Effects of Hemoconcentration on Renal Function during Cardiopulmonary Bypass

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Disclosures

- I have No Disclosures
Overview

- Purpose of the study
- Definition of terms
- Methods
- Results of the meta-analysis
  - Fisher’s combined probability test
  - Risk difference analysis
- Discussion
- Implications for clinical practice and future research
Determine whether the use of hemoconcentration during CPB is associated with adverse renal events, specifically acute kidney injury (AKI)

Research hypothesis:
“There is a significant difference in renal functions between patients undergoing CPB with and without hemoconcentration”
Definition of Terms

UF = Ultrafiltration

HC = Hemoconcentration

HF = Hemofiltration

HD = Hemodialysis

HDF = Hemodiafiltration
Methods

- A literature search was performed to identify eligible studies \((n = 5)\) for a meta-analysis based on the following criteria:
  - use of hemoconcentration during CPB
  - compare the results of surgeries with and without hemoconcentration
  - contain a minimum of two data points pertinent to acute kidney injury (AKI)

- Statistical analyses:
  - Fisher’s combined probability test
  - Risk difference analysis
## Results: Overview of Findings

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>AKI Prevalence</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foroughi et al. (2014)</td>
<td>Prospective RCT</td>
<td>11% intervention vs. 5% control</td>
<td>NS, p = 0.2</td>
</tr>
<tr>
<td>Kanji et al. (2010)</td>
<td>Prospective observational</td>
<td>42% intervention vs. 41% control</td>
<td>NS, p = 0.98</td>
</tr>
<tr>
<td>Matata et al. (2013)</td>
<td>Pilot randomized trial</td>
<td>11% intervention vs. 5% control</td>
<td>NS, small sample size</td>
</tr>
<tr>
<td>Musleh et al. (2009)</td>
<td>Prospective RCT</td>
<td>18% intervention vs. 5% control</td>
<td>NS, p = 0.071</td>
</tr>
<tr>
<td>Pérez–Vela et al. (2008)</td>
<td>Prospective non-RCT</td>
<td>4% intervention vs. 3% control</td>
<td>NS, p = 0.36</td>
</tr>
</tbody>
</table>
# Results: Fisher’s Test

<table>
<thead>
<tr>
<th>STUDY</th>
<th>p–value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foroughi et al. (2014)</td>
<td>0.20</td>
</tr>
<tr>
<td>Kanji et al. (2010)</td>
<td>0.98</td>
</tr>
<tr>
<td>Musleh et al. (2009)</td>
<td>0.071</td>
</tr>
<tr>
<td>Pérez–Vela et al. (2008)</td>
<td>0.36</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>0.2258</strong>*</td>
</tr>
</tbody>
</table>

* The study by Matata et al. (2013) was excluded from Fisher’s test because the authors did not report significance due to small sample size.
Results: Risk Difference

RR (fixed effects) = 0.0491
95% CI = -0.0124 – 0.111
p = 0.118
Discussion

- None of the studies included in the analysis found a significant difference in AKI prevalence between the two groups.

- The risk difference analysis found that hemoconcentration during CPB reduces risk for AKI, but the difference was not statistically significant.
Discussion

- Alternative mechanisms for CPB-associated AKI pathogenesis:
  1. Duration of CPB
  2. Reduction of blood flow index (< 54 mL/min/m² of body surface area)
  3. Other independent predictors
Discussion

- Gaps identified in current research:
  1. Severity of adverse outcomes not measured
  2. None of the variables included as covariates:
     1. Glomerular filtration rate
     2. CPB duration
     3. Preoperative risk factors
     4. Blood flow index
## Discussion

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heterogeneous dataset</td>
<td>Only five studies satisfied inclusion criteria</td>
</tr>
<tr>
<td>Large sample size from studies (n = 510)</td>
<td>CPB flow rates not included in the analysis</td>
</tr>
<tr>
<td>Prospective studies only</td>
<td>AKI severity data unavailable</td>
</tr>
</tbody>
</table>
Hemoconcentration during CPB could reduce risk for AKI in low-risk patients.

Hemoconcentration does not appear to moderate the relationship between independent risk factors and AKI.

Hemoconcentration should be used to prevent severe hemodilution, but maintaining a moderate level of hemodilution can reduce risk for adverse renal events.
Future Research

- Multi-site randomized controlled trials with intervention (hemoconcentration) and control (no hemoconcentration) groups
- Use KDIGO guidelines to classify AKI based on severity
- Control confounding variables (e.g., CPB duration)
- Identify strategies for moderating relationships between independent risk factors (e.g., old age and medical history) and AKI
Take Home Points

- There is no significant risk difference for AKI between patients with and without hemoconcentration.
- Hemoconcentration does not moderate the relationship between preoperative risk factors and AKI.
- Moderate hemodilution can reduce risk for AKI.