

Lung Resuscitation with Perfluorocarbons Vapor: A Future Outlook

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Hypoxia is a major concern for human health. Multiple new techniques were proposed for tissue oxygenation in different variety of patients.

Clark Jr. et al. presenting their article titled “Fluorovent: A New Perfluorocarbon for Liquid Ventilation”, at a symposium in neonatology, in 1995, described the scientific importance for perfluorocarbons which would be ideally suited for use in liquid ventilation and artificial blood as well. In 1966, Clark published his article that demonstrated that spontaneously breathing mice could survive when submerged in perfluorocarbons (PFCs) under normobaric conditions. The first trial of liquid ventilation in preterm neonates in 1989 showed the feasibility and potential of liquid ventilation in humans [1]. So liquid ventilation became as an alternative ventilation strategy for respiratory distress.

The administration of perfluorocarbons in liquid form to the lungs has been associated with improved gas exchange, respiratory mechanics, and lung structure in different models of acute lung injury.

Because of the characteristically high density of this chemical group, liquid perfluorocarbon columns may also exert a mechanical effect in dependent lung zones, contributing to the opening of atelectatic areas and maintaining them open at end-expiration, as well as diverting pulmonary blood flow to nondependent lung zones. In addition, perfluorocarbons are able to attenuate the proinflammatory response during lung injury, which may improve pulmonary function and histologic findings. [2].

The preterm infant also experiences improvement in lung compliance and gas exchange within hours of partial liquid ventilation initiation, most likely due to reductions in surface tension and volume recruitment. Some investigators suggested that liquid ventilation could generate a “baby lung” effect, due to the migration of an incompressible liquid in the dependent lung and the resulting overdistension of the nondependent zones [3].

However, some clinical trials failed to demonstrate the ability of partial liquid ventilation to decrease morbidity in acute respiratory failure.

Due to some complications and morbidities, less invasive

modes of PFC application have been developed, whereby PFC was either vaporized or aerosolized, especially using perfluorohexane vapor. Perfluorohexane has a relatively low molecular weight and unique physicochemical properties among the perfluorocarbons, particularly the relatively high vapor pressure which permits its administration in vapor form [4].

The administration of vaporized perfluorohexane is particularly interesting because of the ease of its application. This vapor is distributed directly to ventilated regions that may be damaged in respiratory distress syndrome. In addition, some adverse effects of filling the lungs with a liquid perfluorocarbon, as pneumothorax, and formation of liquothoraces, can be avoided in this approach [5]. Ventilation with oxygen vaporized perfluorohexane can facilitate some catastrophic situations in anesthesia field, for example this method can be used in the time of laryngeal laser surgeries, or bronchus anastomosis, for a short period of time to avoid hypoxia, or for acute treatment of burn victims. Oxygenation with perfluorohexane vapor can be used in the time of resuscitation, in the time of difficult intubation or for treatment of severe asthma.

Lung lavage associated with perfluorocarbons and antibiotics can be used to eradicate infectious and inflammatory debris from the airways. Oxygenated perfluorocarbons can also have some other useful application in medical practice. Treatment of helicobacter pylori can be facilitated by drinking this fluid. Necrotizing cholangitis can be treated by enema of this fluid. Chronic or acute sinusitis or pilonidal sinus can be treated by injection of this fluid to the infected sinus. Induced hypothermia for brain protection can be performed by cold oxygenated liquid ventilation, but the heart muscle must be heated by a laser apparatus or other devices to avoid arrhythmia.

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