

# Hemoconcentrator Priming and the Impact on Efficiency



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## Disclosures

No disclosures



## Overview

- History
- Background
- Methods
- Results
- Conclusions



## History

Brull, L.- 1928

Realization de l' ultrafiltration in vivo. C R Soc Biol (Paris) 1928;99:1605-1608.

Introduced the concept of removing excess fluid from the intravascular space in patients with renal failure by the filtration of blood through an ultraporous membrane.



## History

Romagnoli A, et al.- 1976



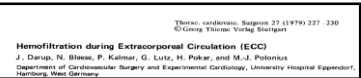
The 1<sup>st</sup> use associated with CPB

“External hemoconcentration after deliberate hemodilution.”

Annual meeting of the American Society of Anesthesiologists, extracts of scientific papers, San Francisco, October 1976,209



## 1979- Darup



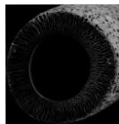
Hemofiltration can be used to:

1. Balance fluids during ECC/ reversal of hemodilution
2. Treat renal insufficiency on CPB
3. Treat acute hyperkalemia



## 1980's

- Concept of CUF, volume overload
- More widespread use on CPB
- Emergence of products



## 1990- Wheeldon



- Technique paper
- Conclusions:
  - Simple
  - Efficient
  - Inexpensive
- Blood volume control
- Blood conservation



## 1995- Groom et al

Perfusion 1995; 10: 393-401

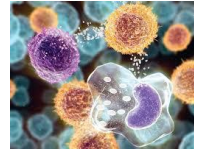
**Paediatric perfusion practice in North America: an update\***

Robert C Groom, Aaron G Hill The Virginia Heart Center at Fairfax Hospital, Falls Church, Virginia, Mark Kurusz The University of Texas Medical Branch, Galveston, Texas, Nelson Munoz, Kelley J McGowan, Justin J Rowley, Bechters F AM, Alan Spahr and Edward A Lefrak The Virginia Heart Center at Fairfax Hospital, Falls Church, Virginia

76% use hemoconcentration during CPB

## Why?

- Removal of complement and cytokines
  - TNF- $\alpha$ , IL-6, IL-8
- Decrease tissue edema
- Increase HCT
- Decrease total body water
- Improve pulmonary compliance



## Pediatric Perfusion



- Groom survey, 2017
  - 86% of respondents utilize UF during CPB
- Decreasing prime volumes
- Hemofilter can be significant volume to add routinely into circuit
- HPH Jr

## HPH® Jr

Product	HPH Junior
Membrane Surface Area (m <sup>2</sup> )	0.09
Membrane Material	Polysulfone
Prime Volume (ml)	8
Molecular Weight cut-off (Daltons)	65,000
Pressure Drop <sup>1</sup> (mmHg)	55
Maximum Transmembrane Pressure (mmHg)	500
Overall Unit Length (cm)	15
Internal Unit Diameter (cm)	2.5
Fiber Internal Diameter (microns)	200
Tubing Connections	
Blood [mm (inch)]	Male Luer
Filtrate [mm (inch)]	Female Luer



## The "Burnside" Method

Lower efficiency of the HPH Jr

Primed with Albumin

Anecdotally better fluid removal rate



## Methods

- All congenital cardiac patients
- < 15 kgs (HPH Jr)
- Undergoing CPB
- Requiring cross clamp (circuit design)



## Methods

- Randomized into 2 groups:
  - Coated: 50 mls 25% Albumin/ 200 mls prime
    - Circulated for 5 minutes
    - Clamped off until after 1st dose of CPG
    - Measured fluid removal over 30 minutes
    - Standard flow: 70 ml/min, Vacuum: -150 mmHg
  - Uncoated: Normosol® only



## Results

Variable	All (N=42)		Non-coated (n=22)		Coated (n=20)		P-value
	Mean	SD	Mean	SD	Mean	SD	
Height	68.1	18.0	72.1	21.4	63.8	12.6	0.13
Weight	7.7	4.3	8.7	5.1	6.6	2.9	0.49
CPB	128	84	128	86	138.5	83	0.41
XC	50	35	51.5	34	48	35.5	0.89

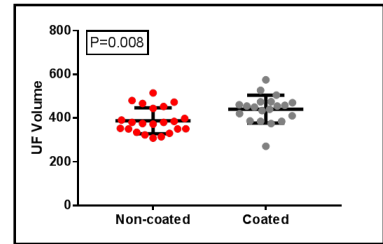


Results

Variable	All (N=42)		Non-coated (n=22)		Coated (n=20)		p-value
	Mean	SD	Mean	SD	Mean	SD	
UF Volume	412.8	66.4	387.6	59.3	440.6	63.9	0.008



Results



Conclusion

- Albumin coating of the HPH Jr significantly improves the efficiency of fluid removal



Perfusion, 2018 Oct 33(7):620-624. doi: 10.1177/0267659118764270. Epub 2018 Apr 11.

Albumin priming improves the efficiency of the Minntech HPH Jr. hemoconcentrator.

Burnside JL<sup>1</sup>, Rattih TM<sup>1</sup>, Salvator A<sup>2</sup>, Hodges AB<sup>1</sup>.

Author Information

Abstract

The desired use of the HPH Jr. is optimal due to the low priming volume; however, the lower rate of volume removal necessitates utilization of a larger hemofilter. Larger hemofilters carry a higher prime volume, which is impactful in the pediatric setting. Pediatric cardiac surgery patients under 18 kilograms requiring cardiopulmonary bypass were randomly assigned to one of two study groups. Group 1 (coated) contained an HPH Jr. hemofilter that was primed with the addition of 25% albumin and heparin. Group 2 (non-coated) contained an HPH Jr. hemofilter that was primed with only Normosol-RB. After cardioplegia delivery, zero balance ultrafiltration (ZBUF) was initiated and maintained for thirty consecutive minutes. The flow through the hemofilter was standardized at 70 ml/min and the vacuum applied to the effluent line was set at -150 mmHg. Effluent fluid removal was measured at the termination of thirty minutes and compared between the groups. Group comparisons between the coated vs non-coated hemofilter groups were assessed using two-sample t-tests or the Mann-Whitney U test, when appropriate. Forty-two patients were included in the analysis. There were 22 patients who had the non-coated hemofilter and 20 patients with a coated hemofilter. The differences between the two groups are illustrated in Table 1. There was a statistically significant higher ultrafiltration volume with the coated hemofilter group (p<0.008) (Figure 1). These results illustrate the improved efficiency of the HPH Jr. with the addition of 25% albumin and heparin during the priming process.

KEYWORDS: albumin coating; fluid removal rate; hemodilution; hemofiltration; pediatric cardiopulmonary bypass

## Future Directions

- Contrast:
  - HCT
  - TMP
  - Heparin Concentration
- Time analysis- loss of efficiency over time without albumin



### The BURNSIDE Method

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