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On Clinic-Laboratory Features of The Course of Acute Purulent-Destructive Lung Diseases in Patients Undergoing SARS-CoV-2

Sh.A. Bobokulova¹

ABSTRACT

Background. The frequency of registration of acute purulent-destructive lung diseases in patients with SARS-CoV-2 during the pandemic was ambiguous. A study on the features of the clinical, radiological, and microbiological manifestations of purulent-destructive lung diseases in patients with SARS-CoV-2 deserves close attention.

Material and methods. The results of a comprehensive examination and treatment of 65 patients with acute purulent-destructive lung diseases who underwent SARS-CoV-2 in 2020 are analyzed.

Conclusion. When determining the severity of the condition of patients with acute purulent-destructive lung diseases after suffering SARS-Co V-2, the true picture can be obtained only by applying the criteria of septic complications, because the organ failure and/or dysfunction considered to reflect the true picture of the development of the purulent-inflammatory process.

Keywords: acute purulent destructive lung diseases, SARS-CoV-2, clinical manifestation, diagnosis, treatment

INTRODUCTION

According to the results of clinical observations, most publications note that 2/3 of patients with SARS-CoV-2 at the dawn of the pandemic developed acute respiratory distress syndrome. These patients had an increased risk of developing ventilation-associated pneumonia [11, 25-27].

V. Beaucote et al. In their observations, they noted a characteristic trend in the development of purulent-destructive lung diseases in patients with SARS-CoV-2

who were under mechanical ventilation in the intensive care unit [14].

Indeed, pulmonary endotheliitis [23], which provokes the development of microthromboembolism of peripheral lung tissue [22], has been widely reported among critically ill patients with COVID-19.

Wicky P.H. et al. [28] noted that it is in such patients, due to insufficient concentration of antibiotics in the lesion, that the risk of developing purulent-destructive diseases becomes very high.

¹ Assistant at the Department of General and Pediatric Surgery, Tashkent Medical Academy, Tashkent, Uzbekistan. Email: shokhista.bobokulova@gmail.com

Libby L.S. and others argue that purulent-destructive lung diseases in seriously ill patients with SARS-CoV-2 can also develop because of the addition of superinfection against the background of pulmonary microthromboembolism and endotheliitis [21]. The prerequisites for the development of purulent-destructive lung diseases in such cases are also the development of infarction of lung tissue [29].

Kalenchits T.I. et al. [1] described a case of poly segmental destructive viral-bacterial pneumonia complicated by acute lung abscess and pleural empyema in a 50-year-old patient who was treated in a hospital for SARS-CoV-2. In the patient, the first clinical, laboratory-radiological signs of acute purulent-destructive lung diseases appeared 20 days after receiving a positive result of the polymerase chain reaction test in a smear from the nasopharyngeal mucosa. A month later a forming abscess in the lower lobe of the right lung was diagnosed, which subsequently spontaneously drained into the pleural cavity. The authors believe that one of the factors in the formation of a lung abscess in SARS-CoV-2 may be a violation of the blood coagulation system with the formation of microthrombi in small pulmonary vessels.

The frequency of registration of acute purulent-destructive lung diseases in patients with SARS-CoV-2 during the pandemic was ambiguous [2, 19]. Thus, according to a number of hospitals in Europe, if during the first wave (from March to June 2020) the incidence of acute purulent-destructive lung diseases was noted in the range of 35-46%, then during other waves (from August 2020 to April 2021) there was an increase in the incidence of patients with acute purulent-destructive lung diseases in the range of 52-65% [30].

Based on the foregoing, we can state that any study on the features of the clinical, radiological and microbiological manifestations of purulent-destructive lung diseases in patients with SARS-CoV-2 deserves close attention.

The aim of our study was to assess the features of the course of acute purulent-destructive lung diseases in patients who underwent SARS-CoV-2.

MATERIAL AND METHODS

The results of the diagnosis and treatment of 65 patients with acute purulent-destructive lung diseases who underwent SARS-CoV-2 in 2020 are analyzed.

Because patients were admitted to the clinic with different duration of the anamnestic period of the development of the disease and the timing of SARS-CoV-2 in front of us, there was a need to randomize patients.

Based on the principles of evidence-based medicine [7], the group of patients was divided into:

Subgroup I – 37 (56.9%) patients who were transferred from a specialized infectious diseases clinic after achieving a negative PCR test result for SARS-CoV-2.

Subgroup II - 28 (43.1%) patients who were transferred from other therapeutic clinics or hospitalized as in the initial treatment for the underlying disease. All of them had a history of SARS-CoV-2 and were treated in an inpatient setting.

The severity of the manifestation of the disease and its manifestations in dynamics was assessed according to the standard methodology developed by G.I. Marchuk et al. [15], in the modification of Y.N. Levashov and L.I. Kobrin [13]. The essence of this technique is based on the calculation of two integral indicators of the manifestation of acute purulent-destructive disease, based on which laboratory and clinical indices of the severity of the disease are distinguished. According to the scale developed by the authors, clinical and X-ray data in acute purulent-destructive disease. All data have their own gradation digital value, which depended on the severity of a particular symptom and the reactivity of the organism. According to the dynamics of the indices on the graph, it was possible to judge the course of the disease and the effectiveness of treatment. At the same time, the mathematical method contributed to an objective determination of the severity of the disease, making it possible to assess the effectiveness of conservative therapy or preoperative preparation promptly.

To determine the incidence of sepsis and organ failure associated with its presence, we used the classification of sepsis according to R.C. Bone [5], adopted as a basis at the conciliatory conference of pulmonologists and intensive care physicians in the USA (Chicago) in 1991. The verified diagnosis of sepsis as a complication of acute purulent-destructive lung disease was made by us based on clinical and pathogenetic signs proposed by the conciliation conference.

Along with general clinical methods, the complex examination of patients with acute purulent-destructive lung diseases who underwent SARS-CoV-2 included the following mandatory diagnostic key links:

1. The clinical examination was based on a standard approach and included the collection of complaints, history of the development of the disease and the history of the course of SARS-CoV-2, its form and severity, in conducting a general examination of the patient, palpation, auscultation, percussion of the chest cavity, control

of blood pressure, pulse, respiratory rate, visual control of the amount and nature of sputum.

2. Laboratory tests included a general blood test; determination of hematocrit value, prothrombin index, plasma tolerance to heparin, fibrinogen, fibrinolytic activity, prothrombin time and free heparin was investigated on an automatic closed-type analyzer Humaclot DUO (Germany) using a set of reagents from Human (Germany); conducting a general urinalysis; biochemical blood tests with the determination of total protein, protein fractions, creatinine, urea, glucose, lipid profile on the biochemical analyzer FP-901 (Finland).

3. Instrumental research methods were one of the most important and included: a) polypositional fluoroscopy, which was performed by the patient upon admission and at least 1-2 times a week; b) chest X-ray in two projections, computed tomography, bronchography, pleurography, were performed by patients according to indications. X-ray examinations were performed on the EDR-750B apparatus (Germany), and angiographic studies (angiopulmonography and bronchial arteriography); endoscopic examinations (bronchofibroscopy).

4. Bacteriological studies were carried out in the research laboratory at the Tashkent Medical Academy. To detect bacteremia, blood was sown in two vials with media for the study of aerobic and anaerobic microorganisms. Sowing was carried out in several environments. A microanaerostat and cups with 5% blood agar were placed in a thermostat, and incubated at a temperature of +37°C for 48-72 hours. Smears were stained according to Gram. Colonies grown under aerobic and anaerobic conditions were compared according to their morphology and microscopy results. Quantitative assessment of microflora was carried out according to the method of V. I. Kocherovets et al. [16] and Gould [8]. The content of microorganisms in 1 ml of pathological material (exudate) was expressed in decimal logarithms of absolute numbers.

5. Morphological studies: for histological examination, pieces of tissue were fixed in neutral formalin, Carnois liquid and poured with paraffin. The sections were stained with hematoxylin and eosin according to Van Gieson. Light microscopy and morphometry were performed on a trinocular microscope of the XSZ-20 sample (China) with an optical resolution of 4 to 400 x with a direct electronic nozzle of digital format. The morphological study was carried out by the protocol of the autopsy at the Republican Center for Pathological Anatomy of the Ministry of Health of the Republic of Uzbekistan.

The data obtained in the study were subjected to statistical processing on a Pentium-IV personal computer using the Microsoft Office Excel-2016 software package, including the use of built-in aggregation functions and BioStat for Windows (version 2007). The level of significance $p < 0.05$ was taken as statistically significant changes. The results of the research were expressed in units of the International System of Units.

RESULTS

The distribution of patients by the nature of the disease at the time of admission to the clinic showed that patients (53.9%) with limited purulent destruction of the lungs prevailed. Among them, 18 (27.7%) patients with purulent processes, and 17 (26.2%) patients with gangrenous processes. Widespread purulent destruction was represented by nosological forms of acute lung diseases in the form of abscessed pneumonia (32.3%) and pulmonary gangrene (13.8%). In a separate analysis, it can be noted that the first subgroup of patients was dominated by widespread purulent destruction (56.7%), while among the patients of the second subgroup, cases with limited purulent destruction of the lungs prevailed (67.8%).

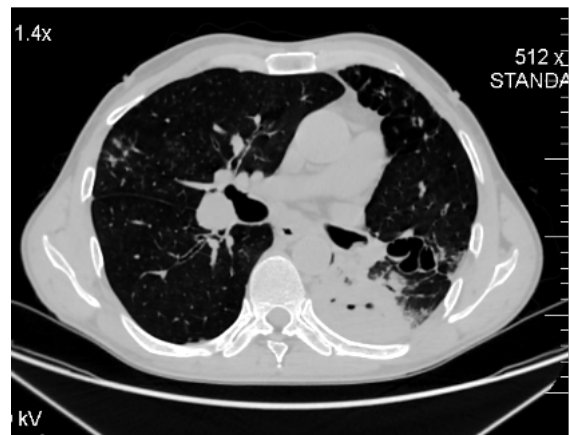


Fig.1. Abscessed pneumonia

According to the anamnesis of the course of SARS-CoV-2 in patients of subgroup I, in the majority (94.6%) of cases, the presence of such a formidable complication as the development of ventilation-associated pneumonia was revealed, which, along with the addition of superinfection, is one of the leading factors in the development of purulent destruction of the lungs. This is confirmed by the fact that in patients of the first subgroup, cases with bilateral lung damage prevailed (33.8%).

In the second subgroup, patients with acute purulent abscesses prevailed (46.4%). According to the medical

history, only 9 (32.1%) patients from this subgroup were under mechanical ventilation during treatment in the covid centre. The anamnestic period of the development of the disease included the period of the patient's stay outside a specialized hospital with the continuation of treatment in a therapeutic clinic or on an outpatient basis. In patients II Subgroups of bilateral lung lesions were noted in only 4.6% of cases.



Fig.2. Acute purulent lung abscess

Local complications of acute purulent-destructive lung diseases, according to the medical history, were pleural empyema, pyopneumothorax, exudative pleurisy, purulent endobronchitis and hemoptysis. In some cases, these complications occurred in a combined form. On average, there were 1.51 complications per patient.



Fig.3. Gangrenous lung abscess

The most common type of local complication (52.04%) was the presence of purulent endobronchitis, which was usually diagnosed by the results of bronchofibroscopy. Exudative pleurisy (19.39%) and pleural empyema (18.37%) were diagnosed in almost the same

proportion. Pyopneumothorax (8.16%) was diagnosed in 8 patients, and hemoptysis (2.04%) was noted in 2 patients.

On average, there were 1.7 local complications per patient of subgroup I and 1.25 complications per patient of subgroup II. At the same time, if among the patients of the first subgroup such local complications as purulent endobronchitis (37.76%) and exudative pleurisy (17.35%) were most often noted, then in the second subgroup pleural empyema (15.31%) and purulent endobronchitis (14.29%) prevailed.

Common complications of acute purulent-destructive lung diseases, characterizing the generalization of the inflammatory process, were diagnosed in 52 (80.0%) patients. At the same time, in 71.15% of cases, they accounted for patients of the first subgroup. One patient accounted for 0.8 common complications of purulent-destructive lung diseases. At the same time, if in the first subgroup, each patient had a general form of complication of the underlying disease, then in the second subgroup - every second (0.54).

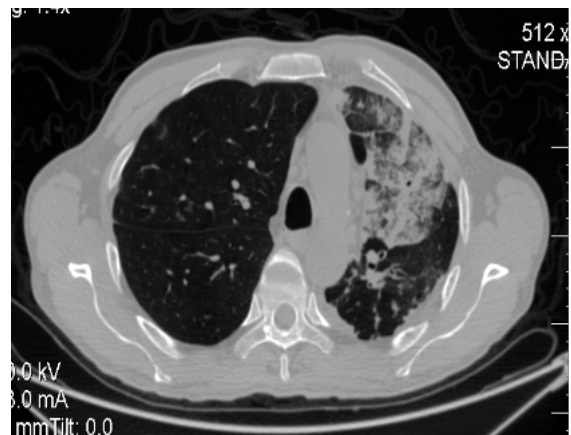


Fig.4. Gangrene of the lung

Among 52 patients with the generalization of the inflammatory process, sepsis syndrome was diagnosed in 46.15% of cases, severe sepsis in 40.38% of cases, and septic shock in 13.46% of cases. At the same time, cases with severe sepsis prevailed in the first subgroup of patients (18 patients - 34.62%), and among patients of the second subgroup - with sepsis syndrome (12 patients - 23.08%).

Such a high frequency of generalization of the inflammatory process with the phenomena of multiple organ dysfunction is to some extent associated with the presence of a morbid background in this group of pa-

tients. Thus, among 65 patients, the presence of 150 names of concomitant diseases was stated.

There were 2.68 concomitant diseases per patient of subgroup I and 1.82 names of concomitant diseases per patient of subgroup II. In 56.0% of cases, these were chronic obstructive pulmonary diseases and coronary heart disease.

Clinical and laboratory signs of generalization of infection were ascertained in all patients and by the classification of the conciliatory conference on sepsis. A total of 164 records were made in the medical history. On average, there were 2.43 clinical signs of systemic inflammatory response syndrome (SIRS) per patient. At the same time, there were 3.1 clinical and laboratory signs per patient of the I-subgroup and 1.7 clinical and laboratory signs per patient of the II-subgroup.

The greatest combination was noted such signs as tachycardia and dyspnea (62.2%). Hyperthermia was noted in 24.4% of cases, and leukocytosis in 13.4% of cases. In the first subgroup of patients, the frequency (22.6%) of dyspnea in combination with palpitations (20.1%) prevailed. In the second subgroup of patients, heart failure prevailed (10.98%), to a lesser extent shortness of breath (8.54%).

When assessing the severity of the patient's condition by the number of signs, SIRS showed that dyspnea, noted in 51 cases (31.1%) in 72.55% of cases, was observed among patients of subgroup I. In the same subgroup, tachycardia was observed in 64.71% of patients. Among patients of subgroup II, these clinical signs were noted in 27.45% and 35.29%, respectively.

Hyperthermia, noted in 13.41% of cases, also prevailed among patients of subgroup I (80.0%). As for leukocytosis, it should be noted that the frequency of registration is approximate among patients of subgroup I (59.09%) and subgroup II (20.0%).

Analysis of the severity of the condition of patients with acute purulent-destructive lung diseases showed that at the time of admission, the bulk of patients (69.23%) were in severe (21 patients) or moderately serious condition (24 patients). The severity of the condition of these patients was due to the presence of pronounced clinical signs of inflammation and endotoxiosis. In 7 cases (10.77%), the condition of the patients was extremely severe and in 20.0% of cases it was satisfactory.

All patients with a satisfactory general conditions were represented by subgroup II. The average severity of the condition was noted equally among both patients of subgroup I and subgroup II (exactly 12 patients each).

Patients with a serious condition in 85.71% of cases were represented by patients of subgroup I and only 14.29% by patients of subgroup II. All patients with an extremely serious condition were representatives of I subgroups who had pulmonary gangrene, severe morbid background and a complication in the form of septic shock.

Analysis of changes in Marchuk indices showed that on the day of admission, the clinical index averaged 4.4 ± 0.15 units, and the laboratory index was slightly higher (4.7 ± 0.15 units), but also determined the magnitude of the severe course of the process.

In the dynamics of treatment, these indicators decreased, but not proportionally. In particular, laboratory parameters decreased, in contrast to clinical indicators, only by 1.5 times (1.95 ± 0.15 units and 3.2 ± 0.2 units, respectively). By the period of completion of treatment, the clinical index decreased to 0.55 ± 0.07 units, indicating clinical signs of recovery, but the level of laboratory parameters remained in the range of 1.35 ± 0.05 units, which corresponded to the preservation of the purulent-inflammatory process.

Analysis of the indicators of the Marchuk indices in the first subgroup of patients showed that during the admission period, the main clinical indicators corresponded to an extremely severe and severe course of the process (5.6 ± 0.4 units). Meanwhile, the laboratory indicator, which amounted to 5.4 ± 0.7 units, had a direct correlation with the clinical one ($r = 0.975$). In the dynamics of the treatment, the level of the clinical index remained at the level of moderate severity of the process, but the laboratory indicator is still was at the level of severe purulent-inflammatory lung disease (3.29 ± 0.12 units and 4.22 ± 0.17 units, respectively). By the period of completion of treatment, clinical indicators already corresponded to the mild course of the process and the period of recovery, but laboratory parameters of 2.33 ± 0.12 units characterized the state of the severity of the process on the verge of mild and medium course.

In the second subgroup of patients, the dynamics of changes in the Marchuk index during the treatment tended to decrease from 3.33 ± 0.52 units to 0.58 ± 0.22 (clinical) and from 4.2 ± 0.28 units to 0.59 ± 0.13 units (laboratory), respectively. By the stage of completion of treatment, clinical and laboratory signs reliably corresponded to the recovery period

When analyzing the bacteriological results of the study, a complete polymorphism of microbial contamination was revealed. Already during the initial puncture,

rapid diagnostics made it possible to assume the presence of non-clostridial anaerobic microflora in 40 cases.

A detailed bacteriological analysis in 80% of cases revealed anaerobic microflora, the coincidence with the results of rapid diagnostics was 85%. It should be noted that in 37.5% of cases, an aerobic-anaerobic association was detected. Only 15% detected aerobes, while in 5 cases the disease was monoinfectious.

An extended quantitative analysis of microbial contamination at the time of the initial puncture showed that the main representatives of the anaerobic microflora were *B. Melaninogenicus* (22 ± 0.8 lgCFU/ml), *B. fragilis* (17 ± 0.4 log CFU/ml) and *Fusobacterium nucleatum* (10 ± 0.2 log CFU/ml). Of the representatives of aerobes, the most frequent were *Staphylococcus Aureus* and *Streptococcus* (10 ± 0.2 lgCFU/ml).

The dynamics of treatment showed that already on the 3rd day, the sanitation of purulent-necrotic foci led to a progressive decrease in the level of anaerobes in almost all types. At the same time, the number of peptococci and eubacteria by this time reliably reached a critical level. About aerobic representatives, it can be noted that by this time their pathogenic level has been preserved.

Even on the 7th day of sanitation of purulent-destructive foci by intensive treatment, purification of the exudate from microorganisms was not achieved. Only by the 10th day of treatment, most representatives of anaerobes reached a critical level, even though the level of staphylococci remained in the range of 9.6 ± 0.2 lgCFU / ml.

DISCUSSION

In the first subgroup of patients, such nosological forms as abscessed pneumonia (37.8%) and acute gangrenous lung abscess (29.7%) prevailed. This nature of the frequency of occurrence of nosological forms of acute purulent-destructive lung diseases, in our opinion, is associated with the peculiarities of etiological factors [3, 4, 6, 9].

We deliberately state the fact that such a sign of sepsis as a respiratory disorder prevails, since such a high frequency of dyspnea among patients of subgroup I indicate targeted respiratory damage after a recent SARS-CoV-2 infection, which is probably due to certain changes in the structure, the non-respiratory function of the lungs, namely, barrier-filtration [10, 12, 17, 18].

Already at the first stage of studying the severity of the patient's condition, inconsistent data on the two indicators were obtained. Hypodiagnosis of the condition of patients in the presence of pronounced signs of septic complications is demonstrated above. At the same time,

changes in the Marchuk indices also showed the preservation of laboratory signs of the inflammatory process by the period of completion of treatment, with relative normalization of clinical signs [20].

Probably, the complexity of the differentiated interpretation of the severity of the patient's condition is associated with the presence of such a different degree of damage to the bronchopulmonary system by the purulent-destructive process after suffering SARS-CoV-2 [24].

CONCLUSION

Summing up these indicators, it can be noted that when determining the severity of the condition of patients with acute purulent-destructive lung diseases after suffering SARS-Co V-2, the true picture can be obtained only by applying the criteria of septic complications, because the organ failure and/or dysfunction took into account reflect the true picture of the development of the purulent-inflammatory process. At the same time, the analysis of the dynamics of the Marchuk indices also found that, For a full-scale assessment of the severity of the course of the purulent-destructive process, they are not entirely consistent.

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Conflict of Interest – The authors state that they have no conflict of interest.

Ethical Statement - to publish these results we obtain the Ethics Committee of the Tashkent Medical Academy. All patients were informed about the research process. All of them signed the relevant letter of consent.

Data Availability Statement - Data supporting the results of this study are available at the request of the respective author. The data is not publicly available because it contains information that could compromise the privacy of study participants.

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SARS-COV-2 BILAN OG'RIGAN BEMORLARDA O'TKIR YIRINGLI-DESTRUKTIV O'PKA KASALLIKLARINING KLINIK-LABORATORIYA XUSUSIYATLARI.

Bobokulova Sh.A.

Toshkent tibbiyot akademiyasi

Dolzarbli. Pandemiya paytida SARS-CoV-2 bilan og'rigan bemorlarda o'tkir yiringli-destruktiv o'pka kasalliklarini ro'yxatdan o'tkazish chastotasi noaniq edi.

SARS-CoV-2 bilan og'rigan bemorlarda yiringli-destruktiv o'pka kasalliklarining klinik, radiologik va mikrobiologik ko'rinishlarining xususiyatlari to'g'risida o'tkazilgan tadqiqot diqqatga sazovordir.

Material va usullar. SARS-CoV-2 SARS-CoV-2 ni boshdan kechirgan o'tkir yiringli-destruktiv o'pka kasalliklari bo'lgan 65 nafar bemorni kompleks tekshirish va davolash natijalari tahlil qilinadi.

Xulosa. SARS-CoV-2 dan aziyat chekkanidan so'ng o'tkir yiringli-destruktiv o'pka kasalliklari bo'lgan bemorlarning ahvoli og'irligini aniqlashda haqiqiy rasmni faqat septik asoratlar mezonlarini qo'llash orqali olish mumkin, chunki a'zo etishmovchiligi va / yoki disfunktsiyani hisobga olgan holda yiringli yallig'lanish jarayonining rivojlanishining haqiqiy tasvirini aks ettiradi.

Kalit iboralar: o'tkir yiringli o'pka kasalliklari, SARS-CoV-2, klinik ko'rinish, tashxis, davolash

КЛИНИКО-ЛАБОРАТОРНЫЕ ОСОБЕННОСТИ ТЕЧЕНИЯ ОСТРЫХ ГНОЙНО-ДЕСТРУКТИВНЫХ ЗАБОЛЕВАНИЙ ЛЕГКИХ У БОЛЬНЫХ, ПЕРЕНЕСШИХ SARS-CoV-2.

Бобокулова Ш.А.

Ташкентская Медицинская Академия

Актуальность. Частота регистрации острых гнойно-деструктивных заболеваний легких у больных с SARS-CoV-2 в период пандемии была неоднозначной. Любое исследование относительно особенностей клинического, радиологического и микробиологического проявления гнойно-деструктивных заболеваний легких у больных с SARS-CoV-2 заслуживает пристального внимания.

Материал и методы. Анализируются результаты комплексного обследования и лечения 65 пациентов с острыми гнойно-деструктивными заболеваниями легких, которые перенесли SARS-CoV-2 в 2020 году.

Заключение. При определении тяжести состояния больных с острыми гнойно-деструктивными заболеваниями легких после перенесенного SARS-CoV-2 истинную картину можно получить только применив критерии септического осложнения, ибо принятые во внимание органную недостаточность и/или дисфункции отражают истинную картину развития гнойно-воспалительного процесса.

Ключевые слова: острые гнойные деструктивные заболевания легких, SARS-CoV-2, клиническое проявление, диагностика, лечение