NEXT GEN OXYGENATORS

SUPERIOR GAS EXCHANGE CAPACITY THROUGH OPTIMAL PERFUSION

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BACKGROUND

Oxygenators, regardless of shape, size, and build quality, suffer from inadequate blood perfusion due to:

- Wake zone formation in oxygenator's chambers
  - Blood gets trapped in gas/heat exchanger corners
  - Reduced membrane surface area efficacy
  - Increased risk of blood trauma and clot formation
- Wall effect phenomena due to loose packing density
  - Lower blood flow resistance near the walls
  - Shunt effect

Outcome

- Attenuated gas/heat exchange performance

Objectives

- Novel design utilizing an elastic frame amplifying pulsation
- Optimal performance via improved efficacy per surface area
- Inherent compliance eradicates blood pressure spikes
- Compact system design & priming volume minimization

METHODS & MATERIALS

- In vitro investigations with isotonic solution and pig's blood
- Elastic mantle surrounding the oxygenator's fiber bundle
- Rigid oxygenator shell featuring array(s) of identical cavities
- Diverse oxygenator blood pumping modes:
  - RP - Roller pump
  - EDU - External drive unit & check valves (no roller pump)
  - RP + EDU - Roller pump & EDU (no check valves)

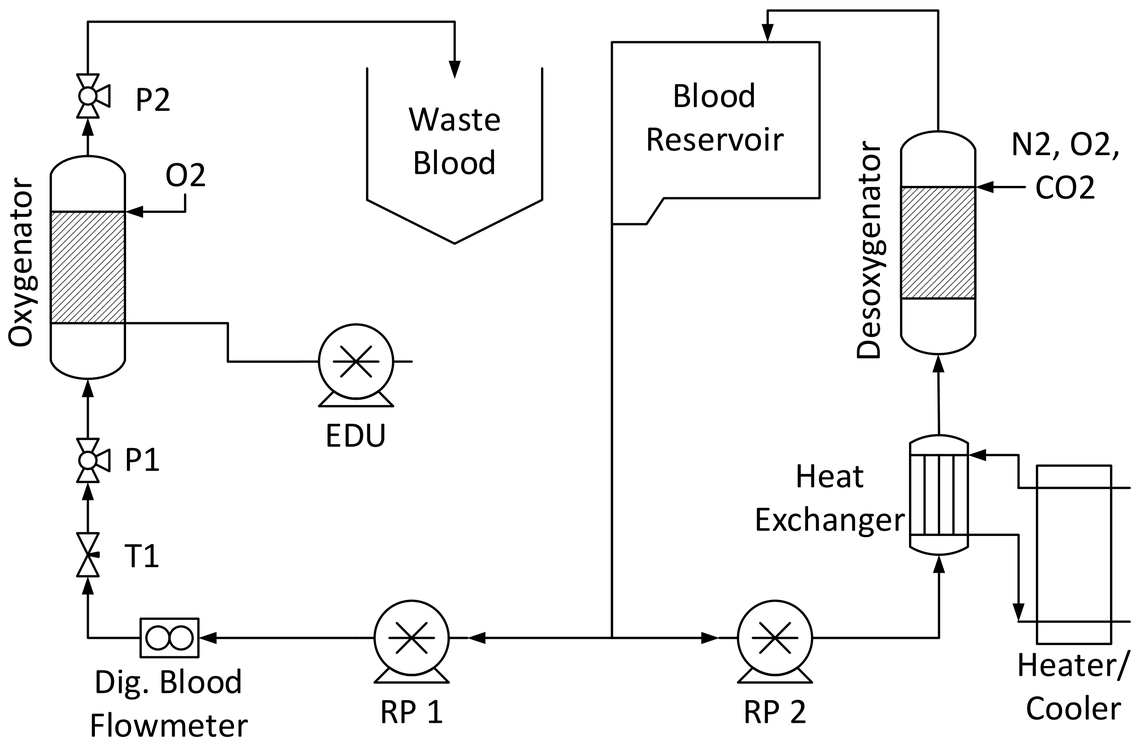

Fig. 1. Enhanced experimental setup with roller pump (RP1) and external drive unit (EDU). P1, P2, T1: Pressure and temperature sensors

RESULTS

- Gas exchange evaluation with fresh heparinized pig's blood
- Miniature test oxygenator
  - Effective surface area: A_{eff} = 0.06 m²
  - Priming volume: V_{prim} = 10 cm³
- EDU mode (pump-less operation) brings more than 30% increase in pO_2 and 27% improvement in CO_2 elimination (in comparison with regular operation RP)
- Enhanced active mode (RP & EDU) yields almost 75% improvement in pO_2 and 31% higher CO_2 removal

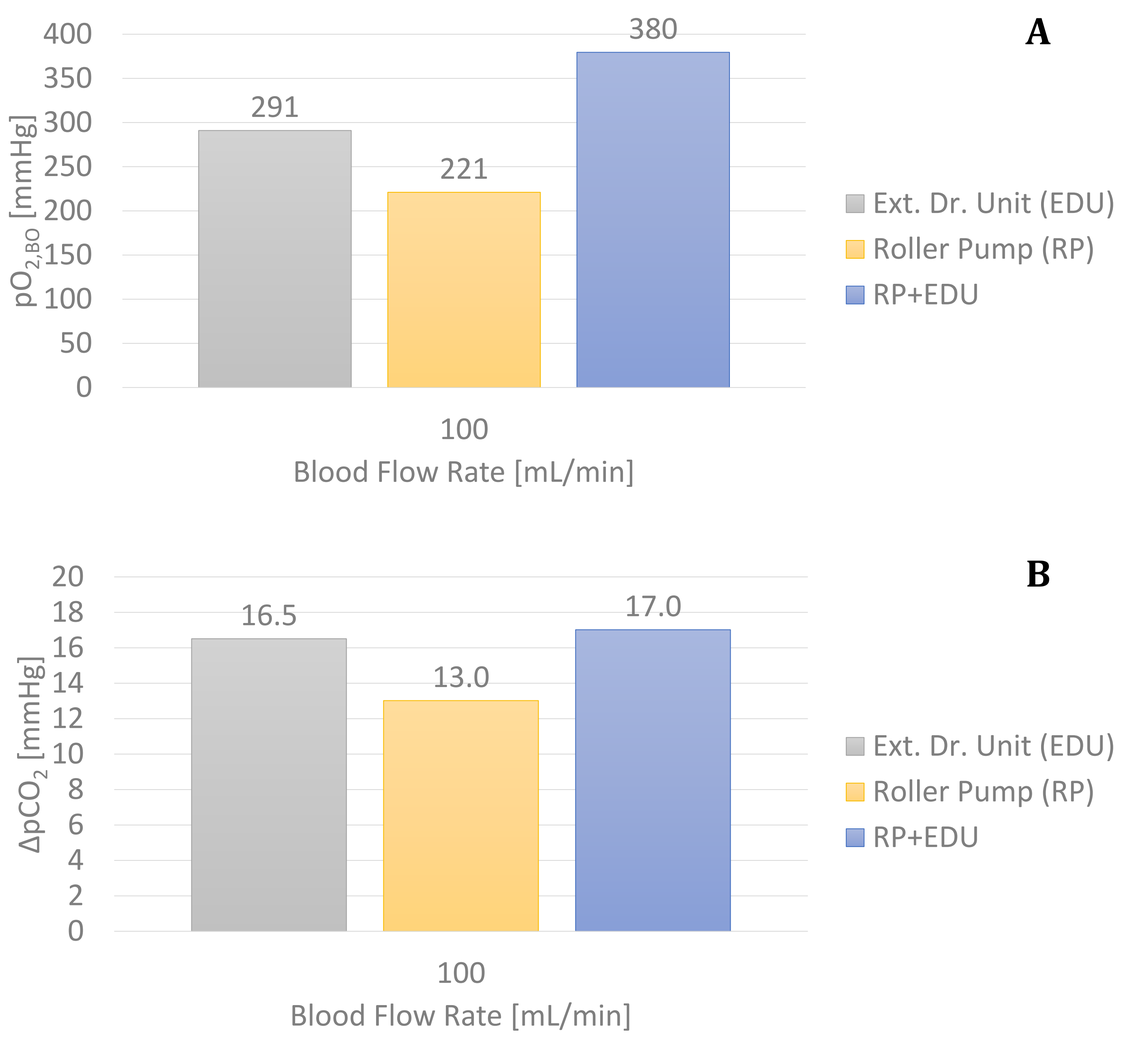

Fig. 2. A: Oxygen partial pressure at the oxygenator's inlet. B: Carbon dioxide partial pressure difference.

CONCLUSION

- Elimination of possible stagnation zones
- Secondary flow augmentation
- Minimized wall effect phenomena
- Improved surface area efficacy → Downsizing
- Manifold medical / research applications
  - Large scale models for future clinical implementation
  - Experimental medicine
  - Small scale model for pharmaceutical industry

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