Patent

METHOD FOR PREDICTION OF OUTCOME OF VIRAL PNEUMONIA IN COVID-19

N/A RU-2763765-C1

Abstract

FIELD: medicine. SUBSTANCE: invention relates to medicine, namely to radiation diagnosis, and can be used to predict the outcome of viral pneumonia in COVID-19. By the method of computed tomography, images of the patient's lungs are obtained on the 1st and 5th days of hospitalization. The functioning volume of the lungs is determined, ml, the volume of areas of tissue compaction with a density of -400 to 0 HU, ml, the volume of areas of compaction by the type of "ground glass" with a density of -750 to -400 HU, ml. According to the obtained parameters, the coefficients are calculated: K1 = (functioning lung volume, ml)/(volume of areas of tissue compaction with a density of -400 to 0 HU, ml) on the 1st and 5th days of hospitalization; K2 = (functioning lung volume, ml)/(volume of areas of compaction of the "frosted glass" type with a density of -750 to -400 HU, ml) on the 5th day of hospitalization; the ratio of the coefficients K1 for 1 and 5 days = (K1 for 1 day)/(K1 for 5 days); K3 = (the volume of areas of compaction of the “frosted glass” type with a density of -750 to -400 HU, ml)/(volume of areas of tissue compaction with a density of -400 to 0 HU, ml) on the 1st and 5th days of hospitalization; the ratio of the coefficients K3 for 1 and 5 days = (K3 for 1 day)/(K3 for 5 days). Upon receipt of at least three of the listed values: K1 on the 5th day <1.33, K2 on the 5th day <0.83, the ratio of the coefficients K1 on the 1 and 5 days≥3.06, the ratio of the coefficients K3 on the 1 and 5 days≥1.60 predict an unfavorable outcome of viral pneumonia in COVID-19. EFFECT: method provides the ability to predict the outcome of viral pneumonia in COVID-19 by determining the diagnostic coefficients. 1 cl, 1 dwg, 6 tbl, 6 ex

Figures

Description

The field of technology to which the invention belongs

The invention relates to medicine, namely to radiology. The method can be used to predict the outcome of viral pneumonia.

State of the art

Currently, qualitative and quantitative indicators of chest computed tomography have been identified, which are predictive factors for mortality in patients with viral pneumonia in COVID-19. Quantification of ground glass, software-assisted consolidation, and Cox proportional hazards regression analysis has established hazard ratios of computed tomography scores in the development of adverse outcome of viral pneumonia in COVID-19 (Davide Colombi, Gabriele D. Villani, Gabriele Maffi, Camilla Risoli 2020 Oct 29: Flavio C. Bodini, Marcello Petrini, Nicola Morelli, Pietro Anselmi, Gianluca Milanese, Mario Silva, Nicola Sverzellati, Emanuele

Michieletti 1–10 doi: 10.1007/s10140-020-01867-1). The resulting regression model has a high predictive value. It has been established that the volume of interstitial pneumonia > 40%, the volume of lung lesions with a density of 700 HU > 35%, visual detection of consolidation and calcification of the coronary arteries are independent predictors of mortality in patients with viral pneumonia in COVID-19.

Despite the sufficient predictive value of the proposed indicators, this model does not take into account the nature of the course of viral pneumonia and the relationship between the functional, interstitial and exudative components of lung damage. Therefore, predicting the dynamics of indicators that reflect the main pathophysiological components of lung damage can improve the prognosis of the outcome of viral pneumonia in COVID-19.

The technical problem solved by the present invention is to improve the accuracy of predicting the outcome of viral pneumonia in COVID-19.

Disclosure of the essence of the invention

The achieved technical result consists in obtaining an accurate prediction of the outcome of viral pneumonia in COVID-19 by monitoring computed tomography data obtained on the 1st and 5th days of hospitalization, due to a comprehensive dynamic assessment of diagnostically significant indicators: functioning lung volume, ground glass volume » and the volume of semi-consolidation-consolidation (ml).

The developed method makes it possible to predict the outcome in patients with viral pneumonia, which increases the accuracy of diagnosis and influences the tactics of treatment.

The technical result is achieved due to the following set of essential features:

• assess the level of functioning lung volume, ground glass volume and volume of semi-consolidation-consolidation (ml) on the 1st and 5th days of hospitalization;

• determine the coefficient of the functioning lung volume/volume of semi-consolidation-consolidation on the 5th day, the coefficient of the functioning volume of the lungs/ground glass volume on the 5th day, the ratio of the coefficients of the functioning volume of the lungs/the volume of semi-consolidation-consolidation (1 day to 5 days), the ratio of the coefficients of the volume "frosted glass" / volume of semi-consolidation-consolidation (1 day to 5 days);

• when receiving at least three values from the following:

coefficient functioning lung volume / volume of semi-consolidation-consolidation (on day 5) <1.33,

Coefficient of functioning lung volume/ground glass volume (on day 5) <0.83,

the ratio of the coefficients of the functioning volume of the lungs / the volume of semi-consolidation-consolidation (1 day to 5 days) ≥3.06,

the ratio of the coefficients of the volume of "ground glass" / the volume of semi-consolidation-consolidation (1 day to 5 days) ≥1.60,

predict unfavorableoutcome of viral pneumonia in COVID-19 (death).

Implementation of the invention

12.5% (18 out of 144) of patients with viral pneumonia with COVID-19 had a poor outcome (death). Clinical and laboratory studies were carried out on the first day of admission to the hospital. According to the anamnesis, this corresponded to 9.8±5.8 days (M±SD) from the onset of the first symptoms of the disease (minimum-maximum 1-39 days). The mean age of patients was 57.0±12.6 years (M±SD) (minimum-maximum 27 years - 91 years). The gender distribution is 60% men (n=86) and 40% women (n=58).

Computed tomography was performed on the 1st and 5th days of hospitalization due to the minimum period when a prognosis of the outcome is required. According to our data, an unfavorable outcome was observed from 5 days. The intensity of the risk of death in patients with viral pneumonia with COVID-19 was significantly uneven, having three peaks. The first peak of the intensity of the risk of death reached a maximum by day 15 (from 5 to 20 days - 14 deaths), the second peak - by 36 days (2 deaths), the third peak - by 56 days (1 death). Therefore, it becomes necessary to predict the outcome of viral pneumonia with COVID-19 already in the first 5 days of hospitalization, after which the first adverse outcomes of the disease appear.

According to the method, quantitative indicators of computed tomography of the lungs are determined (3D Slicer 4.11.20210226, Slicer Community), calculating the functioning volume of the lungs (ml; in the range -950 ~ -750 hnsf'U), ground glass volumes (ml; in the range - 750 ~ -400 hnsf'U), semi-consolidation (ml; in the range -400 ~ -200 hnsf'U) and consolidation (ml; in the range -200 ~ 0 hnsf'U). Semi-consolidation is defined as an area of intermediate homogeneous induration between ground glass and consolidation. Thorac Surg 2006 81: 413-9 https://doi.org/10.1016/j.athoracsur.2005.07.058 Fengjun Liu, Qi Zhang, Chao Huang, Chunzi Shi, Lin Wang, Nannan Shi, Cong Fang, Fei Shan, Xue Mei, Jing Shi, Fengxiang Song, Zhongcheng Yang, Zezhen Ding, Xiaoming Su, Hongzhou Lu, Tongyu Zhu, Zhiyong Zhang, Lei Shi, Yuxin Shi. a cohort of COVID-19 patients Theranostics 2020 10(12): 5613–5622 Published online 2020 Apr 27 doi: 10.7150/thno.45985). Based on the volumes of functioning, "ground glass", semi-consolidation-consolidation coefficients are calculated: coefficient K1 = (functioning volume of the lungs, ml; in the range -950 ~ -750 hnsf'U) / (volume of semi-consolidation-consolidation, ml; in the range -400 ~ 0 hnsf'U) on day 5, coefficient K2 = (functioning lung volume, ml; in the range -950 ~ -750 hnsf'U) / (ground glass volume, ml; in the range -750 ~ -400 hnsf' U) on the 5th day.

Three indicators were selected for analysis - the functioning volume of the lungs, which reflects the volume of normal lung tissue, the volume of "ground glass", which reflects the volume of interstitial changes in viral pneumonia, the volume of semi-consolidation-consolidation, which reflects the volume of exudative changes in the lungs. Therefore, the proposed coefficients objectively reflect the ratio of functioning-interstitial and functioning-exudative processes in the lungs in viral pneumonia with COVID-19.

A set of diagnostically significant indicators was obtained based on the results of studies using machine learning in the Orange 3.0 program (University of Ljubljana, Slovenia) using the simplified Bayesian algorithm for indicators assessing the state of the lungs on computed

tomography of the chest, to predict two outcomes - favorable and unfavorable . The analysis included the ratios of the main indicators obtained according to computed tomography performed on the 1st and 5th days of treatment. After discretization, four indicators were left for analysis - the ratio of the functioning volume of the lungs / the volume of semi-consolidation-consolidation on day 5, the coefficient of the functioning volume of the lungs / the volume of "ground glass" on the 5th day, the ratio of the coefficients of the functioning volume of the lungs / the volume of semi-consolidation-consolidation (1 day to 5 days), the ratio of the coefficients of the volume of "ground glass" / the volume of semi-consolidation-consolidation (1 day to 5 days). As a result of the simplified Bayesian algorithm, a nomogram was obtained for predicting the probability of an unfavorable outcome (death) by 4 coefficients of CT indicators in dynamics (drawing).

The greatest contribution to the prediction (Gain ratio) of the outcome is made by the ratio of the functioning volume of the lungs / the volume of semi-consolidation-consolidation (on day 5) (35.6%), the ratio of ground glass volume / the volume of semi-consolidation-consolidation (on day 5) (26 .2%), the lower one is the ratio of the coefficients of the functioning volume of the lungs / the volume of semi-consolidation-consolidation (1st day to the 5th) (23.6%), the minimum is the ratio of the coefficients of the volume of "ground glass" / the volume of semi-consolidation-consolidation (1 day to day 5) (14.7%)

To predict the probability of an unfavorable outcome (death) of viral pneumonia, it is necessary that the values of at least 3 indicators be in the following ranges: coefficient of functioning lung volume / volume of semi-consolidation-consolidation (on day 5) <1.33, coefficient of functioning lung volume / volume " ground glass (on day 5) <0.83, the ratio of the coefficients of the functioning volume of the lungs / the volume of semi-consolidation-consolidation (1 day to 5 days) ≥3.06, the ratio of the coefficients of the volume of "ground glass" / the volume of semi-consolidation-consolidation (1 day to 5 days) ≥1.60 (drawing).

Ranges for predicting a favorable outcome should be opposite: functioning lung volume/semi-consolidation-consolidation volume ratio (at day 5) ≥1.33, functioning lung volume/ground-glass volume ratio (at day 5) ≥0.83, odds ratio functioning lung volume/volume semi-consolidation-consolidation (1 day to 5 days) <3.06, ratio of ground glass volume/volume semi-consolidation-consolidation (1 day to 5 days) <1.60. A reliable forecast ($p<0.02$) is possible only with a combination of the indicated ranges of the listed indicators.

Analysis of the classification matrix of 144 patients with viral pneumonia in COVID-19 showed 94% (n=135) reliability in predicting outcome. The developed simplified Bayesian algorithm has a high ability to predict the outcome of viral pneumonia in COVID-19 and recognize the absence of the disease with excellent (AUC = 0.96) predictive quality of the model, which reflects their high sensitivity (94%) and high specificity (98%). When predicting outcome using the test, the need for a repeat refining study is only 1% (positive predictive value - 99%). With a negative test result, the probability that the patient will actually predict a wrong outcome was 15% (predictive value of a negative result is 85%). Thus, the developed method allows to achieve high accuracy (95%) in predicting the outcome of viral pneumonia.

Clinical example 1. Patient A., 70 years old. Clinical, Primary Diagnosis: Coronavirus infection, virus identified (confirmed by laboratory testing regardless of severity of clinical signs or symptoms). On computed tomography of the chest, the levels of the functioning volume of the

lungs (200 and 194 ml), the volume of "ground glass" (490 and 1774 ml) and the volume of semi-consolidation-consolidation (695 and 613 ml) on the 1st and 5th days of hospitalization. The calculated coefficients and their ratios are presented in Table 1.

Table 1

No.IndicatorsExodusFavorableUnfavorableoneCoefficient of functioning lung volume / volume of semi-consolidation-consolidation 5 days**0.32**≥1.33<1.332The ratio of the coefficients of the functioning volume of the lungs / volume of semi-consolidation-consolidation0.29/0.32= **0.91**<3.06≥3.063Coefficient of functioning lung volume/ground glass volume on day 5**0.11**≥0.83<0.834The ratio of the ratios of the volume of "ground glass" / the volume of semi-consolidation-consolidation0.71/2.89= **0.25**<1.60≥1.60

Two of the four indicators are in the range of predicted favorable outcome. On the 17th day the patient was discharged from the hospital with improvement.

The predicted favorable outcome (improvement) according to the coefficients reflecting the functional, interstitial and exudative components of pneumonia, corresponds to the data of the medical history.

Clinical example 2. Patient S., 60 years old. Clinical, Primary Diagnosis: Coronavirus infection, virus identified (confirmed by laboratory testing regardless of severity of clinical signs or symptoms). On computed tomography of the chest, the levels of the functioning volume of the lungs (418 and 49 ml), the volume of "ground glass" (639 and 645 ml) and the volume of semi-consolidation-consolidation (580 and 983 ml) on the 1st and 5th days of hospitalization. The calculated coefficients and their ratios are presented in Table 2.

table 2

No.IndicatorsExodusFavorableUnfavorableoneCoefficient of functioning lung volume / volume of semi-consolidation-consolidation 5 days**0.05**≥1.33<1.332The ratio of the coefficients of the functioning volume of the lungs / volume of semi-consolidation-consolidation0.72/0.05= **14.1**<3.06≥3.063Coefficient of functioning lung volume/ground glass volume on day 5**0.07**≥0.83<0.834The ratio of the ratios of the volume of "ground glass" / the volume of semi-consolidation-consolidation1.10/0.65= **1.69**<1.60≥1.60

Four out of four indicators are in the range of predicted poor outcome. On the 36th day - the patient died from complications of the underlying disease: bilateral polysegmental viral pneumonia, respiratory failure stage II, progressive multiple organ failure (cardiovascular, respiratory, renal). IVL. resuscitation activities. The predicted adverse outcome (death) according to the coefficients reflecting the functional, interstitial and exudative components of pneumonia, corresponds to the data of the medical history.

Clinical example 3. Patient B., 58 years old. Clinical, Primary Diagnosis: Coronavirus infection, virus identified (confirmed by laboratory testing regardless of severity of clinical signs or symptoms). On computed tomography of the chest, the levels of the functioning volume of the lungs (2202 and 728 ml), the volume of "ground glass" (3185 and 1472 ml) and the volume of

semi-consolidation-consolidation (407 and 1054 ml) on the 1st and 5th days of hospitalization. The calculated coefficients and their ratios are presented in Table 3.

Table 3

No.IndicatorsExodusFavorableUnfavorableoneCoefficient of functioning lung volume / volume of semi-consolidation-consolidation 5 days**0.69**≥1.33<1.332The ratio of the coefficients of the functioning volume of the lungs / volume of semi-consolidation-consolidation5.41/0.69= **7.84**<3.06≥3.063Coefficient of functioning lung volume/ground glass volume on day 5**0.69**≥0.83<0.834The ratio of the ratios of the volume of "ground glass" / the volume of semi-consolidation-consolidation7.83/1.39= **5.63**<1.60≥1.60

Four out of four indicators are in the range of predicted poor outcome. On the 8th day - the patient died from complications of the underlying disease: bilateral polysegmental viral pneumonia, respiratory failure, progressive multiple organ failure (cardiovascular, respiratory, renal). IVL. resuscitation activities. The predicted adverse outcome (death) according to the coefficients reflecting the functional, interstitial and exudative components of pneumonia, corresponds to the data of the medical history.

Clinical example 4. Patient A., 64 years old. Clinical, Primary Diagnosis: Coronavirus infection, virus identified (confirmed by laboratory testing regardless of severity of clinical signs or symptoms). On computed tomography of the chest, the levels of the functioning volume of the lungs (1632 and 309 ml), the volume of "ground glass" (2114 and 1704 ml) and the volume of semi-consolidation-consolidation (607 and 728 ml) on the 1st and 5th days of hospitalization. The calculated coefficients and their ratios are presented in Table 4.

Table 4

No.IndicatorsExodusFavorableUnfavorableoneCoefficient of functioning lung volume / volume of semi-consolidation-consolidation 5 days**0.42**≥1.33<1.332The ratio of the coefficients of the functioning volume of the lungs / volume of semi-consolidation-consolidation2.68/0.42= **6.38**<3.06≥3.063Coefficient of functioning lung volume/ground glass volume on day 5**0.18**≥0.83<0.834The ratio of the ratios of the volume of "ground glass" / the volume of semi-consolidation-consolidation3.48/2.34=1.48<1.60≥1.60

Three out of four indicators are in the range of predicted poor outcome. On the 15th day - the patient died from complications of the underlying disease: bilateral polysegmental viral pneumonia, respiratory failure, progressive multiple organ failure (cardiovascular, respiratory, renal). IVL. resuscitation activities. The predicted adverse outcome (death) according to the coefficients reflecting the functional, interstitial and exudative components of pneumonia, corresponds to the data of the medical history.

Clinical example 5 . Patient A., 59 years old. Clinical, Primary Diagnosis: Coronavirus infection, virus identified (confirmed by laboratory testing regardless of severity of clinical signs or symptoms). On computed tomography of the chest, the levels of the functioning volume of the lungs (5060 and 1073 ml), the volume of "ground glass" (896 and 3545 ml) and the volume of

semi-consolidation-consolidation (276 and 866 ml) on the 1st and 5th days of hospitalization. The calculated coefficients and their ratios are presented in Table 5.

Table 5

No.IndicatorsExodusFavorableUnfavorableoneCoefficient of functioning lung volume / volume of semi-consolidation-consolidation 5 days**1.23**≥1.33<1.332The ratio of the coefficients of the functioning volume of the lungs / the volume of semi-consolidation-consolidation18.3/1.23= **14.9**<3.06≥3.063Coefficient of functioning lung volume/ground glass volume on day 5**0.30**≥0.83<0.834The ratio of the coefficients of the volume of "ground glass" / the volume of semi-consolidation-consolidation3.24/4.09=0.79<1.60≥1.60

Three out of four indicators are in the range of predicted poor outcome. On the 32nd day - the patient died from complications of the underlying disease: bilateral polysegmental viral pneumonia, respiratory failure, progressive multiple organ failure (cardiovascular, respiratory, renal). IVL. resuscitation activities. The predicted adverse outcome (death) according to the coefficients reflecting the functional, interstitial and exudative components of pneumonia, corresponds to the data of the medical history.

Clinical example 6. Patient A., 48 years old. Clinical, Primary Diagnosis: Coronavirus infection, virus identified (confirmed by laboratory testing regardless of severity of clinical signs or symptoms). On computed tomography of the chest, the levels of the functioning volume of the lungs (200 and 194 ml), the volume of "ground glass" (1490 and 1174 ml) and the volume of semi-consolidation-consolidation (695 and 913 ml) on the 1st and 5th days of hospitalization. The calculated coefficients and their ratios are presented in Table 6.

Table 6

No.IndicatorsExodusFavorableUnfavorableoneCoefficient of functioning lung volume / volume of semi-consolidation-consolidation 5 days**0.32**≥1.33<1.332The ratio of the coefficients of the functioning volume of the lungs / the volume of semi-consolidation-consolidation0.29/0.21=1.38<3.06≥3.063Coefficient of functioning lung volume/ground glass volume on day 5**0.17**≥0.83<0.834The ratio of the coefficients of the volume of "ground glass" / the volume of semi-consolidation-consolidation2.14/1.28= **1.67**<1.60≥1.60

Three out of four indicators are in the range of predicted poor outcome. On the 9th day - the patient died from complications of the underlying disease: bilateral polysegmental viral pneumonia, respiratory failure, progressive multiple organ failure (cardiovascular, respiratory, renal). IVL. resuscitation activities. The predicted adverse outcome (death) according to the coefficients reflecting the functional, interstitial and exudative components of pneumonia, corresponds to the data of the medical history.

More

Claims - 1

1. A method for predicting the outcome of viral pneumonia in COVID-19, which consists in obtaining images of the patient's lungs on the 1st and 5th days of hospitalization using the

computed tomography method, which determine the functioning volume of the lungs (ml), the volume of areas of tissue compaction with a density from -400 to 0 HU (ml), the volume of areas of "ground glass" compaction with a density from -750 to -400 HU (ml), and the coefficients are calculated based on the obtained parameters:K1 = (functioning lung volume, ml)/(volume of tissue compaction areas with a density from -400 to 0 HU, ml) on the 1st and 5th days of hospitalization;K2 = (functioning lung volume, ml)/(volume of areas of ground glass opacity with a density of -750 to -400 HU, ml) on the 5th day of hospitalization;the ratio of the coefficients K1 on the 1st and 5th days = (K1 on the 1st day)/(K1 on the 5th day);K3 = (volume of areas of ground glass compaction with a density of -750 to -400 HU, ml)/(volume of areas of tissue compaction with a density of -400 to 0 HU, ml) on days 1 and 5 of hospitalization;the ratio of the coefficients K3 on the 1st and 5th days = (K3 on the 1st day)/(K3 on the 5th day),upon receipt of at least three of the following values:K1 on the 5th day <1.33,K2 on the 5th day <0.83,the ratio of the K1 coefficients on days 1 and 5 is ≥3.06,the ratio of the K3 coefficients on days 1 and 5 is ≥1.60predict an unfavorable outcome of viral pneumonia in COVID-19.

Patent references - 2

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COMPUTERIZED SYSTEM TO PROVIDE MEDICAL DIAGNOSIS, PROGNOSIS, AND TREATMENT USING MORE REFINED DIGITAL HEALTH RECORDS HAVING IMPROVED CONTEXT

Md Aware LLC - HABBOUSHE JOSEPH, WALKER GRAHAM

Application US-20210074395-A1 - Published 2021-03-11 Filed 2020-11-23 Priority 2016-02-01

Family: 1

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Early prediction method and system for prognosis risk degree of patient infected with COVID-19

Jiangsu Province Hospital - LIU YUN, LI YONG, LU RONGSHENG, XIA YANKAI, PENG ZHIXING, SHAN TAO

Application CN-112185560-A - Published 2021-01-05 Filed 2020-09-27 Priority 2020-09-27

Family: 1

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Publication references - 3

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Prognostic Factors of Initial Chest CT Findings for ICU Admission and Mortality in Patients with COVID-19 Pneumonia

Mohammad Ali Kazemi, Hossein Ghanaati, Behnaz Moradi, Mohammadreza Chavoshi, Hassan Hashemi, Samira Hemmati, Pouria Rouzrokh, Masoumeh Gity, Zahra Ahmadinejad, Hamed Abdollahi

2020, Iranian Journal of Radiology - Article

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Qualitative and quantitative chest CT parameters as predictors of specific mortality in COVID-19 patients

Davide Colombi, Gabriele D. Villani, Gabriele Maffi, Camilla Risoli, Flavio C. Bodini, Marcello Petrini, Nicola Morelli, Pietro Anselmi, Gianluca Milanese, Mario Silva, Nicola Sverzellati, Emanuele Michieletti
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Predictive value of CT in the short-term mortality of Coronavirus Disease 2019 (COVID-19) pneumonia in nonelderly patients: A case-control study

Seyed Mohammad Hossein Tabatabaei, Habibollah Rahimi, Fahimeh Moghaddas, Hamid Rajebi
2020, European Journal of Radiology - Article

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METHOD FOR PREDICTING CLINICAL COURSE OF PNEUMONIA IN PATIENTS WITH CONFIRMED COVID-19

Gosudarstvennoe byudzhetnoe uchrezhdenie zdravookhraneniya Moskovskoj oblasti "Moskovskij oblastnoj nauchno-issledovatelskij klinicheskij institut im. M.F. Vladimirskogo" (GBUZ MO MONIKI im. M.F. Vladimirskogo) - Rozanova Ekaterina Andreevna, Balanyuk Eleonora Aleksandrovna, BALKANOV ANDREJ SERGEEVICH
N/A RU-2820459-C1 - Published 2024-06-04
Family: 1
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METHOD FOR ASSESSING UNFAVORABLE OUTCOME OF SEVERE PNEUMONIA ASSOCIATED WITH COVID-19 BY s-CysC LEVEL

Avtonomnaya nekommercheskaya organizaciya dopolnitelnogo professionalnogo obrazovaniya "Moskovskii mediko_socialnii institut imeni F.P. Gaaza" - Magomedaliev Magomedali Omaraskhabovich, Korabelnikov Daniil Ivanovich, Khoroshilov Sergei Evgenevich
N/A RU-2779581-C2 - Published 2022-09-09
Family: 1
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METHOD FOR ASSESSING UNFAVORABLE OUTCOME OF SEVERE PNEUMONIA ASSOCIATED WITH COVID-19 BY u-CysC LEVEL

Avtonomnaia nekommercheskaia organizatsiia dopolnitelnogo professionalnogo obrazovaniia «Moskovskii mediko-sotsialnyi institut imeni F.P. Gaaza» - Magomedaliev Magomedali Omaraskhabovich, Korabelnikov Daniil Ivanovich, Khoroshilov Sergei Evgenevich
N/A RU-2779579-C2 - Published 2022-09-09
Family: 1
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METHOD FOR PREDICTING THE EFFICIENCY OF ANTI-INFLAMMATORY THERAPY WITH GLUCOCORTICOSTEROID HORMONES IN PATIENTS WITH MODERATE COVID-19

Efremov Dmitrij Olegovich, BELOBORODOV VLADIMIR BORISOVICH - Efremov Dmitrij Olegovich, BELOBORODOV VLADIMIR BORISOVICH
N/A RU-2780933-C1 - Published 2022-10-04

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