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СРАВНЕНИЕ РЕЗУЛЬТАТОВ КТ ОРГАНОВ ГРУДНОЙ КЛЕТКИ ПРИ ПНЕВМОНИИ, ВЫЗВАННОЙ COVID-19, И ГРИППОЗНОЙ ПНЕВМОНИИ

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Comparison of Chest CT Findings between COVID-19 Pneumonia and Influenza Pneumonia

Резюме

Введение. С ростом мировой проблемы распространенности COVID-19 визуализация органов грудной клетки имеет важнейшее значение для эффективной постановки диагноза и лечения. Необходимо разграничивать характерные черты пневмонии, вызванной COVID-19, и других вирусных пневмоний, например, гриппа, на снимках. С этой целью проводилось исследование для сравнения результатов КТ грудной клетки при пневмонии, вызванной COVID-19, и гриппозной пневмонии. **Методы.** В период с марта по май 2020 г. в исследовании приняло участие 50 пациентов с симптомами со стороны органов дыхания и положительным результатом ПЦР (ПЦР-ОТ) в режиме реального времени мазков из носоглотки на грипп и 50 пациентов с симптомами со стороны органов дыхания и положительным результатом ПЦР в режиме реального времени мазков из носоглотки на COVID-19. В документацию пациентов заносили демографическую информацию (возраст, пол), результаты лабораторных исследований, включая С-реактивный белок, СОЭ, лейкоциты, а также клинические симптомы (повышение температуры, кашель, усталость, одышка). **Результаты.** Симптомы со стороны ЖКТ, отсутствие аппетита, высокий С-реактивный белок, симптом «матового стекла» чаще встречаются у пациентов с пневмонией, вызванной COVID-19, чем у пациентов с гриппозной пневмонией, поэтому это различие является статистически значимым (P <0,05). Тем не менее, повышение температуры чаще наблюдается при гриппозной пневмонии, чем при пневмонии, вызванной COVID-19, поэтому это различие является статистически значимым (P= 0,029). Что касается расположения поражений на снимках КТ, у пациентов с COVID-19 поражаются периферические участки (54 %), а у пациентов с гриппозной пневмонией — чаще центральные зоны (32 %), что является статистически значимым (P <0,05). **Заключение.** Согласно результатам исследования, снимки КТ органов грудной клетки вкупе с некоторыми клиническими и лабораторными показателями могут помочь разграничить

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пневмонию, вызванную COVID-19, и гриппозную пневмонию, что крайне важно для скорейшей постановки диагноза и своевременного лечения обоих заболеваний.

Ключевые слова: *компьютерная томография, COVID-19, грипп, рентгенография, заболевания легких, диагностическая визуализация*

Конфликт интересов

Авторы заявляют, что данная работа, её тема, предмет и содержание не затрагивают конкурирующих интересов

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Abstract

Introduction: With increasing global concerns about the prevalence of COVID-19, chest imaging findings are essential for effective diseases diagnosis and treatment. There is a need to distinguish between imaging features of COVID-19 pneumonia and other viral pneumonia like Influenza.For this purpose, a study was performed on a comparison of chest CT findings between COVID-19 pneumonia and Influenza pneumonia. **Methods:** Fifty patients with respiratory symptoms and positive real-time PCR (RT-PCR) of nasopharyngeal swab for Influenza and fifty patients with respiratory symptoms and positive real-time PCR (RT-PCR) of nasopharyngeal swabfor COVID-19 from March to May 2020 were enrolled in the study. In the patient's checklist, information such as demographic characteristics (age, sex), laboratory findings including (CRP, ESR, WBC), and clinical signs (fever, cough, fatigue, dyspnea) were also recorded. **Results:** Gastrointestinal symptoms, anorexia, high CRP, ground-glass opacityare more common in patients with COVID-19 pneumonia than in patients with influenza pneumonia and this difference was statistically significant (P <0.05). But, fever is more common in influenza patients than in Covid-19 patients and this difference is statistically significant (P=0.029). The location of CT scan findings in COVID-19 patients was dominant in peripheral (54 %), while the location of CT scan findings in patients with Influenza was dominant in central (32 %), which is statistically significant (P <0.05). **Conclusion**: According to the results of the study, lung CTscan findings along with some clinical and laboratory findings can help differentiate COVID-19 pneumonia from influenza pneumonia, which is very important in faster diagnosis and timely treatment of both diseases.

Key words: *Computed tomography, COVID-19, Influenza, Radiology, Lung Diseases, Diagnostic Imaging*

Conflict of interests

The authors declare no conflict of interests

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COVID-19 — Corona virus disease of 2019, SARS-CoV-2 — severe acute respiratory syndrome coronavirus 2, RT-PCR: real-time polymerase chain reaction, CRP — C-reactive protein, ESR — erythrocyte sedimentation rate, WBC — white blood cells, WHO — World Health Organization, ARS — Acute Respiratory Syndrome, CDC — centers for Disease control and Prevention, RNA — ribonucleic acid, H1N1 — hemagglutinin1 neuraminidase1, HRCT — high-resolution computed tomography, GGO — ground-glass opacity, DAD — diffuse alveolar damage

Introduction

In late 2019, the World Health Organization (WHO) warned of numerous cases of respiratory disease of unknown origin from Wuhan, China, with clinical presentations similar to those of viral pneumonia and patients often had pulmonary parenchymal opacity on chest radiography. Analysis of bronchoalveolar lavage fluid samples and electron microscopy showed that the cause of this disease was coronavirus. The newly discovered virus was temporarily named (coronavirus 2019, SARS-CoV-2). The main route of transmission of the virus is through respiratory droplets as well as physical contact [1, 2]. Before the current COVID-19 epidemic, there have been several global outbreaks of Acute Respiratory Syndrome (ARS). ARS is one of the leading causes of death and disease in the world, commonly caused by viruses including influenza, rhinovirus, enterovirus, coronavirus, respiratory syncytial virus, parainfluenza, and adenovirus. The most recent of ARS was the influenza A (H1N1) epidemic in 2009, which spread to 214 countries between March 2009 and August 2010, resulting in 18,449 deaths worldwide [3,

4]. The gold standard for diagnosing these viral infections is the confirmation of viral RNA by real-time reverse transcription-polymerase chain reaction (RT-PCR). However, according to a previous report on COVID-19, the positive rate of RT-PCR in the initial presentation is 30-60 %. This may be due to low viral load, hence the need for repeated tests [5]. Existing kits for testing for respiratory viruses are reported to have a sensitivity of 66-100 % [6]. However, in some cases, it may have a false-negative result, which may have been due to insufficient viral material in the sample or technical problems during nucleic acid extraction [7]. In such cases, with typical clinical manifestations, computed tomography (CT) may be a valuable asset and show disease even with a negative RT-PCR screening test [8]. According to the WHO and centers for Disease control and Prevention (CDC) Guidelines, chest radiographs and CT scans were the most important diagnostic devices at the time of the SARS outbreak [9]. Thus, CT of the chest, especially high-resolution computed tomography (HRCT), is a valuable tool in identifying patients in the early-stagesof respiratory infections like COVID-19 and Influenza. Other imaging techniques, such as plain chest radiographs, can help assess many chest disorders, including viral chest infections [8, 10]. With increasing global concerns about the prevalence of COVID-19, chest imaging findings are essential for effective diseases diagnosis and treatment. CT scan has higher resolution and more ability to prepare accurate chest anatomy than a plain chest radiographs and also it is a better tool to compare patients with Influenza and COVID-19. There is a need to distinguish between imaging features of COVID-19 pneumonia and other viral pneumonia due to the similarity in clinical symptoms as well as laboratory findings, to provide focused care in any situation [3]. For this purpose, this study was performed on a comparison of chest CT findings between COVID-19 pneumonia and Influenza pneumonia.

Materials and methods

Patients

This retrospective cross-sectional study was reviewed and approved by the Ethics Committee of Babol University of medical sciences. The present study has conducted at Ayatollah Rohani hospital in Babol, Iran.Fifty patients with respiratory symptoms and positive real-time PCR (RT-PCR) of nasopharyngeal swab for Influenza and fifty patients with respiratory symptoms and positive real-time PCR (RT-PCR) of nasopharyngeal swab for COVID-19 from March to May 2020 were enrolled in the study. In the patient`s checklist, information such as demographic characteristics (age, sex), laboratory findings including (CRP, ESR, WBC), and clinical signs (fever, cough, fatigue, dyspnea) were also recorded. Patients with history of lung surgery or lung cancer were excluded from the study.

CT image review

All CT images were reviewed by two radiologists with approximately 10 years of experience in chest CT interpretation and then final decisions were reached by consensus. Disagreements were resolved by a third radiologist. The CT findings included ground-glass opacity (GGO), consolidation, air bronchogram, reticulation, pleural effusion, pleural thickening, nodules, distribution, air space opacity, pleurisy, atelectasis, and emphysema.

Statistical Analysis

We used version 22.0 of SPSS software for the statistical analysis. The Mann-Whitney and chi-square test was used to compare the differences between the two groups for continuous variables. A p-valueless than 0.05 was considered to indicate a statistically significant difference.

Results

Clinical characteristics

Fifty patients with COVID-19 (mean age, 63 years; 29 men and 21 women) and 50 patientswith Influenza (mean age, 59 years; 22 men and 28 women) were enrolled in the study. They were no significant differences in mean age between the two groups (P >0.05). Gastrointestinal symptoms, anorexia, high CRP, and lymphocytopenia are more common in patients with COVID-19 than in patients with Influenza and this difference was statistically significant (P <0.05). But, fever is more common in ILI patients than in COVID-19 patients and this difference is statistically significant (P=0.029) (Table1).

CT Findings

Comparisons of the CT characteristics COVID-19 and influenza are presented in Table 2. There was no significant difference between the two groups concerningnodules, pleural effusion, pleural thickening, air space opacity, air bronchogram, atelectasis, pleurisy, and emphysema (P >0.05). The following findings did reach statistical significance in COVID-19 and influenza group: GGO (43 vs 25, respectively; P=0.002), consolidation (22 vs 23 patients, respectively; P=0.01) and distribution (49 vs 26, respectively; P <0.0001).

Table 1. *Demographic and clinical characteristics in patients with COVID-19 and with influenza*

Parameters	Covid-19 (n=50)	Influenza (n=50)	P <0.05
Age	63.26 ± 20.64	59.62 ± 21.27	0.38
Sex:			
Male	29(58 %)	22 (44 %)	
Female	21 (42 %)	28 (56 %)	
Signs and symptoms:			
Fever	38(76 %)	46 (92 %)	0.029
Cough	41 (82 %)	33 (66 %)	0.06
Myalgia	29 (58 %)	32(64 %)	0.53
Dyspnea	37 (74 %)	28 (56 %)	0.059
Headache	14 (28 %)	17 (34 %)	0.51
Fatigue	32 (64 %)	26 (52 %)	0.22
Gastrointestinal symptoms	19 (38 %)	2 (4 %)	0.003
Anorexia	33 (66 %)	23 (46 %)	0.04
Laboratory assay results:			
Leukocytosis	14 (28 %)	7 (14 %)	0.94
Leukopenia	7 (14 %)	6 (12 %)	
ESR	27 (54 %)	26 (52 %)	0.84
CRP	39 (78 %)	24 (48 %)	0.0001
Lymphocytopenia	27 (54 %)	17 (34 %)	0.04
Neutrophilia	10 (20 %)	18 (36 %)	0.07

Таблица 2. *Результаты КТ 50 пациентов с COVID-19 и 50 пациентов с гриппоподобным заболеванием*
Table 2. *CT imaging findings in 50 patients with COVID-19 and 50 with influenza-like illness*

CT findings	COVID-19	nfluenza-like illness	P <0.05
Ground glass opacity	43 (86 %)	25 (50 %)	0.002
Consolidation	22 (44 %)	23 (46 %)	0.01
Pleural effusion	8 (16 %)	11 (22 %)	0.28
Air bronchogram	3 (6 %)	6 (12 %)	0.29
Pleural thickening	9 (18 %)	3 (6 %)	0.06
Nodules	11 (22 %)	7 (14 %)	
single nodule	2 (18.2 %)	5 (71.4 %)	0.051
two and more nodules	9 (81.8 %)	2 (28.6 %)	
Air space opacity	4 (8 %)	3 (6 %)	0.69
Pleurisy	4 (8 %)	3 (6 %)	0.69
Atelectasis	6 (12 %)	3 (6 %)	0.29
Emphysema	2 (4 %)	4 (8 %)	0.39
Distribution			
peripheral distribution	27 (54 %)	4 (8 %)	<0.0001
central distribution	14 (28 %)	16 (32 %)	
peripheral and central	8 (16 %)	6 (12 %)	

Discussion

Clinical evidence, laboratory parameters, biomedical and imaging findings in patients with COVID-19and Influenza have been evaluated in a few studies. In Influenza from the histological point of view, mucosal/submucosal mononuclear cell infiltration of the bronchial walls with multifocal desquamation of the epithelium occur and in later stage, organized DAD (diffuse alveolar damage), massive intra-alveolar edema with variable degrees of hemorrhage is seen which in the CT of the chest, they show themselves as ground-glass opacities, focal areas of consolidation, bronchial wall thickening and airspace nodules [11, 12]. In COVID-19, the histological examination reveals mainly septal lymphatic stasis, edema and exudative or proliferative phase of DAD with excessive epithelial leakage and also vascular

damage and thrombosis which on CT of the chest manifests itself in the form of GGO with thickened interlobular septa and crazy paving [13].

Faster and more accurate differentiation of COVID-19 virus from other viruses with Pulmonary involvementis very important. Therefore, this study compared the findings of high-resolution CT scans in patients with COVID-19 and influenza. We also evaluated laboratory finding and clinical signs in addition to CT scan findings in two groups of patients. The common chest CT findings of mild to moderate influenza pneumonia consist of diffuse or multifocal ground-glass opacities and small centrilobular nodules and in mild to moderate stage of COVID pneumonia GGO is also the earliest and predominant CT abnormality that usually located peripherally compared with influenza which is central and random locations. Crazy pattern and reticular changes are more common in COVID-19 and the presence of it indicates an advanced disease stage [14, 15]. Both COVID-19 and influenza patients in severe stage (mainly patients with DAD and ARDS) show diffuse ground glass pattern and air filled cystic changes and with HRCT findings of parenchymal or alveolar involvement, it is not possible to distinguish them [16].

The most important result of the present study was the differentiation between the percentages of CT scan findings of patients with COVID-19 and influenza. In other words, GGO was more prevalent in COVID-19 patients than influenza (43 vs 25, respectively), and also consolidation was 46 % in patients withinfluenza and 44 % in patients with COVID-19. In a variety of respiratory infections, evidence of chest involvement such as GGO, consolidation, is characterized through radiographic evaluation and CT scan [17]. Also, studies of COVID-19 showed the most common attenuation was a pattern of consolidation and GGO [18-22]. Therefore, the study of imaging manifestations of COVID-19 in the early stages and providing imaging for early detection of suspected cases can help reduce the complications of the disease and increase the chance of recovery [23]. The frequency of nodules on CT scans also differed between the two diseases. Nodules on CT scans of COVID-19 patients were more than patients with influenza (22 % to 14 %). Our results were in line with the results expressed by Gao et al. that showed the number of nodules is in COVID-19 patients is higher than Influenza [20]. Another notable finding is that the order of location of CT scan involvement in patients with COVID-19 is also different from patients withinfluenza. According to the location of CT scan distribution, it was found that the site of lung involvement in patients with COVID-19 pneumonia was mostlyin the periphery but lung involvement in patients with influenza was mostly seen in central parts. Different studies have reported the same statistics on the prevalence of lesion distribution [18, 19, 21, 24].

The similarity of clinical symptoms between COVID-19 and other viral pneumonia in many cases leads to delayed diagnosis, increaseddisease progressionand mortality. Evaluation and comparison of clinical symptoms in patients with COVID-19 and patients with influenza have also been one of the objectives of the present study. The results showed the symptoms like fever, cough, headache, myalgia and fatigue were manifested by both COVID-19 disease and influenza. Dai et al. showed fever and cough were the main symptoms of patients with COVID-19 and patients with lung pneumonia (41). The results of Yin et al.'s study showed that fever, cough, sputum, and shortness of breath were the main symptoms in both COVID-19 and influenza pneumonia, but cough and sputum were more common in the influenza group (48). In our study, there was a significant differencein the prevalence of dyspnea, gastrointestinal symptoms, and anorexia between two groups and these were more common in patients with COVID-19. So, maybe these symptoms can be used as one of the criteria for differentiating COVID-19 from influenza pneumonia. Examination of laboratory parameters showed the level of CRP as well as lymphopenia in patients with COVID-19was more than in patients with influenza. The result of the Yin et al. study is similar to our study (48).

Based on the results of our study, lung CTscan findings along with some clinical and laboratory findingscan help differentiate COVID-19 pneumonia from influenza pneumonia, which is very important in faster diagnosis and timely treatment of both diseases.

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All the authors contributed significantly to the study and the article, read and approved the final version of the article before publication

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