EVALUATION OF A DISPOSABLE PLASTIC, LOW VOLUME, PUMPLESS OXYGENATOR AS A LUNG SUBSTITUTE

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Objective
Show feasibility of pumpless lung assist in a femoral artery to vein shunt in animals and humans.

Study Design
1. Animal experiment, canine model (puppies).
2. Observational clinical study.

Study Population
15 puppies.
10 moribund infants and children with respiratory failure due to pulmonary or congenital cardiac disease.

Methods
Animal model: Tracheal obstruction to create hypercapnia and hypoxemia or complete pulmonary capillary-alveolar block.

Attachment of artificial lung between 1 or both femoral arteries and vein for 4–27 hours (clinical trials).

Endpoints: Arterial blood pressure, oxygen saturation (continuously), arterial blood gases in inflow and outflow blood, serum ketone, shunt blood flow.

Results
Oxygen partial pressure increased from inflow (27–119 mmHg) to outflow (59–654 mmHg), and $PaCO_2$ dropped from 40–85 mmHg (inflow) to 26–53 mmHg (outflow). Depending on the method, blood flow amounted to 42 - 101 ml/min/kg body weight. Gas exchange could be maintained via the homologous lung perfused by the heart.
All children awakened after marked lowering of their pCO_2, and became alert and responsive. No neurologic sequel was observed. One child is alive 18 months after lung assist without apparent harm.

Commentary
Landmark study that for the first time demonstrates feasibility of interposing an artificial lung in a systemic arteriovenous shunt in humans. Cannulation is considered the critical part of the technique: “It is essential to use the largest-caliber thinnest-wall cannula that can be inserted”. Small filling volume was achieved thus allowing to use normal saline to fill the lung prior to use.