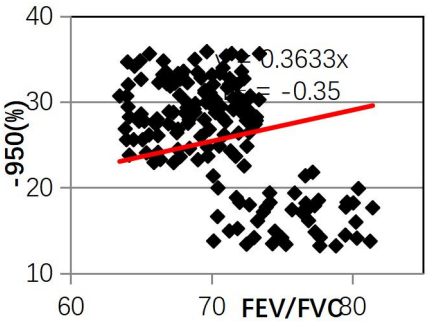

Figure 1 Scatter Chart of Correlation between IV-950 and FEV/FVC

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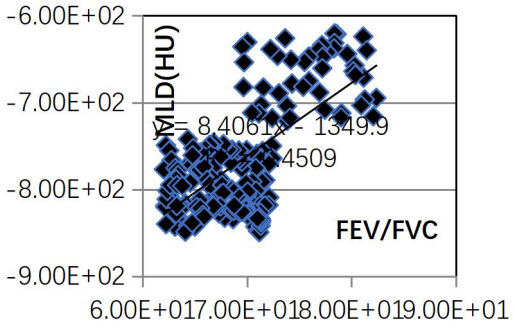

Figure 2 Scatter Chart of Correlation between MLD and FEV/FVC

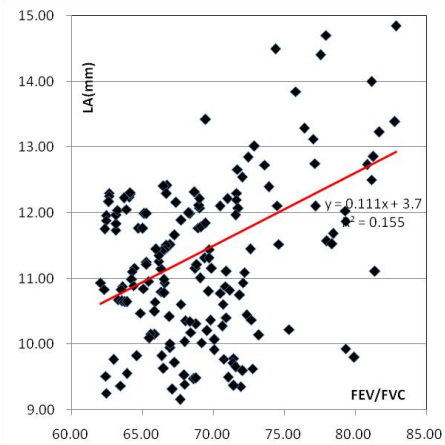

Figure 3 Scatter Chart of LA and FEV/FVC Correlation

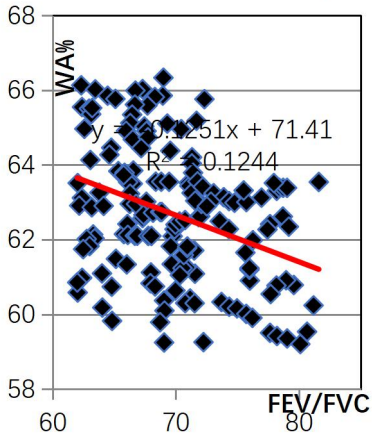

Figure 4 Scatter Chart of WA and FEV/FVC Correlation

3. Results

3.1. Testing results of COPD

The results of COPD detection were 157 suspected patients with C0PD, among which 112 patients (71.34%), 20 patients with bronchial asthma (12.74%), 15 patients with bronchiectasis (9.55%) and 10 patients with other diseases (6.37%) were finally detected.

There was no statistically significant difference in sex, age and body mass index between the two groups in baseline data (P>0.05); FEV, FVC, FEV/FVC, MLD and LA in COPD group were lower than those in non-COPD group, and VI-950 and WA% were higher than those in

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non-COPD group, with statistically significant difference (P<0.05). See Table 1

(The correlation between CT quantitative parameters and lung function showed that the lung function index FEV/FVC was negatively correlated with VI-950 and WA% (r <0, P<0.05), and positively correlated with MLD and LA stars (r >0, P<0.05), as shown in Table 2. Correlation scatter

See Figure 4.

Table 1 Comparison of general data of two groups of patients ($\bar{x} \pm s$)

project	COPD group (n=113)	Non-COPD group (n=44)	$x^{2}/_{t}$	P value
Gender (male/female)	84/27	30/14	one point three nine five	zero point two three eight
Age/year	65.72±8.76	64.82±7.98	zero point five nine seven	zero point five five two
Body mass index/(kg/m^2)	24.16±4.83	23.87±4.72	zero point three four two	zero point seven three three
FEV/L	58.73±5.23	78.65±4.17	twenty-two point seven nine one	＜0.001
FVC/L	87.26±13.83	104.76±17.23	six point six six six	＜0.001
FEV/FVC(%)	67.30±5.12	75.05±6.43	seven point nine five zero	＜0.001
IV-950/%	29.63±6.34	17.84±4.34	eleven point four three four	＜0.001
MLD/HU	-728.23±63.82	-687.65±58.25	three point six nine one	＜0.001
LA/mm	10.65±1.43	12.34±2.59	five point two one seven	＜0.001
WA/mm2	18.87±3.76	19.76±3.98	one point three one nine	＜0.189
WA/%	63.26±3.17	61.54±2.23	three point three two two	＜0.001

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Table 2 Correlation analysis between CT quantitative parameters and lung function (FEV/FVC)

CT quantitative parameters	*r*	*P*
IV-950	-0.635	＜0.001
MLD	zero point six five one	＜0.001
LA	zero point four one three	＜0.001
WA%	-0.325	＜0.001

3.2. The value analysis of CT quantitative detection parameter prediction for COPD prediction will

COPD is taken as the state variable, and the parameters of CT quantitative detection, VI-950, MLD, LA, WA%, are taken as the test variables. The results show that the AUC of CT quantitative detection VI-950, MLD, LA, WA% to predict COPD is greater than 0.7, which has high predictive value. When the best threshold is obtained, the best predictive value can be obtained. See Table 3 for specific parameters.

Table 3 Analysis of the value of CT quantitative detection parameter prediction for COPD prediction

CT quantitative parameters	AUC	95% CI of AUC	Optimal threshold	Sensitivity	Specificity	Joden index
IV-950	zero point eight seven two	0.788~0.913	22.100%	zero point eight five seven	zero point eight two two	zero point six seven nine
MLD	zero point eight six zero	0.796~0.925	-709.129 HU	zero point eight four four	zero point eight one three	zero point six five seven
LA	zero point eight four three	0.767~0.918	11.195mm	zero point eight two two	zero point eight zero four	zero point six two six
WA%	zero point seven two five	0.644~0.805	sixty-two point three one six	zero point eight two one	zero point seven seven eight	zero point five nine nine

4. Discussion

COPD is a chronic lung disease with pulmonary vascular and canalicular remodeling as the main pathological changes. Its clinical manifestations are diverse, high heterogeneity, complex pathological mechanism, and difficult to diagnose and evaluate the disease in early clinical

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stage. The results of this study showed that of 157 suspected C0PD patients, 112 (71.34%) were finally detected as C0PD, suggesting that the incidence of clinical C0PD was high, and early diagnosis should be made clear in order to carry out early targeted treatment and control disease progression. At present, the clinical diagnosis of COPD mainly depends on the traditional lung function test and clinical symptoms and signs, with the lung function test as the gold standard. However, in general, the lung function has a strong compensatory ability, and when the body is in a static and resting state, only the B of the lung function is used, while the B of the lung function is 23 when the body is exercising. This normal physiological function causes many early COPD patients to have decreased lung function, but there is no significant sign, As a result, these patients are easily neglected or confused with other respiratory or pulmonary diseases, which increases the incidence of clinical misdiagnosis and missed diagnosis, affects early control and treatment, and leads to disease progression. Therefore, on the basis of traditional diagnosis, it is of great significance to actively find a safe, fast and convenient auxiliary detection scheme.

CT detection can quickly obtain clear lung image images through scanning detection, and can objectively reflect the early lung lesions, while quantitative detection can complete various chest imaging after processing by workstation, with the advantages of accurate positioning, clear morphology, functional consideration and quantitative, and can reflect the severity of emphysema, pulmonary vascular and bronchial remodeling, It can make up for the deficiency of early changes in lung tissue that are difficult to detect in lung function, and improve the diagnosis of clinically atypical COPD. CT quantitative detection of lung density is determined by the relative proportion of air, blood flow and lung tissue in the lung. Therefore, lung density detection can reflect the specific changes of the lung as a whole, and provide an objective basis for evaluating the changes of lung function. CT quantitative evaluation of emphysema often uses the percentage method and threshold method. The threshold method sets the threshold value, and calculates the percentage of CT value lower than the set threshold value in the total lung volume, so it is used as the evaluation parameter of emphysema. The literature reports that - 950HU is often used as the reference threshold in clinic, which can objectively reflect the pathological changes of lung tissue. Both LA and WA% can reflect the changes of airway remodeling. The decrease of LA and the increase of WA% indicate the occurrence of airway remodeling, the thickening of tracheal wall and the occurrence of airway stenosis. Airway remodeling is the pathological feature of COPD. The results of this study showed that FEV, FVC, FEV/FVC, MLD and LA in COPD group were lower than those in non-COPD group, and VI-950 and WA% were higher than those in non-C0PD group. It is suggested that the patients with C0PD have a significant decline in lung function, while the quantitative CT examination has a significant decrease in MLD and LA, and an increase in VI-950 and WA%. Further, the results of variate Spearson correlation test showed that FEV,/FVC were negatively correlated with VI-950 and WA%, and positively correlated with MLD and LA. It is suggested that the lower the VI-950 and WA% of C0PD patients, the more serious the lung function injury, and the higher the MLD and LA, the more serious the lung function injury. The reason may be that the early pathological changes of lung and airway have no significant characteristics, but with the progress of the disease, the remodeling of the airway is aggravated, the airway wall is thickened, the airway airflow is blocked, and the lung function damage is further aggravated, while the lung parenchyma damage in COPD patients leads to the decrease of lung density. With the progress of the disease, the lung function

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damage is aggravated, leading to the decline of lung function, Therefore, the parameters related to quantitative CT detection in patients with COPD are closely related to the changes of lung function. The ROC curve drawn in this study showed that the AUC of VI-950, MLD LA and WA% predicted COPD by CT quantitative detection was higher than 0.7, which had high predictive value. The best predictive value could be obtained when the optimal threshold was 22.100%, - 709.129HU, 11.195mm and 62.316, which confirmed that the parameters related to CT quantitative detection had high application value in COPD diagnosis. However, the insufficient sample of selected cases in this study failed to reflect the overall change. There may be some deviation in case selection, which may lead to some deviation in the research results. In the future, large sample studies are still needed to confirm.

To sum up, CT quantitative detection has high diagnostic efficiency in the differential diagnosis of COPD. In clinical practice, it can be used to carry out COPD auxiliary detection through CT quantitative detection to improve the early detection rate and provide objective reference basis for early treatment.

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