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Principles of Diagnosis and Treatment of Patients with Diagnosis of Covid-19 and Developing Viral Pneumonia

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Abstract: The article provides information on our achievements in the application of modern diagnostic methods and modern methods of treating patients with viral pneumonia, confirmed by covid-19. For this, statistical data of 2,000 patients were used. Of the 2,000 patients treated, 920 were men, 1,070 were women and 10 were children. Viral pneumonia-glaucoma syndrome in 1650 out of 2,000 patients with 10-20% damage; In 350, the diagnosis of viral pneumonia-frostbite syndrome with 50-85% damage, CRDS, respiratory failure was confirmed. Thus, 50 out of 350 patients treated at the intensive care unit (ICU) out of 2,000 were intubated and connected to artificial ventilation. The research was carried out in 3 stages: I stage- admission to the intensive care unit; II stage- from the day of intubation to spontaneous breathing (7-14 days); and III stage – covers the period of extubation and recovery. The results of clinical, functional, hemodynamic and echocardiographic studies of the patients participating in the examination were analyzed. Also, the patients underwent bacteriological research studied the sensitivity to antibiotics. In addition, the composition of blood gases and the oxygenation index – Carrico were studied.

Key words: Covid-19, acute respiratory distress syndrome total pnevmonia, acute respiratory failure, oxygenation index.

1. Objectives

The diagnosis and treatment of acute respiratory distress syndrome (ARDS), which developed in the context of viral pneumonia caused by Covid-19, which has become one of the a scourge of the 21st century [1, 2]. The Covid-19 epidemic is a common pandemic in the world and continues to pose a serious threat to life [3, 4]. The disease started in Wuhan City, Hubei Province, China in December 2019. İts rapid spread andthe increase in the number of patients and deaths have caused panic and anxiety around the world [5, 6]. That's why we decided to draw public attention to be statistical analysis of patients treated in the intensive care unit of our clinic. Covid-19 was approved by the in Coronavirus Control Centers in the Republic of Azerbaijan and it includes sharing our experience and achievements in the diagnosis and treatment of respiratory failure in patients with severe somatic viral pneumonia and ARDS respiratory failure that developed in this context.

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2. Methods

By the time we were deployed in 2020, Covid-19 had been confirmed and included up to 2,000 patients with developed viral pneumonia. Scientific analysis of clinical observations and treatment results was performed in these patients. 350 patients were treated in the intensive care unit. The study was conducted in 3 stages:

- Phase I: The period of entry into the ICU
- Phase II: The period from the day of intubation to the time of spontaneous breathing (within 7–14 days)
- Phase III: Including time to extubation and recovery (15-25 days).

Observing the results of our research, it was found that there are significant differences in hemodynamic and laboratory parameters at different stages.

Of the 2,000 patients, 1,650 (82.5%) patients had a damage rate of 10-20% with viral pneumonia glaucoma syndrome, and 350 (17.5%) patients had a damage rate of 50-85% with viral pneumonia frosted glass syndrome, accompanied by ARDS, diagnosised as respiratory failure. Under the background of complete pneumonia, 350 patients with severe somatic diseases complicated with advanced ARDS and acute respiratory failure were treated at the ICU. Among them, 50 (14.29%) patients were intubated, and 300 people (85.71%) was ventilated with the continuous positive airway pressure (CPAP) mask with BENNET^{TM}840 artificial respiration devices. Of the patients receiving treatment, 920 (46%) were men, 1,070 (53%) were women, and 10 (1%) were children. The age of adult patients ranged from 32 to 84 years old (47.11 ±5.47), height 160–172 cm (165.8 ±2.67), and weight 60–150 kg (93.33 ± 8.88). Among the co-morbidities, 624 (31.2%) out of 2,000 patients of had type II diabetes, 456 (22.8%) patients had essential hypertension, 96 (4.8%) patients had chronik ischemic heart disease (CIHD) and post-infarction cardiosclerosis, 15 (0.75%) patients with left ventricular failure (ejection fraction (EF) 25-40%), 110 (5.5%) patients were class II-III obesity, 8 (0.4%) patients had vibration of the ears and fibrillation, 22 (1.1%) with allergicbronchial asthma (ABA), 30 (1.5%) with chronik obstructive pulmonary disease (COPD); 8 (0.4%) patients had chronic duodenal ulcer complicated with bleeding, 5 (0.25%) had thalassemia, and 6 (0.3%) had leukemia (Figure 1). Of the patients, 1,085 (54.25%) had two or more concomitant diseases.

Only 32 (1.6%) of the 2,000 patients smoked. The diagnosis is based on clinical analysis, laboratory tests and functional tests. In order achieve our goal, we have adopted the general and biochemical analysis of blood, C-reactive protein (CRP), procalcitonin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehidrogenase (LDH), γ-glutamyltransferase (GGT), ferritin, albumin, creatinine, blood gas composition, acid-base balance. Acomputed tomography (CT) scans of the chest is also used to specify the diagnosis in patients. In order to study the functional status of the lungs, in addition to non-invasive monitoring, the dynamic changes ofoxygenation index-Carrico index (CI), pulse

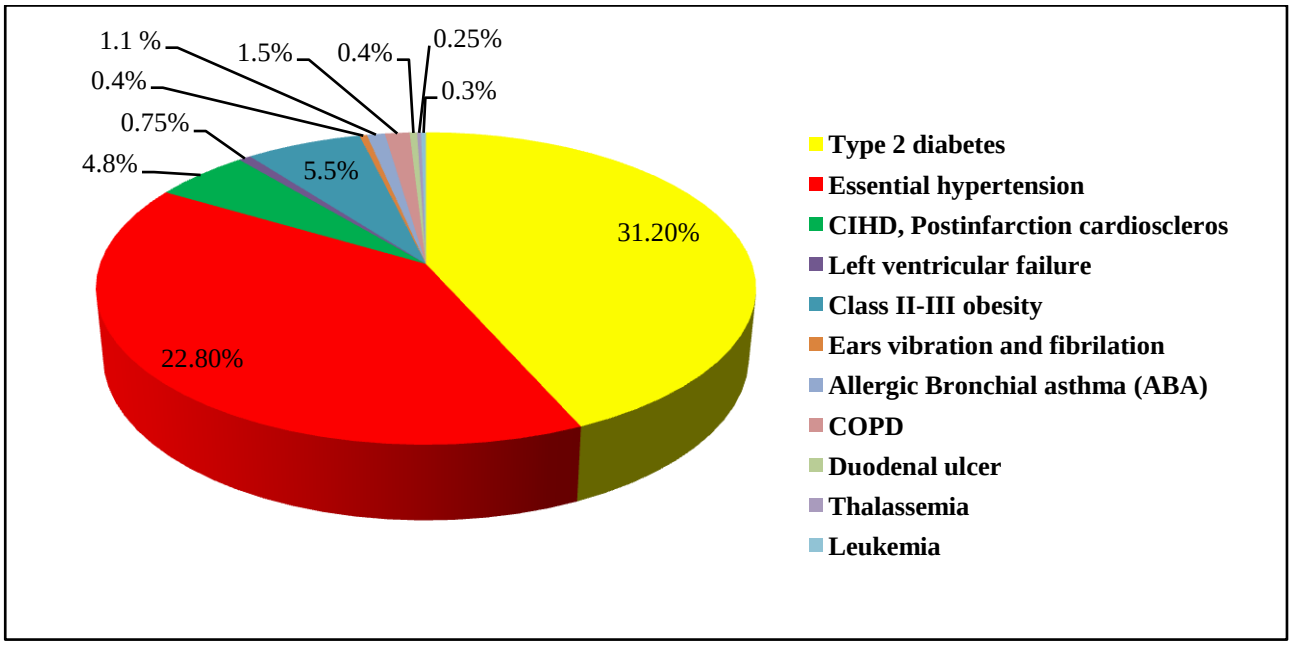

Fig. 1 Concomitant diseases found in patients (n = 2000).

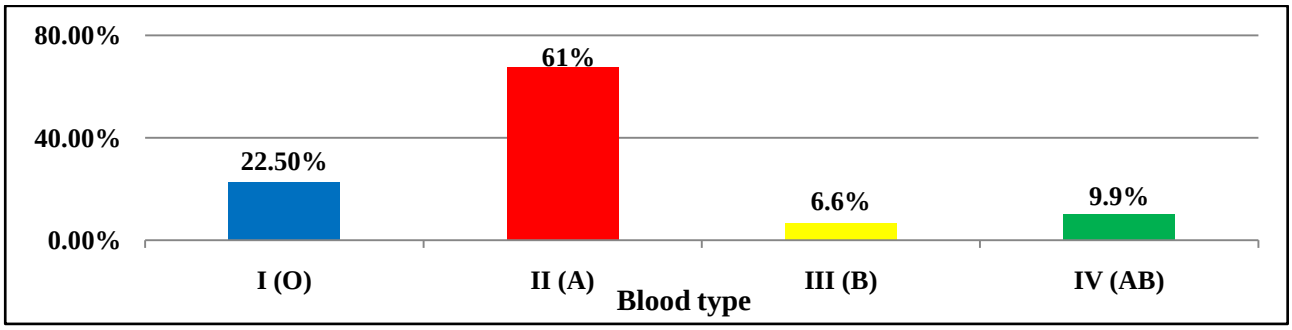

Fig. 2 Percentage of blood type (n = 2000).

oximetric saturation (SpO_2), central venous pressure (CVP), and heart rate (HR) were also studied. Peripheral hemodynamics was monitored with a Bionet cardiomonitor, and blood gas composition and acid-base balance were determined with an automatic analyzer ABL-5 (Radiometer medical ApS-Denmark). Among the 2000 patients surveyed, 1220 (61%) patients had blood type A; 450 (22.5%) patients were blood type O; 132 (6.6%) patients were blood type B, the remaining 198 (9.9%) patients are blood type AB (Figure 2).

3. Results and Discussion

A patient born in 1958 infected with Covid-19 (Medical History № 23512) was admitted to the ICU with hipoxia on April 11, 2020 in the context of 80% injury with viral pneumonia and acute respiratory failure. In addition, the patient has thalassemia, diabetes and hypertension and the blood type A is Rhesus positive ($RH^{+)}$. The patient was in a forced sitting position when entering the ICU, respiratory rate of 45–47 breaths per minute, body surface covered with cold sweat, cyanotic, and the body temperature is 39.8 ℃, BP = 140/100 mm.Hg. Heartrate stress 148 beats per minute, SpO_2–52%, CI–92, EF–50%, pH–7.02, partial pressure of oxygen (PaO_2)–38 mmHg, partial pressure of carbon dioxide ($PaCO_2$)–75 mmHg, base excess (BE) = -12, lactate = 9 mmol/L, blood sugar–360 mg/dL, leukocyte–28 x 10^3 per/L, CRP–455 mg/L, procalcitonin (PKT)–27 ng/mL, creatinine–1.9 mg/dL, albumin–2.7 g/dL, ALT–34.2 IU/L; AST–83.8 IU/L, LDH–986 IU/L, GGT–508 IU/L, prothrombin time (PT)–15.6 sec, prothrombin index (PI)–75%, international normalized ratio (INR)–1.32, D-dimer–3200 ng/mL, Ferritin–2256 ng/mL. Statistical processing of the obtained numerical data: for quantitative indicators was carried out in the EXCEL-2010 spreadsheet using the U-Wilcoxon (Manna-Whitney) rank criterion. In addition, the average values and average statistical errors of the obtained parameters were calculated.

In stage I patients had tachycardia, in stage II patients with dynamics tachycardia 1.18 times ($t = 3.9$; $p < 0.001$), in stage III, it decreased 1.26 times. In the background of proper intensive care, hemodynamic parameters decreased and stabilized in the dynamics to normal. In the diagnosis of Covid-19 lung disease, central venous catheters were closely monitored using CVP and Waldman blood pressure monitor in all patients in order to assess the patient's blood volume status and fluid needs. In the stage I, the CVP was higher than the norm, in the stage II, it decreased by 1.44 times, but it was at the upper limit of the norm ($t = 3.7$; $p < 0.001$) and it is statistically correct. In stage III, it decreased to normal level, decreased by 2.16 times ($t = 2$; $p < 0.05$) in comparison with stage I. Myocardial oxygen demand (MOD) accepted 8-11 c.u in norm. MOD was high due to hypoxic and hyperthermic conditions in patients admitted to the intensive care unit (İCU) of resuscitation, although MOD dynamics decreased by 1.44 times ($t = 2$; $p < 0.05$) in stage II, remained above normal, but reached normal level in stage III. All patients had high fever. In stages II and III, it decreased by 1.05 times ($t = 3.2$; $p < 0.01$) and reached normal level. Heart tension

Table 1 Dynamic changes in some peripheral and central hemodynamic parameters.

Respiratory Parameters	Stages (Mean ± SD)		
	I	II	III
Pulse (ps)	117.12 ±9.15	98.58 ±8.67***	92.53 ±6.45
CVP (cm.w.c)	18.61 ±2.33	12.89 ±0.78***	8.21 ±0.52*
Myocardial oxygen demand (MOD) ml/min	19.61 ±3.13	14.53 ±1.72	13.38 ±1.29
Heart tension volume (HTV) (48-90 ml)	42.28 ±5.3	65.0 ±27.8	84.2 ±33.3*
Total Peripheral Vascular Resistance (TPVR) (800-1500 kpa. S/L)	1820 ±760.23	1610.7 ±622.5	1400 ±325.3***
Temperature (℃)	38.83 ±0.44	37.98 ±0.15**	37.07 ±0.22*

The Statistical accuracy of the difference of different time indexes in patients. Note: Compared to stage I.: *$p < 0.05$; ** $p < 0.1$; *** $p < 0.001$.

volume (HTV) was studied in these patients by echocardiography (ECHO). It was found that in the first stage, against the background of hypoxia, as a compensator, the HTV was less than normal, and in the following stages it increased 2 times ($t = 2.2$; $p < 0.05$) and reached the normal level. In addition, it was studied in patients with total peripheral vascular resistance (TPVR) that was initially high and decreased 1.5 times in stage III ($t = 3.9$; $p < 0.001$) to normal. The temperature was high in stage I, which once again proves the presence of an inflammatory process in the lungs. In the third stage, the body temperature has already stabilized ($t = 2.3$; $p < 0.05$) (Table 1).

According to the initial results of diagnostic tests, 310 (88.57%) out of 350 patients wore CPAP mask + PEEP (positive end-expiratory pressure)–6-8 cmH_2O. Pressure support (PS) due to the development of primary respiratory acidosis, marked hypoxemia and deep homeostasis disorders in the background of respiratory failure in all patients with ARDS, which is a complication of viral bilateral pneumonia caused by Covid-19 virus. 40 (11.43%) patients were immediately intubated as soon as they entered the ICU, artificial ventilation with FiO_2-60% in forced ventilation mode (PEEP is 8-10 cmH_2O) was synchronized BENNET^{TM}840 artificial respiration device (ARD) and patients were given a pron state. In addition, dynamic CT observation was performed during treatment, as shown in Figure 3.

Dynamic changes in some respiratory parameters were also studied in the examined patients, which resulted in the acquisition of very important indicators and are reflected in Table 2.

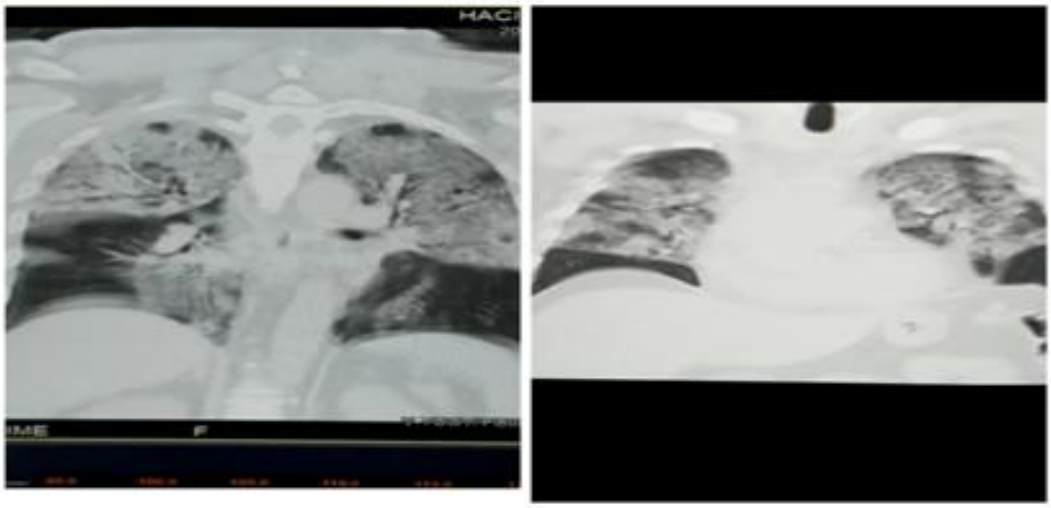

Fig. 3 X-ray of the lungs in patients diagnosed with Covid-19. The lung of a patient with COVID-19 is at the left. At the right is a patient undergoing pulmonary recovery from COVID-19 treatment.

Patients who were admitted to the ICU urgently had minute number of breaths (MNB) in the first stage more than the norm, and MNB in the first stage was 2.53 times higher due to the development of severe hypoxia and patients were intubated with fraction of inspiration O_2 (FiO_2)-60%, PEEP 8-10 cmH_2O (invasive) ARD in ACV-PS mode. CPAP-PS already in the second stage: FiO_2 50%; It was PEEP 4-5. Extubated on stage 7-14 in stage III, MNB decreased by 2.72 times ($t = 2.2$; $p < 0.05$) compared to stage I and was statistically accurate.

In patients breathing in room air, SpO_2 was 48% lower than normal. Against the background of ventilation, in the third stage it increased 1.43 times ($t = 3.8$; $p < 0.001$). One of the differential-diagnostic criteria of ARDS is the Oxygenation (Carrico) index, which (OI = PaO_2/FiO_2) is 300-500 mmHg. Due to the disruption of the diffusion process in the lungs, the Oİ in stage I was 75% less than the lower limit of the norm. It increased 1.54 times in the second stage ($t = 3.9$; $p < 0.001$); In the third stage, it increased 3 times ($t = 2.0$; $p < 0.05$) and reached the lower limit of the norm.

Another important fact is that the partial pressure of O_2 and CO_2 in the arterial blood of patients has been studied. The pH in stage II was 1.05 times compared to stage I ($t = 2.0$; $p < 0.05$); In the third stage, it increased 1.06 times and reached normal levels.

PaO_2 was 50% less than normal, it increased 1.43 times in stage II ($t = 1.9$; $p < 0.05$); In the third stage, it increased 1.66 times ($t = 3.94$; $p < 0.001$) and reached the lower limit of the norm. $PaCO_2$ was 18% higher than normal and decreased 1.67 times ($t = 3.78$; $p < 0.001$) in stage III and reached normal levels (Figure 4).

Table 2 Dynamics of respiratory parameters in patients.

Respiratory Parameters	Stages (Mean ±SD)		
	I	II	III
MNB	38.42 ±2.38	15.16 ±0.71**	14.15 ±1.93***
SpO_2 (%)	65.95 ±5.33	88.63 ±2.26**	94.37 ±1.19***
Oİ	99.29 ±20.25	153.78 ±8.06***	297.42 ±30.52*
pH	7.02 ±0.1	7.34 ±0.04*	7.42 ±0.04
PaO_2 (mm.cv.st)	53.63 ±5.78	76.84 ±4.09*	89.26 ±5.98***
$PaCO_2$ (mm.cv.st)	68 ±5.4	47.16 ±2.16**	40.68 ±2.79***
BE	-16 ±0.8	-3 ±0,01	2 ±0.01
Leukocytes x 10^3	32.6 ±3.6	12.5 ±3.2*	7.91 ±9.0**
CRP	358.8 ±47.29	32.58 ±43.56***	12.35 ±13.02***

The Statistical accuracy of the difference of different time indexes in patients. Note: Compared to stage I.: *p < 0.05; ** p < 0.1; *** p < 0.001.

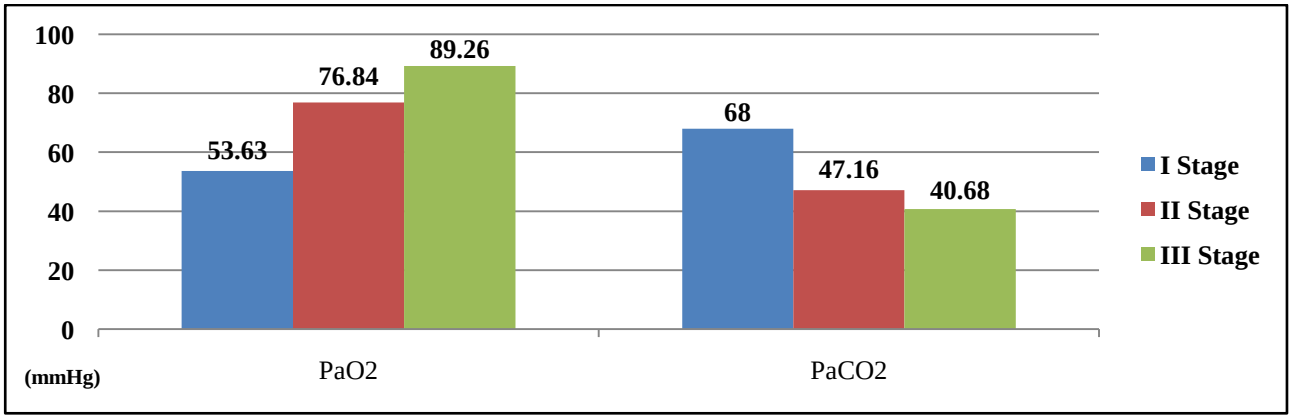

Fig. 4 Dynamic changes in arterial oxygen partial pressure and arterial carbon dioxide partial pressure. Compared to stage I.: *p < 0.05; **p < 0.01; ***p < 0.001.

Examination of patients' blood gases and acid-base state (ABS) revealed that the patients had primary respiratory acidosis and hypoxemia. These violations were eliminated due to proper ventilation parameters.

In patients, leukocytes were initially high, decreased by 2 times in stage III ($t = 2.8$; $p < 0.01$). CRP was also studied to determine the activity of the inflammatory process in the lungs, which was high in stage I. In the third stage, it decreased by 4.33 times ($t = 3.5$; $p < 0.001$) and reached the normal level.

4. Treatment

Bacteriological examination of tracheal material was carried out in all patients, and their susceptibility to antibiotics and antifungal drugs was studied. According to the results of the examination, 60% of patients had viral pneumonia, 40% had bacterial infections (30% of them were infected with *Acinetobacter baumannii* and *Candida ssp*, 10% were *Klebsiella pneumoniae*). Initially, in addition to receiving daily broad-spectrum antibiotics (Merapenem-16.5 mcg/kg; Linezolid-13 mcg/kg; Levofloxacin (1000 mg) was infused at 6.99 μg/kg), the patients also received CVP-controlled infusion. Cardiotonics, small-molecule heparins (fraxyparin or clexane) and hormonal and nutritive therapy were also given when necessary. Methylprednisolone is prescribed at 1 mg/kg and N-acetylcysteine at 19 mcg/kg. Favipiravir, an antiviral drug, was given 1600 mg per day, then reduced to 600 mg for the next 4 days. And in some patients, Remidesivir was given 200 mg per day, followed by 400 mg for the next 4 days. Intubated patients were fed through a gastric tube. General, blood biochemical analysis, pulmonary capillary oxygen content, coagulogram were monitored and corrected daily.

5. Results

Respiration of 50 (14.28%) patients intubated in 350 patients in the RITC with ventilator for 1-7 days in forced ventilation mode, PEEP 8-12; It was synchronized in BiLEVEL mode for 7-12 days. On days 12-15 of treatment, 26 (52%) of 50 patients intubated with SPONTAN regimen were extubated and wet oxygen was infused. During this period, blood sugar concentration, BP, body temperature were strictly controlled. On days 25-30 of treatment, patients were discharged home in adequate condition. Of the 50 patients intubated, 24 (48%) had mortality. Causes of death: 7 (29.17%) cases had acute pulmonary heart failure, 2 (8.33%) had thrombotic hemorrhage syndrome, 4 (16.67%) had pulmonary artery thrombosis, 3 (12.5%) had transmural infarction, 8 (33.33%) had polyorgan (lung-heart-liver-kidney) failure.

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