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Case report

HYPERBARIC OXYGEN THERAPY (HBOT) AS THE TREATMENT OF PROLONGED HYPOXEMIA DUE TO COVID-19

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ABSTRACT

Background - hyperbaric oxygen therapy (HBOT) is a clinical method of treatment with oxygen while under increased atmospheric pressure. It has been proven as an independent therapeutic factor for a number of diseases, and in the case of COVID-19, its potential as an adjuvant therapy is still being studied.

Case report – in the case of a 61-year-old man with severe pneumonia resulting from infection with COVID-19 and persisting hypoxemia and dyspnea after the acute phase. Prescribed continuous oxygenation in home conditions due to deteriorating general condition and quality of life. Undertaken additional hyperbaric oxygen therapy resulting in significant improvement after the 20th session.

Conclusion - the connection between HBOT and improved paraclinical and imaging indicators, in this case, suggests conclusions of a therapeutic effect of HBOT in hypoxemia as a post-COVID symptom.

Keywords: hypoxemia, COVID-19, hyperbaric oxygen therapy, quality of life,

INTRODUCTION

The COVID-19 pandemic has presented real challenges to medical and social care. Like any new nosological entity of human medicine encounters, it represents a springboard for the search for effective preventative, diagnostic, therapeutic and rehabilitative methods [1]. Approximately 15-20% of the infected patients develop/present hypoxemic respiratory failure requiring oxygen therapy [2].The conducted systematic examinations and studies point to the urgent need for massive clinical randomized trials to prove through a strict level of evidence that HBOT is a promising therapy [3, 4, 5]. Studies have already been published reporting improved clinical outcomes in hypoxemic patients [6] as well as fewer potential side effects [7, 8]. HBOT is believed to stimulate tissue oxygenation by increasing plasma soluble oxygen levels and to reduce inflammatory reactions by limiting the effects of the cytokine storm [9, 10].

CASE REPORT

It concerns a 61-year-old Caucasian patient hospitalized on December 15, 2021, after one-week outpatient treatment for sars-cov-2 infection. The only comorbidity - hypertensive heart disease without (congestive) heart failure (i11.9). Reports high fever (intermittent). General status during physical examination - poor general health condition, pale skin without rash, normal vesicular breathing, sonorous wheeze, saturation 92%, blood pressure 130/80, heart rate 75, abdomen soft and painless, respectively movable, bilateral negative succusio renalis. Oxygenation was prescribed the following day, initially at 8l/min, reaching 15l/min on December 20, 2021, with a high flow mask.

PARACLINICAL TESTS DATED DECEMBER 17, 2021

WBC: 16,3 G/L; RBC (Ery): 4,9 T/L; HGB: 155G/L; PLT (Thr): 470G/L; RDW-CV:11,80%; PDW: 10,5 Fl; potassium: 4,6 mmol/l; sodium: 137 mmol/l; GLUCOSE: 7,10 mmol/l; UREA: 6,8 mmol/l; CREATININE: 79 umol/l; ASAT (GOT): 81 U/I; ALAT (GPT): 73 U/I; CKMB: 30,34 U/I; LDH: 275 U/I; CRP: 47,30 mg/l; D-DIMER: 0,34 µg/mL; INR: 1,04; FIBRINOGEN: 6,44 g/l; FERRITIN: 1133,56 ng/mL

ARTERIAL BLOOD GAS ANALYSIS

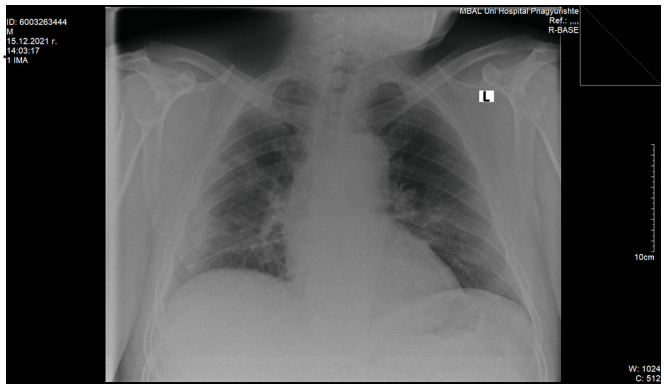
PO, : 59,10 mmHg; PCO, : 31,70 mmHg; pH: 7,36; satO, %: 89,60%; BE-ecf: 7,60 mmol/l; BE-b: 5,5 mmol/l; HCO*f* : 18,10 mmol/l; TCO, : 19 mmol/l; RPO, / FiO, : 282,60 mmHg; SBC: 19.80 mmol/l

IMAGING EXAMINATIONS

Chest x-ray dated December 15, 2021- caudio-cra-

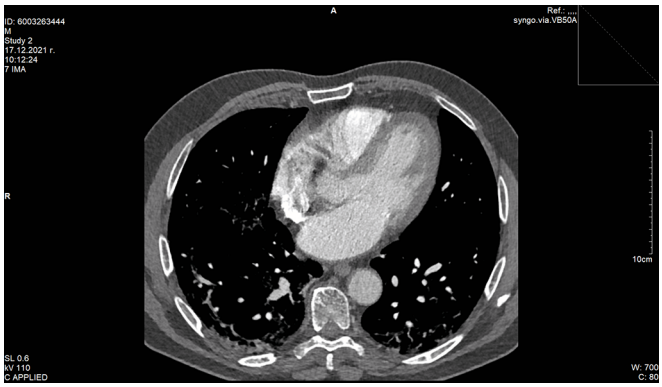
nial distribution of parenchyma condensation type lesions axillary and parahilar and left paracardial. Cor with left ventricle elongation (Fig. 1).

Fig. 1. Evidence for bilateral interstitial inflammatory changes, more predominant in right axillary and left paracardial.



Thoracic CT scan native dated December 17, 2021 - evidence for bilateral interstitial inflammatory changes of "ground-glass" type, located subpleurally. "cobblestone type" parenchyma condensations. No convincing data for pulmonary thromboembolism, no pleural effusion (Fig. 2-9).

Fig. 2-5. Pulmonary artery - main, lobar and segmental branches without evidence of thrombosis. Bilateral subpleural "Ground-glass" type changes and parenchyma condensations were observed in the lung parenchyma.



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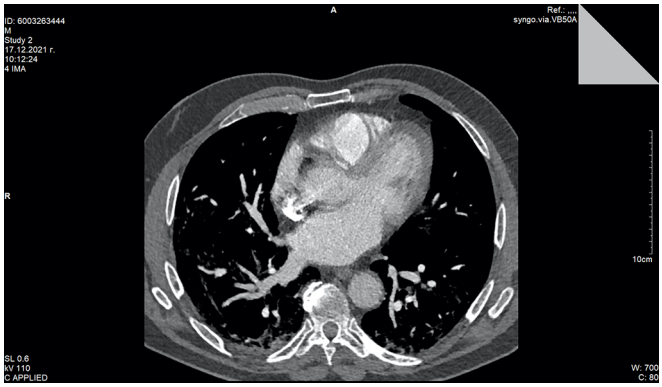

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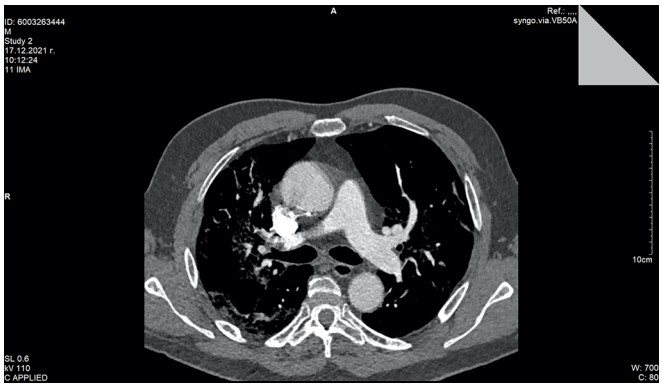


Fig. 5.

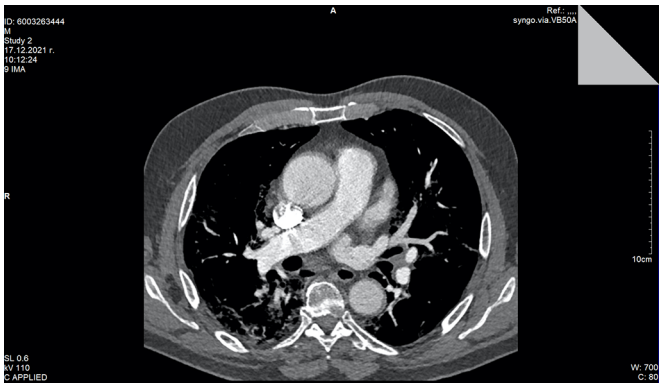


Fig. 6-9. Areas of parenchymal consolidation with fibrotic changes are observed but with a reduction of subpleural interstitial inflammatory changes.

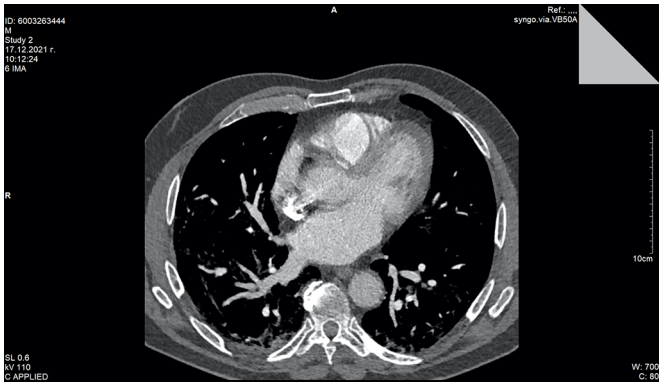


Fig. 7.

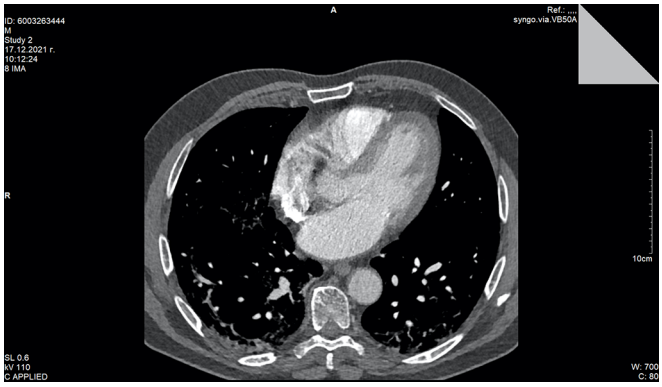


Fig. 8.

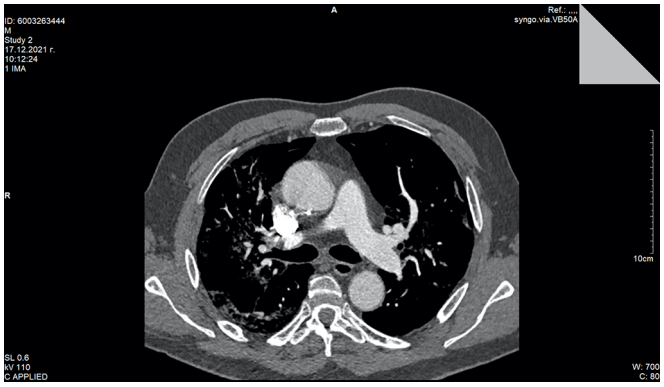
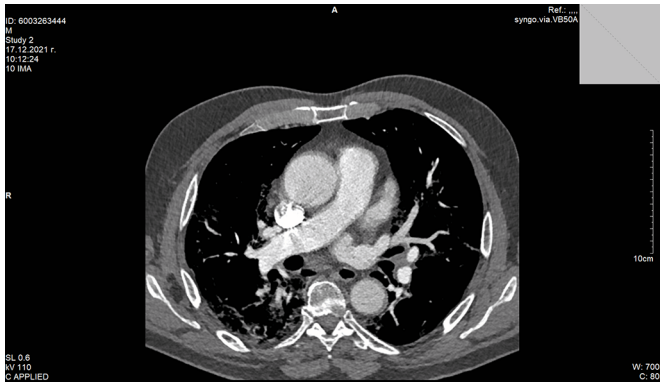


Fig. 9.



The patient was discharged after the period of active treatment on December 29, 2021, with the following medication prescription:

Corticosteroids, hepatoprotector, antibiotics, low molecular weight heparins, vitamins, antihistamines, antiviral (remdesivir), monoclonal antibody (regdanvimab), respiratory rehabilitation. The patient was discharged with a negative pcr-test but with no improvement in breathing.

On January 16, 2022, the patient arrived for a follow-up examination with persistent shortness of breath, difficult expectoration, fatigue, and sweating. Presence of tachycardia (110 beats/min), SAT%: 94% with O, 8l/min. Respiration - bilateral vesicular, weakened at the bases with crepitations in the right half of the lungs.

ARTERIAL BLOOD GAS ANALYSIS

PO, : 50,10mmHg; PCO, : 32, 40 mmHg; pH: 7,49; BE-ecf: 1,10 mmol/l; satO, : 88,30%; BE-b: 2,5 mmol/l; HCO*f* : 24,70 mmol/l; TCO, : 25,70 mmol/l; PRO, / FiO, : 239,80 mmHg; SBC: 26,40 mmol

The performed imaging examination does not report changes compared to the previous one in regarding to the lung parenchyma and adjacent structures.

20 HBOT sessions were held in the period January 26 – February 22, 2022. The regime includes 10-minute compression, 10-minute decompression and 40-minute saturation at 6-7m depth or 0.6 technical atmosphere pressure. The sessions are conducted in a multi-seat barometer model 8400 dl.

DISCUSSION

Impaired diffusion of oxygen due to COVID-19 leads to hypoxemia and subsequent inflammation, which further impairs tissue saturation [11]. There are already proven advantages of oxygen treatment under increased atmospheric pressure over one with normal atmospheric pressure:

- HBOT compensates for practically any form of oxygen deficiency
- HBOT extends the effective oxygen diffusion distance in tissues
- HBOT creates a certain oxygen reserve in the body [12]

The increase in the partial pressure of oxygen in the arterial blood leads to a corresponding increase in the oxygen tension gradient at the level of the tissue capillaries. Even at a lower capillary blood flow velocity, the high partial pressure of oxygen ensures more intensive diffusion of oxygen into the tissues [12].

After the hyperbaric oxygen therapy, the patient was admitted again for consultation with the following indicators:

PARACLINICAL TESTS DATED APRIL 18, 2022

WBC: 9,1 G/L; RBC (Ery): 4,8 T/L; HGB: 145G/L; PLT (Thr): 201G/L; RDW-CV:12,40%; PDW: 10,1 Fl; potassium: 4,4 mmol/l; sodium: 140 mmol/l; GLUCOSE: 5,7 mmol/l; UREA: 6,1 mmol/l; CREATININE: 65,6 umol/l; ASAT (GOT): 10 U/I; ALAT (GPT): 12 U/I; CKMB: 32,44 U/I; LDH: 157 U/I; CRP: 9,1 mg/l; D-DIMER: 0,27 μg/mL; INR: 1,01; FIBRINOGEN: 6,13 g/l; FERRITIN: 786,34 ng/mL

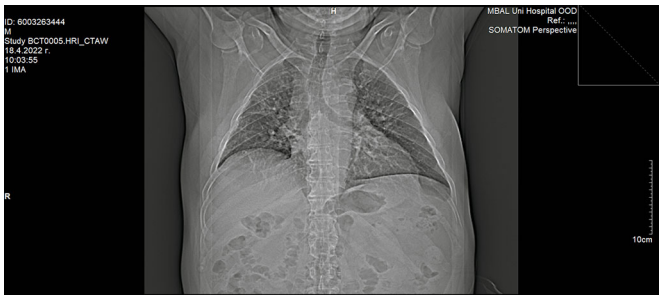
ARTERIAL BLOOD GAS ANALYSIS

PO, : 78,33mmHg; PCO, : 35,67 mmHg; pH: 7,42; BE-ecf: 1,16 mmol/l; satO, : 92,40%; BE-b: 2,5 mmol/l; HCO*f* : 22,36 mmol/l; TCO, : 26,80 mmol/l; PRO, / FiO, : 316,86 mmHg; SBC: 24,70mmol/l

IMAGING EXAMS

Thoracic CT scan - visible dynamics with reduction of the subpleural interstitial inflammatory changes (Fig. 10).

Fig. 10.



CONCLUSION

The progressive improvement of the patient's symptoms and test after the HBOT performed supports the conclusion of the positive effect of hyperbaric oxygen therapy on hypoxemia due to COVID-19. The case requires extrapolation through larger and clinically controlled studies.

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