
Clinical Effects of Extracorporeal Hemodilution in Congenital Cyanotic Heart Disease (*)

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Twenty patients with tetralogy of Fallot who undergone total correction were included in this study on a random basis. They were divided into two groups each consisted of 10 patients. One group received crystalloid priming volume, while in the other 40% of the priming volume was fresh heparinized blood. Hematocrite, blood gases and acid-base, urine output, postoperative drainage and blood replacement values were compared in both groups. Lower hematocrite values were achieved in the hemodilution group with increased urine output. There were no significant differences in blood gases, acid-base, postoperative drainage, and blood replacement values. Further, patients in the hemodilution group were free from risks of transfusion.

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Extracorporeal circulation has features that make it unique, when compared with other surgical procedures. Use of hemodilution is one such asset. Extensive research on limiting the effects of extracorporeal circulation within physiological boundaries continues^{1,2,3,4}.

Hemodilution is a well accepted technique when performed in safe physiologic limits. It decreases blood viscosity, improves microcirculation, and causes changes in oxygen transport, acid-base equilibrium, hemostatic system, cellular and non-cellular blood elements, and fluid contents of various body compartments^{5,6,7,8}.

In this study, we have examined the effects of different hemodilution levels on cyanotic congenital heart disease patients undergone open heart surgery, with special attention to changes in hematocrite, blood gases, urine output, and postoperative drainage values.

Material and Method

This study covered 20 patients with cyanotic congenital heart disease that underwent open heart surgery. All of these patients had tetralogy of Fallot, they weighed bet-

(*) This study was done as thesis at Hacettepe University School of Medicine.

ween 10-15 ks, and their preoperative hematocrite values ranged between 0.55-0.65. Eight patients were female and 12 were male; the youngest 2 and the oldest was 5 years old, the mean age was 3.5 years old.

In Group 1, 10 patients received crystalloid priming volume alone, while in Group 2, 40% of the priming solution consisted of fresh heparinized blood. The preoperative hematocrite value was 0.606 ± 0.007 in the first group and 0.607 ± 0.009 in the second.

In all cases, air-bubble oxygenators, roller pumps, crystalloid cardioplegia, and moderate hypothermia (28 °C) was used. Mean perfusion flow rate was 2.4 L/min/m². Aortic cross-clamp time was comparable in both groups, and all patients received 500 ml/m² fluid.

Hematocrite values were measured preoperatively, after completion of the operation, and on the 24th. postoperative hour. Arterial blood samples were taken and measurements were made by the capillary technique.

Blood gases and pH were evaluated at the beginning of the operation, on the 15th. minute, after end of the operation, and on the 24th hour from arterial blood samples. "Acid-Base Analyzer ABL 30" instrument was used for these measurements.

Mean urine output measurements were made (ml/hr) pre-, during, and post-cardiopulmonary bypass, and in the postoperative 12th and 24 hour periods.

Postoperative 24 hour chest drainage and amount of blood transfusion (ml/hr) were recorded.

The results obtained for each parameter were individually analyzed statistically, using the important control test.

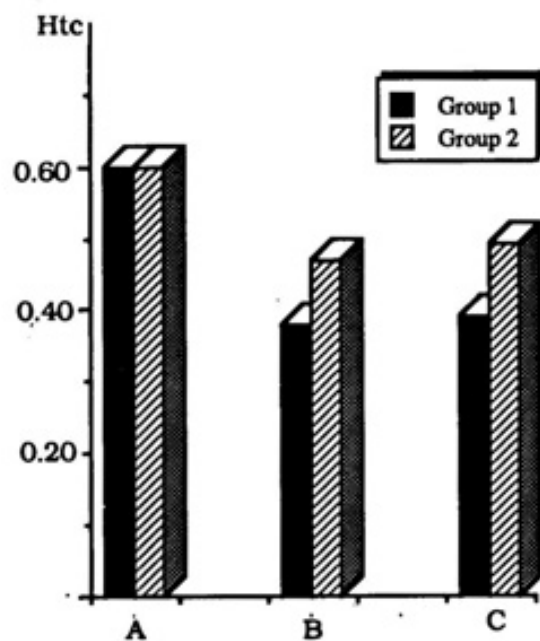


Fig.1: Hematocrite levels of Group and Group 2 patients.

A: Preoperative
B: Early postoperative
C: Postoperative first day

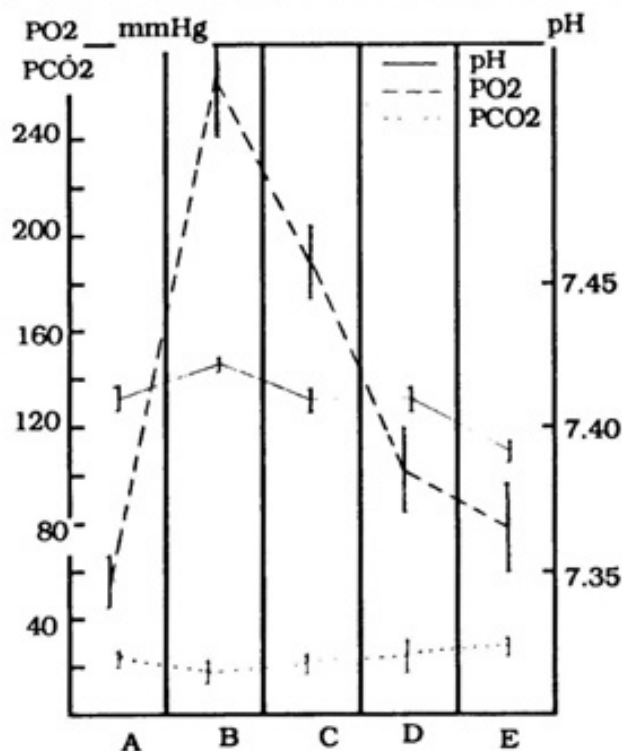


Fig.2: pH, PO2 and PCO2 values of the patients in Group I.

A: 15 minutes after induction
B: 15 minutes after beginning of CPB
C: 15 minutes after weaning from CPB
D: Early postoperative period
E: Postoperative second day

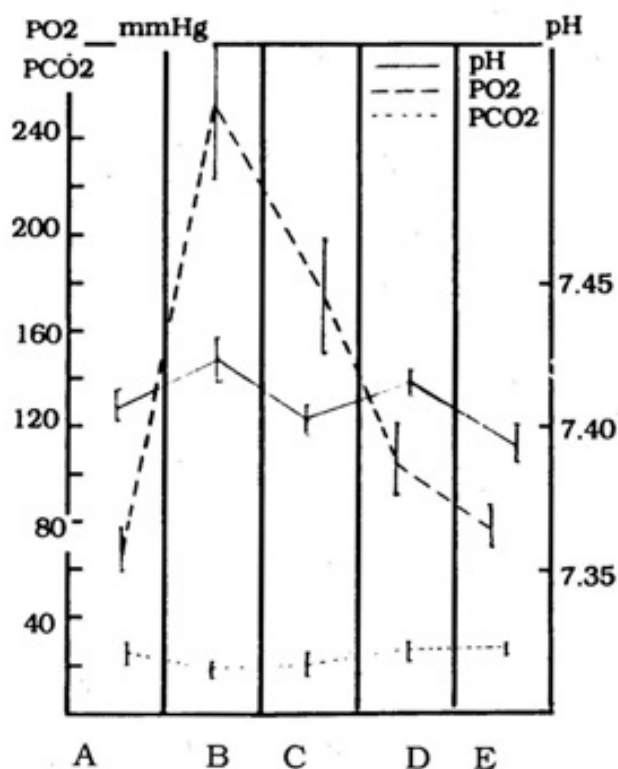


Fig.3: pH, PO₂ and PCO₂ values of the patients in Group 2.

- A: 15 minutes after induction
- B: 15 minutes after beginning of CPB
- C: 15 minutes after weaning from CPB
- D: Early postoperative period
- E: Postoperative second day

Results

Although preoperative hematocrite value differences were insignificant in the two groups, immediate postoperative and postoperative 24th hour measurements disclosed a decrease in the first group ($P < 0.05$) (Fig. 1).

In both groups, pre- and postoperative arterial pH, pO₂, and pCO₂ values did not differ significantly ($P > 0.05$) (Fig. 2,3).

There was also no significant difference in urine output measurements performed before CPB, postoperatively in the first 12 and 24 hour periods in both groups. However, intraoperatively and during perfusion, urine output values were higher in Group 1 ($P < 0.05$) (Fig. 4).

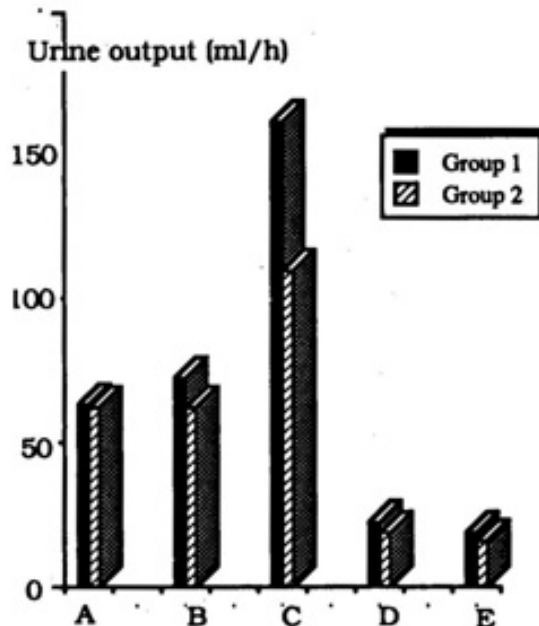


Fig.4: Urine output of patients in Group 1 and Group 2.

- A: Before CPB
- B: During CPB
- C: After weaning from CPB till the end of the operation
- D: Postoperative 12 hours
- E: Postoperative 12-24 hours

Discussion

Despite the decrease in hematocrite level, there was no deficit in oxygen carrying capacity⁹. During extracorporeal circulation, it is possible to compensate this change by adjusting flow rate and deepening hypothermia¹⁰.

There were no differences in hematocrite levels preoperatively, however, in the hemodilution group, postoperative hematocrite values decreased significantly.

Kawashima et al.⁷ evaluated effects of different hematocrite values on O₂ and CO₂ transport capacity under normothermic conditions and fixed perfusion flow rates. They found that with stepwise decrease in hematocrite values down to 0.20, arterial pO₂ and pCO₂ decreases linearly.

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