Abstract of Research Presented at the 37th Annual Meeting of the American Academy of Cardiovascular Perfusion
February 4-7, 2016 | Savannah, GA

Goal-Directed Perfusion Methodology for Determining Oxygenator Performance during Clinical Cardiopulmonary Bypass

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Purpose
New generation oxygenators incorporate arterial line filtration either sequential to, or directly in, the gas exchange module. This unique design may affect gas exchange performance by altering the operational characteristics of the device. The present study was designed to evaluate three oxygenators in a clinical setting using a goal-directed perfusion algorithm during cardiopulmonary bypass (CPB).

Methods
After Institutional Review Board approval, 60 adult patients undergoing cardiac surgery for acquired heart disease were matched for disease state and body size into three groups based upon oxygenator type: Terumo SX18™ (n=20), Terumo FX15™ (n=20), and LivaNova Inspire6F™ 6 Dual (n=20). All perfusion, anesthetic, and postoperative care management was standardized using institutional goal-directed patient management processes. Data were collected and stored according to quality improvement guidelines.

Results
There were no differences in demographics or type of surgical procedure performed amongst groups. The Inspire6F patients required lower fraction of inspired oxygen values as compared to the SX18 (67.9±6.2 vs. 75.4±6.5, p<.005) and FX15 (79.1±8.4, p<0.0001) groups. Arterial oxygen content and oxygen delivery were slightly higher in the FX15 group as compared to SX18 (13.1±1.4 mL O2 dL⁻¹ vs. 12.4±1.1 mL O2 dL⁻¹, 611.1±150.4 mL O2 vs. 528.2±102.3 mL O2, p<0.05). The FX15 patients had significantly higher CPB hematocrits compared to SX18 patients (30.3±3.9 vs. 27.7±2.6, p<.05), but were not different when compared to the Inspire6F group (28.8±3.5, p<0.50). There were no differences in intraoperative transfusion rates, but a higher percent of patients required postoperative transfusions in the SX18 group as compared to either FX15 or Inspire6F groups (p<.039). There were no differences in postoperative morbidity or complications in any group.
Conclusions
In conclusion, the use of the SX18 was comparable to newer generation oxygenators in regards to gas exchange performance and the degree of hemodilution.
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Total Transfusion Volume (mL)

- PRBC: 0.042
- FFP: 0.029
- SDP: 0.104
- CRYO: 0.141

Hospital Stay Transfusion Rate (%)

- Intraop Transfusion: 0.435
- Postop Transfusion: 0.029
- Any Transfusion: 0.281

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**CvO₂ (mL O₂ dL⁻¹)**

- **SX18**: 9.5
- **FX15**: 10.7
- **Inspire6F**: 10.3

vs. FX15 p<0.021

**Line Pressure (mmHg)**

- **SX18**: 160.4
- **FX15**: 209
- **Inspire6F**: 192.1

vs. FX15 p<0.0001
vs. Inspire6F p<0.006