Title: THE EFFECT OF INTENTIONAL HEMODILUTION ON P50 OF BLOOD IN MAJOR VASCULAR SURGERY

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Introduction

Major vascular surgery is usually associated with the administration of banked blood to the patient. In our institution we have found most major vascular surgery is associated with the administration of an average of 2.26 units of homologous blood per case. Homologous (banked) blood is known to cause a decrease in P50 resulting in a shift of the oxyhemoglobin dissociation curve to the left (1). P50 is one of the important factors that influence the delivery of oxygen to the tissues when there is a decrease in blood flow as occurs in major vascular surgery. This study is intended to examine the effects of perioperative intentional hemodilution and autologous blood transfusion on P50.

Methods

Ten patients were used as controls and after anesthesia was induced, 5ccs of blood were collected for P50 determination. This was repeated in the immediate postoperative period and after banked blood had been administered. Other laboratory data was obtained including hemoglobin, hematocrit, arterial blood gases, serum electrolytes, serum pyruvate and serum lactate. Twelve cases were chosen for intentional hemodilution and blood samples were taken before intentional hemodilution, and in the immediate postoperative period. In both groups, the patients either had renal artery bypass graft or aortic graft surgery. The blood was collected with a heparinized syringe from each of the patients. The blood was immediately equilibrated in an IL 237 tonometer with known gas mixtures containing 4% and 4.5% oxygen, 5.6% carbon dioxide and the remaining gas was nitrogen which was at 37° for 15 minutes. Total hemoglobin and percent oxygen saturation were obtained in a Radiometer OSM2 hemoximeter. The blood gases were measured in a Corning 168 pH blood gas analyzer. The measured PO2 data were corrected to a pH of 7.40. For each sample a two point saturation curve was plotted in the linear portion of the oxyhemoglobin dissociation curve and the P50 was read from the saturation curve. Hemodilution was achieved by plebotomizing approximately 2 or 3 units of the patient's blood (depending on preoperative hematocrit) and simultaneously infusing a corresponding volume of Rheomacrodex (Dextran 40) (2).

Results

Figure 1 shows the changes in P50 values in patients who received banked blood (controls) compared with the changes in the patients who received autologous blood (test). In the case of patients receiving banked blood, there was a consistent decrease in P50 values while there was a consistent increase for patients receiving autologous blood. Table I demonstrates that in both cases, the paired differences (pre- to post-) were significantly different from zero ($p<0.002$), and from one another ($p<0.001$) by two tailed t test.

Figure 1.

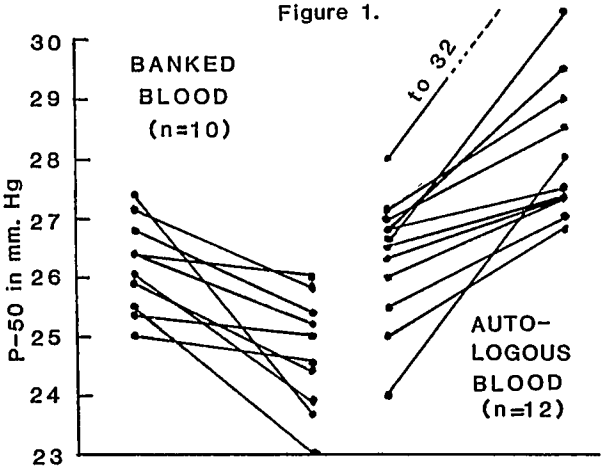

Table I: Comparison of paired difference between pre-transfusion and post-operative P50 values for patients receiving banked blood (control) and autologous blood (test).

	MEAN	SEM	(n)	T	p
Control	-1.5	0.33	(10)	4.48	<0.002
Test*	2.08	0.36	(12)	5.73	<0.001

* test different from control at $p<0.001$.

Discussion

The volume of oxygen that can be unloaded to the tissues is influenced by the affinity of the hemoglobin for oxygen. This characteristic affinity of the hemoglobin for oxygen is commonly expressed as P50. P50 is the partial pressure of the oxygen at which 50% of the hemoglobin is saturated at a pH of 7.4 and temperature of 37°. An increase in P50 is advantageous since at any given PO2, more oxygen is released to the tissues. Hyperthermia, acidemia and increase in 2-3 D.P.G. levels all increase the P50 levels in patients. Intentional hemodilution with Dextran 40 does increase P50 and consequently benefits patients who receive it. This is not the case of patients who receive banked blood. We conclude that intentional hemodilution is beneficial to patients having major vascular surgery by increasing P50 of the blood and facilitating oxygen delivery to the tissues. Supported by a grant from Pharmacia Laboratories, Piscataway, New Jersey.

References 1. Mondzelewski JP, Guy JT, Bromberg PA et al: Oxygen delivery following transfusion of stored blood. II. acidotic rats. J Appl Physiol 37:64, 1974. 2. Matsuda H, Shoemaker WC: Cardiorespiratory responses to Dextran 40. Arch Surg 110:296-300, 1975