COMPARING TWO OXYGENATORS FOR ARTERIAL OXYGEN CONCENTRATION AND DELIVERY OF OXYGEN DURING CARDIOPULMONARY BYPASS

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There are no commercial association's with either company in this study

Comparing Two Oxygenators

Purpose

- The purpose of this clinical analysis was to compare the efficiency of two adult membrane oxygenators, the Affinity Fusion™, (Medtronic, Minneapolis MN) and the Sorin Inspire 6F (Sorin Group USA, Arvada, CO) for the arterial oxygen concentration and delivery of oxygen during cardiopulmonary bypass (CPB).
- Each oxygenator was evaluated for oxygen concentration (CaO_2), to evaluate for adequate patient oxygenation during CPB.
- The control group consisted of patients whose lungs were ventilated by the anesthesia machine; with CaO_2 being calculated from an arterial blood gas sample drawn after intubation of the patient prior to surgery at the respective facilities:
  - St. Vincent Medical Center, Bridgeport, CT- Affinity Fusion™
  - Dartmouth-Hitchcock Medical Center, Lebanon, NH- Sorin Inspire 6F

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Methods

- Patient study criteria: Hemoglobin measurement greater than 7g/dL during the entire procedure. If at any point during the procedure the hemoglobin measurement dropped to less than 7g/dL, that patient's case data was excluded from the study.
- During CPB each patient was circulated with a minimum flow index of 2.0 L/min/m^2.
- During CPB, arterial and venous blood gas values were measured every thirty minutes to determine CaO_2, venous oxygen content (CvO_2), partial pressure of oxygen in arterial blood (PaO_2), partial pressure of oxygen in venous blood (PvO_2), arterial oxygen saturation (SaO_2), and venous oxygen saturation (SvO_2).
- Microsoft Excel was used to gather/organize/compute data

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Materials

- The Affinity Fusion™ oxygenator, manufactured by Medtronic
  - This oxygenator system is designed to allow for better handling of air, allowing bubbles to dispel easily through the purge line
  - Improved hemocompatibility with the Balance™ biosurface coating as well as the Cortiva™ bioactive surface on each part of the oxygenator.
  - Surface area of 2.5 m^2, (Medtronic, n.d.) which is 5% of the average human lung surface area
- Sorin Inspire 6F by LivaNova™
  - With a “dedicated compartment, the integrated arterial filter design offers superior GME [gaseous microemboli] handling compared to competitive designs, while ensuring minimized impact on hemodilution,” (Inspire, n.d.).
  - The Inspire 6F has a surface area of 1.4m^2, (Inspire, n.d.) which is a 2.3% of the average human lung surface area.

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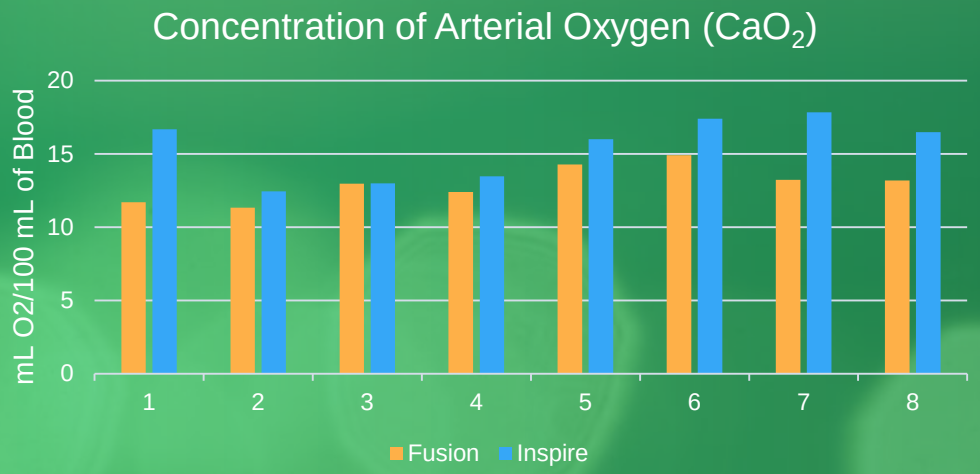
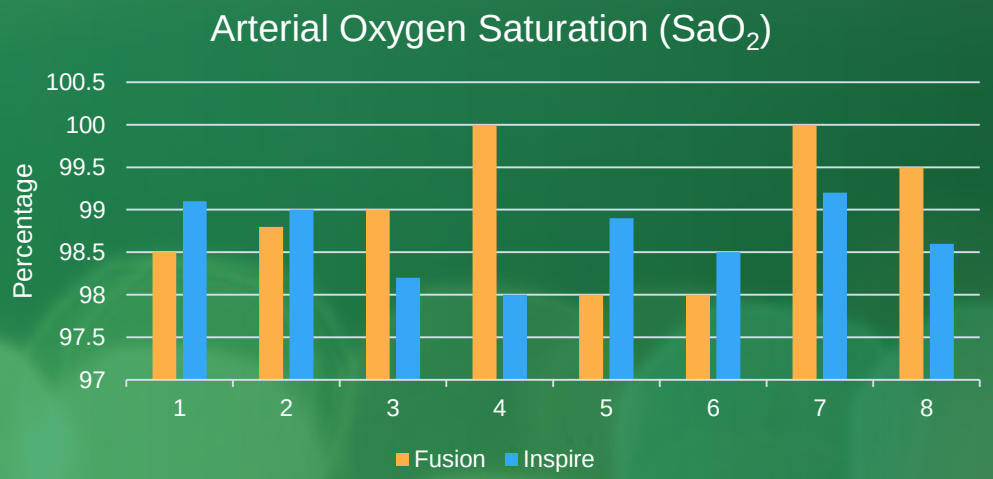
Results



CaO_2 for each patient from the respective oxygenators. The graph shows there is adequate oxygen concentration from each oxygenator, Affinity Fusion™ (orange), and the Inspire 6F (blue).
Average CaO_2 for Affinity Fusion™ 12.99 mL O_2/100 mL Blood;
Average CaO_2 for Inspire 6F 15.41 mL O_2/100 mL Blood.



The SaO_2 for all patients with each oxygenator after the initiation of CPB.
St. Vincent's/Affinity Fusion™ (orange) Dartmouth-Hitchcock/Inspire 6F (blue).
The average St. Vincent's SaO_2 98.975% (orange)
Dartmouth-Hitchcock SaO_2 98.675% (blue).

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Results Continued

- The Inspire 6F allows less blood to come in contact with the membrane and still efficiently diffuses oxygen well enough to adequately deliver oxygen to the patient.
- The Affinity Fusion has a lower concentration with a larger surface area. Larger surface area does not necessarily mean better diffusion of oxygen through the oxygenator membrane.

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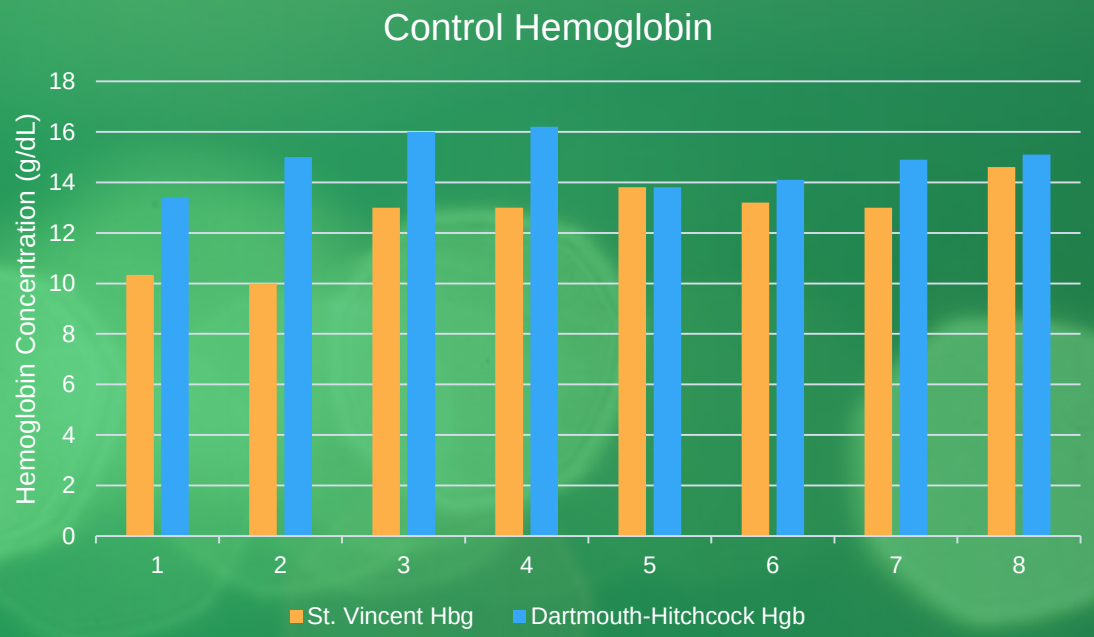
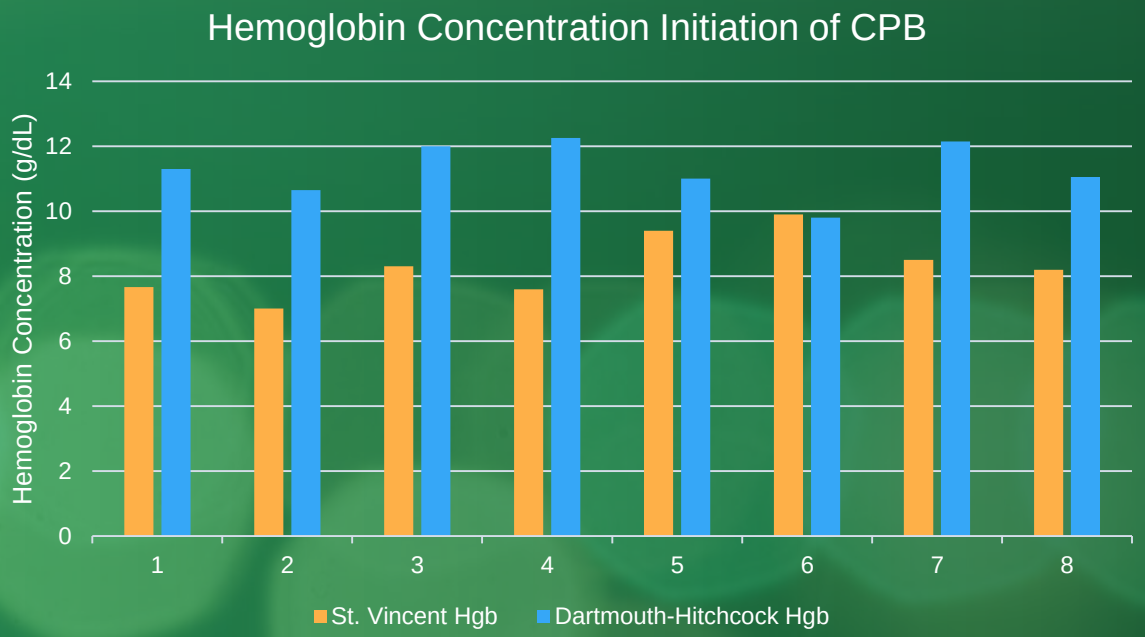
Discussion





The control hemoglobin for St. Vincent Medical Center (orange) drops an average of 4.3 g/dL.
After initiation of CPB the hemoglobin dropped an average of 3.5 g/dL for each patient at Dartmouth-Hitchcock Medical Center (blue).

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Conclusion

- Each oxygenator tested had positives and negatives that allow for each Perfusion team to find the ideal oxygenator(s) that work best for their patient population.
- With a smaller prime volume the Affinity Fusion is a good choice.
- A smaller surface area the Sorin Inspire 6F is a good choice if you want less exposure of platelets and other blood proteins to exogenous surfaces.
- No matter which oxygenator is chosen, parameters are used (Flow, Hg, FiO_2), to ensure the concentration of oxygen is sufficiently saturated appropriately once bypass is initiated.

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References

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