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COVID-19: INTRAPULMONARY ALKALINE HYDROGEN PEROXIDE CAN IMMEDIATELY INCREASE BLOOD OXYGENATION

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KOVID 19: INTRAPULMONALNI ALKALNI HIDROGEN-PEROKSID MOžE TRENUTNO DA POVEĆA OKSIGENACIJU KRVI

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ABSTRACT

It has been shown that the new coronavirus infection is life-threatening for patients not because of the COVID-19 virus, but because of the complications it causes. The most dangerous complication of this disease is the airway obstruction syndrome, which occurs with atypical pneumonia. Blockage of the airways occurs due to the accumulation of excessively large amounts of mucus and pus in them and swelling of the lung tissue, so ventilation of the lungs with air becomes almost impossible. The sad outcome of respiratory obstruction is hypoxia and hypoxic brain damage. Under these conditions, extracorporeal membrane oxygenation remains the only known way to increase blood oxygenation. However, in 2021, it was shown that intra-pulmonary administration of a warm alkaline solution of hydrogen peroxide immediately turns mucus and pus into oxygen foam and increases blood oxygen saturation. The proposed technology is a new variant of emergency blood oxygenation in severe suffocation caused by blockage of the respiratory tract with mucus, pus and blood.

Key words: *airway obstruction; mucus; suppuration; hypoxia; airway management; expectorants; oxygen.*

SAŽETAK

Pokazalo se da je nova infekcija koronavirusom opasna po život pacijenata ne zbog kovida 19, već zbog komplikacija koje izaziva. Najopasnija komplikacija ove bolesti je sindrom opstrukcije disajnih puteva, koji se javlja kod atipične pneumonije. Začepljenje disajnih puteva nastaje usled nakupljanja preterano velike količine sluzi i gnoja i oticanja plućnog tkiva, pa ventilacija pluća vazduhom postaje gotovo nemoguća. Tužan ishod respiratorne opstrukcije su hipoksija i hipoksično oštećenje mozga. U ovim uslovima ekstrakorporalna oksigenacija membrane ostaje jedini poznati način za povećanje oksigenacije krvi. Međutim, 2021. godine pokazalo se da intrapulmonalna primena toplog alkalnog rastvora vodonik-peroksida odmah pretvara sluz i gnoj u kiseoničnu penu i povećava zasićenost krvi kiseonikom. Predložena tehnologija je nova varijanta hitne oksigenacije krvi kod teškog gušenja izazvanog začepljenjem respiratornog trakta sluzi, gnojem i krvlju.

Ključne reči: *blokada disajnog puta; sluz; gnoj; hipoksija; tretman disajnih puteva; ekspektoransi; kiseonik.*

INTRODUCTION

Not only healthy people can get sick with a new coronavirus infection, but also people suffering from various chronic or acute lung infections or other pulmonary pathologies. In particular, COVID-19 can become an additional infection against the background of an existing pulmonary form of tuberculosis, helminthic or fungal infection, as well as against the background of an existing bronchiectatic disease, cystic fibrosis, closed or open lung injury, thermal, chemical or physico-chemical burn of the mucous membranes of the respiratory tract, or against the background of allergic or idiopathic edema of the respiratory system. With all these lung diseases, the respiratory tract can be filled with mucus, sputum with blood veins, pus, serous, fibrous fluid, lymph, blood or liquid waste products of helminths (1-10). Therefore, in all these cases, respiratory distress syndrome is caused (or aggravated) by the accumulation of sputum, mucus, pus, lymph, serous, fibrous fluid, blood and/or waste products by the larva of worms in the alveoli. In this regard, the presence of these biological fluids in the respiratory tract may be one of the causes of hypoxia.

The death of patients in the final stage of bilateral non-specific pneumonia with COVID-19 occurs from hypoxia caused by respiratory obstruction. In this regard, the true cause of death of patients with COVID-19 is a lack of oxygen in the blood. It is hypoxia that causes hypoxic brain damage in patients with COVID-19. Therefore, in a critical situation, gaseous oxygen is used, in the form of forced ventilation of the lungs, and with its low efficiency - in the form of extracorporeal membrane oxygenation of blood (ECMO) (11-13).

It has been suggested that an alternative to ECMO and the strategy of an effective and affordable technology for eliminating hypoxia in respiratory obstruction would be developed by forced ventilation of the lungs with respiratory gases (11,14). However, a new viral pandemic

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has revealed a significant obstacle to saving the lives of COVID-19 patients. It turned out that effective intrapulmonary oxygenation by means of artificial lung ventilation is possible only after a breakthrough technology of immediate restoration of airway patency for oxygen access to lung alveoli. To solve a similar problem with severe asthma in 2021, it was proposed to dissolve thick mucus and thick pus in the respiratory tract by inhaling an aerosol of a warm alkaline solution of hydrogen peroxide, which provides a local mucolytic and pyolytic effect under these conditions (15).

The purpose of this work is to show the high prospects of intrapulmonary alkaline hydrogen peroxide for an emergency increase in blood oxygen saturation in hypoxia due to blockage of the respiratory tract with mucus and pus.

LITERATURE SEARCH

In the period from 2019 to 2021, the content of scientific articles and inventions was studied using the following keywords: COVID-19, SARS, MERS, coronavirus, pneumonia, respiratory obstruction, lung ventilation, mucus, pus, oxygenation, hypoxia, expectorants, mucolytics, hydrogen peroxide, recipe, composition, sodium bicarbonate, oxygen gas, aerosol for inhalation, solution for injection, intra-pulmonary injection, anti-inflammatory drugs, corticosteroids, antihistamines, local anesthetics, local hyperthermia. The following databases were used: search using the online databases of the Federal Institute of Industrial Property of the Russian Federation and the Elibrary library, PubMed, Scopus, Web of Science, Google Scholar, Yandex and ResearchGate. The information was limited to the introduction of drugs into the respiratory tract, into the lungs and the ability to dilute pus and mucus to increase blood oxygenation in hypoxia. The results were analyzed, prioritized, and summarized.

DATA SYNTESIS AND DISCUSSION

A study of the scientific literature has shown that in recent years a new group of drugs has been discovered, called "pus solvents" or pyolytic agents (16). These new drugs were developed by giving certain physical-chemical properties to the old drugs, in particular, a certain alkaline, osmotic, temperature and carbonated activity. It has been established that the most highly effective pyolytic agents are alkaline solutions of hydrogen peroxide, namely solutions of 0.3-3% hydrogen peroxide and 1-10% sodium bicarbonate heated to a temperature of +42 - +45 °C (15,16). It has been proven that with local interaction with purulent masses, these drugs literally "explode" the pus and immediately turn it into oxygen foam. The discovery of this possibility suggested that a new breakthrough technology for the urgent delivery of oxygen to the alveoli of the lungs can be formed on the basis of local application of alkaline solutions of hydrogen peroxide.

It has been shown that the mechanism of action of pyolytic agents is based on the action of the enzyme catalase, under the action of which hydrogen peroxide is converted into water and oxygen gas. As a result, oxygen gas bubbles cause the process of cold boiling and destroy purulent masses. At the same time, the presence of alkali additionally provides alkaline saponification of protein-lipid complexes in purulent masses. Additionally, it has been shown that pus solvents dissolve and turn into oxygen foam not only thick pus, but also blood clots, plaques, sulfur plugs and tear stones (16).

These data increase the likelihood that the introduction of pus solvents into the respiratory tract of the lungs can actually improve lung ventilation, which, in turn, can increase blood oxygenation in the condition of respiratory tract obstruction by pus and mucus. The high probability of achieving these results is shown by the content of the following inventions:

1. Aerosol for inhalation in obstructive bronchitis. RU Patent No. 2735502. (03.11.2020).
2. Aerosol for invasive mechanical ventilation in COVID-19. RU Patent No. 2742505. (08.02.2021).
3. The method of lung oxygenation in COVID-19. RU Application No. 2021102618. (04.02.2021).
4. A method of emergency intrapulmonary blood oxygenation in COVID-19. RU Application No. 2021114105. (20.05.2021).

Due to the high prospects of this area of scientific research, a biological model of respiratory obstruction was developed. The essence of this new model is that the lungs of experimental animals are filled with artificial sputum. Artificial sputum is a special gel prepared according to a special recipe from starch, gelatin, water and hemolysed animal blood (RU Patent No. 2748999). The formulation of artificial sputum includes 4.4-22.0% potato starch, 2.2-11.0% gelatin, 0.9% sodium chloride and 5% blood of an agricultural animal diluted with distilled water in a ratio of 1:1. Artificial sputum has a pH of 7.0 - 7.4, osmotic activity of 280-300 mosmol/l of water and a temperature of +37 °C.

In this invention, starch, gelatin and water are used to give artificial sputum a certain viscosity and stickiness, and hemolysed blood is injected to impart biochemical activity due to the presence of the natural enzyme catalase in the blood.

The fact is that in case of respiratory obstruction caused by COVID-19, in order to eliminate hypoxia, it is necessary to immediately replace the viscous sputum in the lung alveoli with gaseous oxygen. Therefore, it is the thick sputum in the respiratory tract of the lungs that

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should be the basis of the required screening model. The inventors of artificial sputum believe that in order to quickly obtain the desired results at first, it is reasonable to use isolated lungs of experimental animals. To simulate airway obstruction, it is proposed to use warm artificial sputum, which is injected through the trachea in a volume that provides subtotal filling of the airways of the lungs.

This experimental model of airway obstruction by sputum with traces of blood gives hope for the rapid discovery of drugs that eliminate hypoxia and death of patients with nonspecific pneumonia complicated by airway obstruction. The proposed model of airway obstruction can reduce the time and cost of screening, detection and evaluation of the effectiveness of new drugs designed to urgently increase blood oxygenation in patients with severe hypoxia.

It has been shown that a warm alkaline solution of hydrogen peroxide a single inhalation of the developed aerosol can immediately eliminate the attack of suffocation caused by obstructive bronchitis. The resulting positive therapeutic effect can be prolonged by repeated administration of this aerosol. It was also recommended to use this aerosol in inhalations not only to eliminate the attack of asthma, but also to prevent attacks of suffocation. In the latter case, it was recommended to inject the aerosol in the form of inhalations 3 times a day. It is shown that the duration of such inhalations should be no more than 5 minutes each (17).

However, traditional aerosol inhalations do not immediately improve airflow in the airways all the way down to the alveoli of the lungs. There are emerging reports that urgent dissolution of mucus and pus in the airways of peripheral parts of the lungs can be achieved by intrapulmonary injections (18,19). Moreover, calculations showed that this would require 0.5 – 2 ml of an alkaline solution of hydrogen peroxide.

Since hypersecretion of mucus and sputum, as well as accumulation of pus in respiratory tract, often worsen the outcomes of airway obstruction (20,21), the problem of urgent dissolution and removal of mucus, sputum and pus in respiratory tract deserves attention (22). Unfortunately, traditional technologies for the use of well-known mucolytics and expectorants are not yet highly effective (23-26). At the same time, new inventions give hope for the speedy detailed development of a new technology of mucolytic and pyolytic action in the respiratory tract. The fact is that the proposed technologies of topical application (inhalation and/or intra-pulmonary) of a warm alkaline solution of hydrogen peroxide seem quite reasonable. In particular, it has been shown that this solution provides rapid dissolution and foaming of thick pus and blood clots with the formation of gaseous oxygen (17). In late 2021, it was reported that intrapulmonary injection of an alkaline hydrogen peroxide solution eliminates hypoxia and normalizes respiratory biomechanics (27). At the same time, this solution has high efficiency and safety.

CONCLUSION

A review of inventions and scientific articles showed the possibility of effectively increasing airflow in the respiratory tract and oxygenation through intranasal application of a warm alkaline hydrogen peroxide solution. It was found that the administration of an aerosol of hydrogen peroxide and sodium bicarbonate increases the effectiveness of the treatment of severe asthma attacks and suffocation caused by purulent obstructive bronchitis, and also increases the effectiveness of artificial lung ventilation in COVID-19. Therefore, some further investigations are necessary to estimate the potencial thearpeutical role of a warm alkaline solution of hydrogen peroxide in the respiratory tract and into lungs tissue, which deserves further careful study.

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