Intrapulmonary and intrabronchial oxygen-producing antihypoxants eliminate asphyxia and hypoxemia

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Severe hypoxemia caused by sudden asphyxia with blood, purulent contents, food, vomiting, meconium, and severe acute respiratory syndrome can threaten hypoxic brain damage and death within minutes. Moreover, common technologies involving emergency blood oxygenation through the lungs are often ineffective.[1,2] Therefore, at the beginning of the coronavirus disease 2019 (COVID-19) pandemic, the high mortality rate from hypoxic brain damage challenged all researchers worldwide in finding a way to oxygenate the blood through the lungs despite respiratory obstruction immediately. It has been suggested that this problem can be solved by intrapulmonary, endotracheal, and/or endobronchial injection of an oxygen-producing antihypoxant.[3,4] Our experience in the physicochemical repurposing of hydrogen peroxide from an antiseptic into pyolytic, mucolytic, hemolytic, bleach, and antihypoxant agents by alkalizing hydrogen peroxide solutions to pH 8.4, heating them to 37–45°C and enriching them with oxygen gas under overpressure helped us solve this problem (RU 2360685, 10.07.2009; RU 2468776, 27.06.2012; RU 2538662, 10.01.2015; RU 2563151, 20.09.2015).[5-7] In recent years, all of these compounds have been combined into one pharmacological group called "warm alkaline hydrogen peroxide solutions" (WAHPSs).[8,9]

In 2023 and 2024, the first two patents were issued for WAHPSs designed for intrapulmonary injections (RU 2807851, 21.11.2023; RU 2831821, 16.12.2024). These solutions include 4.5% hydrogen peroxide and 1.8% sodium bicarbonate and oxygen gas before creating an overpressure of 0.2 or 0.3 atm. Chemical calculations, laboratory tests with portions of blood, mucus, sputum, pus, and meconium under *in vitro* conditions, and *in vivo* experiments on live rabbits have shown that when 100 mL of the above-oxygenated WAHPSs interact with blood, sputum, or pus, they can release more than 1.5 L of oxygen gas within a few seconds (depending on the interaction conditions). This oxygen-producing effect of oxygenated WAHPSs in the respiratory tract is not separable from the pyolytic, mucolytic and hemolytic impacts, which is manifested by the rapid formation of oxygen gas bubbles, which results in a cold boiling process, the foaming of colloidal liquids, their transformation into oxygen foam with a white color, an increase in the foam volume, the filling of all respiratory tracts with foam, the inflation of the lungs, the pushing of foam out of the upper respiratory tract and an increase in blood oxygenation in the animals (**Figure 1**).

In experimental models of awake rabbits, acute total asphyxia with blood or artificial sputum caused a decrease in the blood oxygenation index, which decreased from 92–94% to 50–55% after 3 minutes. A single intrapulmonary injection of 2–5 mL of WAHPS saturated with oxygen at 37°C under an overpressure pressure of 0.2–0.3 atm immediately stopped the decrease in the blood oxygenation index. Moreover, the index of blood oxygenation in the animals began to increase, and 7–10 seconds after intrapulmonary injection, it reached 90% in the complete absence of respiratory movements of the thorax in the rabbits.

In January 2025, a patent was granted in Russia for a method of endobronchial injection of WAHPSs aimed at urgently alleviating asphyxia (RU 2833321, 17.01.2025). This method involves performing endobronchial injections of WAHPSs via two catheters inserted simultaneously into the right and left bronchi through an intubation tube. In this case, the working end of each catheter is equipped with an inflatable balloon designed to occlude the airway. To eliminate asphyxia, an intubation tube is inserted into the trachea, allowing the insertion of two catheters whose working ends reach the right and left bronchi. The balloons are then inflated to achieve complete bronchial occlusion. Next, 50 mL of WAHPS was injected into each bronchus, and the proximal openings of the catheters were sealed. After 60 seconds, the bronchial occlusion is released, and the catheters are removed.

In the description of the invention, the developed method provides airway sealing for each lung and creates optimal conditions for the subsequent inflation of the lungs with oxygen generated from the catalase breakdown of hydrogen peroxide into water and oxygen gas inside the bronchi and bronchioles. This process increases the pressure inside the airways. The force of the excess pressure pushes the WAHPS deep into the airways. Therefore, in each lung, there is an urgent and violent foaming of biological masses containing the enzyme catalase and the splitting of hydrogen peroxide into water and oxygen gas. In this context, under excessive pressure, oxygen fills with itself all the airways up to the alveoli and spreads through the airways and lungs. Since the exit toward and beyond the trachea is closed, the entire volume of oxygen foam is pushed toward the small bronchi, where the older oxygen gas bubbles quickly and consistently burst one after another because of the alkalinity of the solution. This creates conditions for the absorption of oxygen into the blood.

Experiments conducted with isolated porcine lungs and rabbits demonstrated that elimination of bronchial occlusion and removal of catheters after 60 seconds provides completeness of interaction of WAHPS with biological masses located in the airways during blood asphyxia. The specified duration of airway sealing is necessary

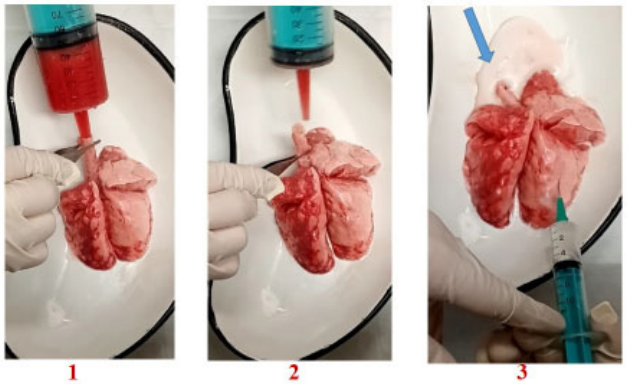

Figure 1 | **Rabbit lung isolation.**
Isolated rabbit lung before (1), after endotracheal injection of 40 mL of artificial sputum (2), and 1 second after intrapulmonary injection of 2 mL of warm alkaline hydrogen peroxide solution (3). The blue arrow indicates white-colored foam.

for the complete transformation of colloidal fluid into oxygen foam and for maximizing lung inflation with oxygen. In this case, maintaining artificial occlusion of the airways does not aggravate suffocation or hypoxemia. In contrast, preservation of airway occlusion creates optimal conditions for intrabronchial oxygen formation and blood oxygenation through the lungs and subsequently removes foam from the bronchi of both lungs through the trachea to the outside via aspiration methods. In particular, in the experiments on rabbits, at total asphyxia by blood, the index of blood oxygenation began to increase immediately after the injection of 2 mL of WAHPS into the right and left bronchi, reached 95% in 5 seconds, and remained at this level for 60 seconds until the elimination of bronchial occlusion and removal of catheters from them to the outside.

Overall, the results of laboratory and experimental studies have shown that intrapulmonary and intrabronchial injections of oxygen-producing antihypoxants, which are based on WAHPSs, can rapidly eliminate asphyxia and urgently oxygenate the blood during hypoxemia. The high speed and efficiency of asphyxia and hypoxemia elimination with the help of WAHPSs injected into respiratory organs support the prospects of further studies of intrapulmonary and intrabronchial WAHPSs to improve the efficiency of emergency medical care with the help of asphyxia caused by blood, purulent masses, food, vomit, and meconium, as well as severe bronchial asthma attack, drowning and hanging.[10]

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