

Original Article

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Heparin Washout in the Pediatric Cell Saver[®] Bowl

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Abstract

The possibility of residual heparin in washed red cells transfused to neonatal or pediatric cardiac patients following bypass prompted a measurement of heparin concentrations. Samples were taken during 10 adult and 10 neonatal and pediatric bypass cases. Sample A was from the bypass circuit, Sample B from the Haemonetics Cell Saver bowl inlet before washing, Sample C from the Cell Saver bowl outlet after washing, and Sample D from the patient ten minutes after protamine. Heparin concentrations were measured by a chromogenic assay using activated Factor X.

There was no significant difference between the adult

and pediatric groups in the levels of heparin concentration on bypass, pre-washing and post-washing, and in the patients following protamine. In the pediatric group, only .002% of the pre-washed heparin remained after washing. This extremely low level of heparin (.0027 units/ml) is only 0.34 units in a 125 ml pediatric unit of Cell Saver blood. Based on post bypass patient samples, this has no clinical significance. Therefore, the Cell Saver can be used safely with neonates and pediatric patients without concern regarding residual heparin when properly processed.

Introduction

Blood conservation techniques and their use in cardiac surgery have decreased the risks of transfusion reactions, sensitization to blood products, and transmission of infectious diseases. (1) Various methods may be employed including use of the Haemonetics Cell Saver^a which is widely used for hemoconcentration, and intraoperative or postoperative autotransfusion. Because of the superior quality of autologous blood which, for example, has been shown to contain higher levels of 2,3 diphosphoglycerate than stored banked blood, we employ the use of cell saving throughout the entire open-heart

procedure. (2) Consideration must be given to the variety of contaminants that may be aspirated from the surgical field before cell processing occurs. This includes heparin and other anticoagulants, as well as antibiotics and various wash solutions. The efficacy of Cell Saver processing, specifically for the removal of heparin, is evaluated by measuring the residual heparin in the washed red cells returned to the patient.

Materials and Methods

Twenty consecutive patients undergoing cardiac surgery with the use of cardiopulmonary bypass were selected for this study. All patients received the use of the Haemonetics Cell Saver 4^a from the time of the skin incision, during cardiopulmonary bypass, and until the chest was closed. The standard Cell Saver protocol for the Haemonetics Cell Saver 4 for

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	ADULT		PEDIATRIC		p-value*
	mean	S.D.	mean	S.D.	
pump (A)	1.66	0.90	1.11	0.45	0.11 NS
pre-wash(B)	1.76	1.38	1.39	0.46	0.42 NS
post-wash(C)	0.009	0.005	0.003	0.03	0.74 NS
patient(D)	0.04	0.04	0.06	0.03	0.23 NS

Table 1.
Heparin Concentrations (units/ml) Adult and pediatric heparin concentrations (units/ml) from the following samples: pump (A), pre-wash (B), post-wash (C), patient (D).

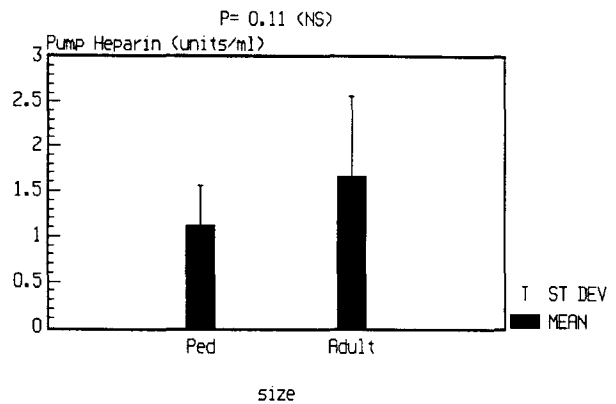


Figure 1.
Pump heparin level (units/ml) comparing pediatric (n=10) and adult samples (n=10).

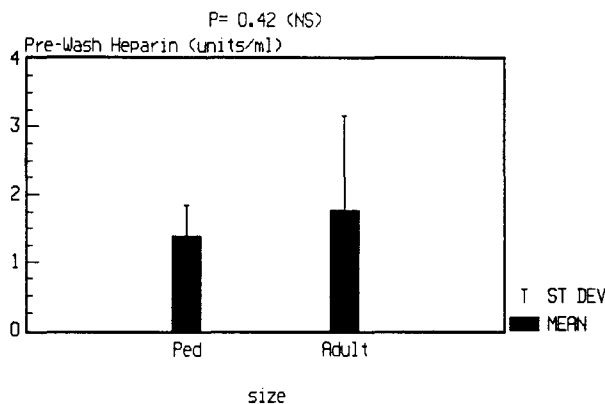


Figure 2.
Pre-washed heparin level (units/ml) comparing pediatric (n=10) and adult samples (n=10).

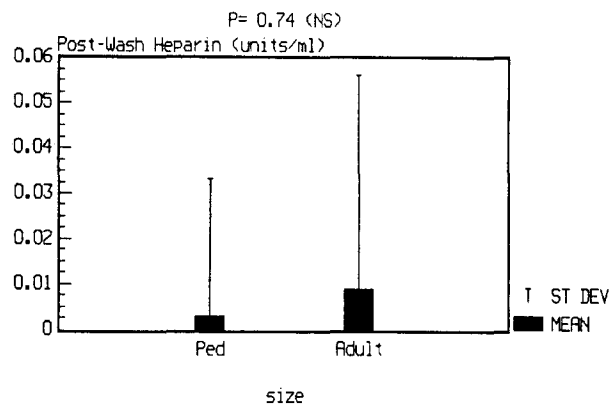


Figure 3.
Post-washed heparin level (units/ml) comparing pediatric (n=10) and adult samples (n=10).

filling, washing, and emptying cycles was used. Analysis was performed on the following samples using a Stachrome Chromogenic Heparin Assay^b.

- Sample A: patient blood sample prior to termination of cardiopulmonary bypass.
- Sample B: collection of blood taken directly from centrifuge bowl with a luer-lock connector inserted into the outflow tubing before washing.
- Sample C: from the cell saver bowl post-washing of cells to be collected in the same manner as sample B.

Sample D: patient blood sample 10 minutes after protamine infusion.

The Hepcon System 4^c was used for determining the protamine dose for heparin reversal as well as heparin neutralization in the adult patients. During the pediatric series, protamine dosage was calculated using the empirical formula method (1.3 mg protamine : 1 mg. heparin), and heparin reversal was determined by a final ACT that is lower than a baseline ACT. It must also be noted that the adult samples were obtained from a standard volume bowl (225 ml), whereas the pediatric samples were obtained from a low volume bowl (125 ml).

Results

The measured levels of heparin concentration (mean and

b. American Bioproducts Corporation, Parsippany, NJ 07054

c. Medtronic HemoTec, Inc., Englewood, CO 80112

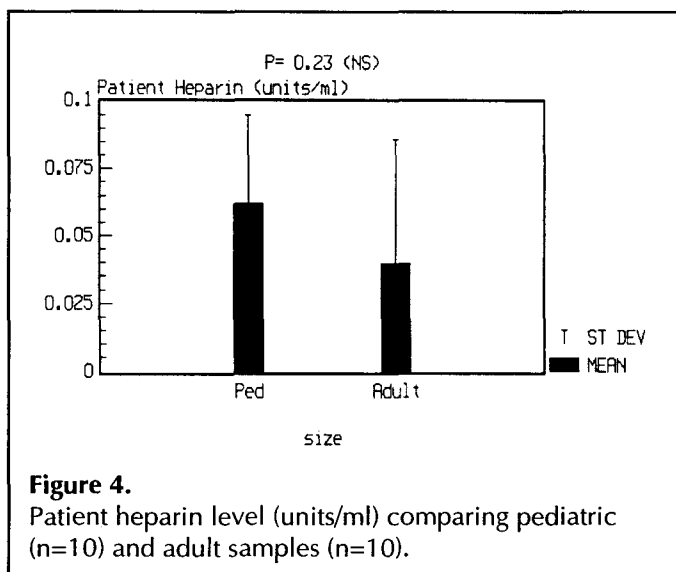


Figure 4. Patient heparin level (units/ml) comparing pediatric (n=10) and adult samples (n=10).

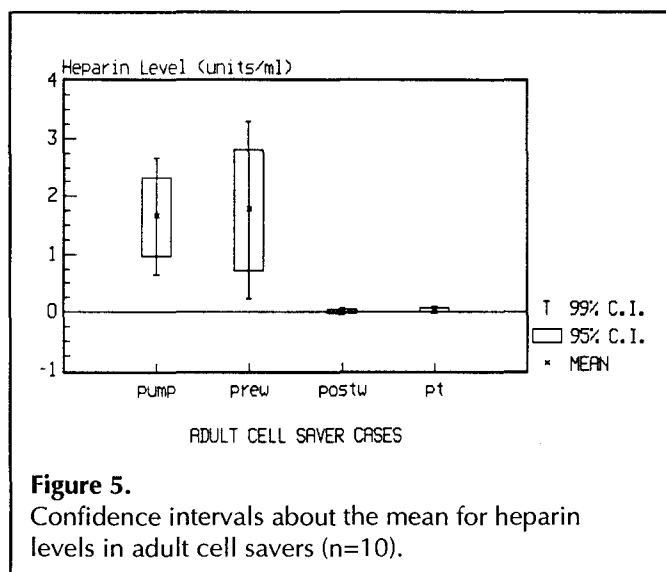


Figure 5. Confidence intervals about the mean for heparin levels in adult cell savers (n=10).

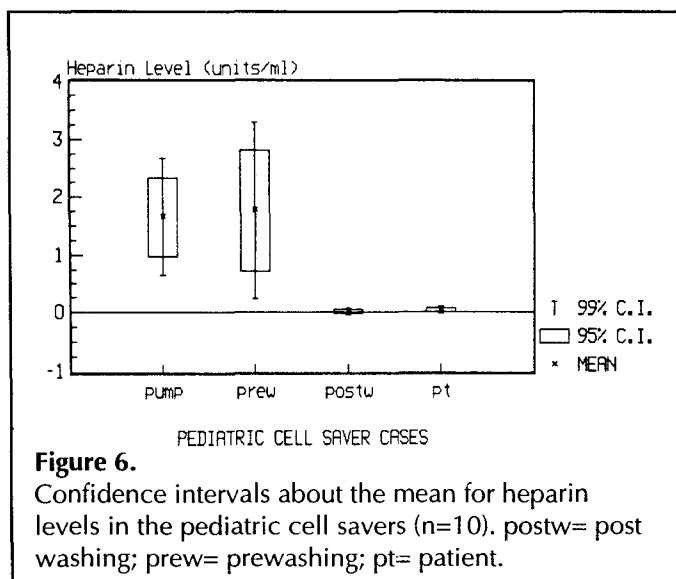


Figure 6. Confidence intervals about the mean for heparin levels in the pediatric cell savers (n=10). postw= post washing; prew= prewashing; pt= patient.

standard deviation) from the four sampling times are reported in Table 1. The level of heparin post-washing in the pediatric group is only 0.0027 units/ml. This would amount to only 0.34 units of heparin in a 125 ml. pediatric Cell Saver blood unit.

The samples for the adult and pediatric groups were compared using the 2-sample t-test. There was no significant difference between the adult and pediatric groups in the levels of heparin concentration on bypass (sample A), pre-washing (sample B), postwashing (sample C), and in the patients following protamine (sample D). The results and p values are reported in Figures 1-4. Confidence intervals of 95% and 99% about the mean for both the pediatric and adult samples are shown in Figures 5 and 6.

Conclusions

Our findings support the effectiveness of the Haemonetics Cell Saver 4 in removing clinically significant amounts of heparin from the washed blood. This permits infusion of Cell Saver units to pediatric patients without concern regarding residual heparin infusion when the manufacturer's recommendations for processing are followed.

References

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