

Title: Stress Responses in Children Undergoing Open Heart Surgery  
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**Introduction:**

The stress response in man and animals is manifested by release of catecholamines. To patients undergoing cardiac surgical procedures, cardiopulmonary bypass is an unusual physiological state, in that the heart is isolated from the rest of the circulation. Adult patients (1) respond to this state of stress by release of vasoactive substances and of epinephrine (E) from the adrenal medulla and norepinephrine (NE) from adrenergic terminals.

The purpose of this study is to determine the degree of catecholamine release that occurs before, during and after cardiopulmonary bypass in children undergoing open heart surgery to correct congenital cardiac defects (ASD, VSD, TOF).

**Methods:**

Institutional approval of the study and individual informed consents were obtained from the patients' parents. So far we have studied 8 children, ranging from 2 to 15 years of age (11-38kg), who electively underwent correction of a congenital cardiac defect. Patients receiving sympathomimetic or sympatholytic agents, and those requiring hemodynamic support were excluded from the study. All received a narcotic and anticholinergic for premedication. Routine monitoring parameters included electrocardiogram, direct arterial blood pressure, central venous pressure, oxygen saturation and end-tidal carbon dioxide tension. Anesthesia was maintained with halothane and fentanyl. Muscle relaxation was obtained with pancuronium or vecuronium. Arterial blood samples were drawn five minutes after induction of anesthesia, 5 minutes after sternotomy, and 5 and 30 minutes after initiation and discontinuation of cardiopulmonary bypass. Samples were assayed for E and NE. Comparisons between means were made using the t-test. P values  $\leq 0.05$  were considered significant.

**Results:**

After induction of anesthesia, the E level was  $108 \pm 42$  ng/l (mean  $\pm$  SEM). There were no significant changes associated with sternotomy or initiation of cardiopulmonary bypass. However, 30 minutes after initiation of cardiopulmonary bypass E levels increased to  $1172 \pm 303$  ng/l ( $p \leq 0.005$ ), and remained elevated,  $1414 \pm 576$  ng/l at 30 minutes after discontinuation of bypass. Norepinephrine concentration was  $265 \pm 33$  ng/l five minutes after induction of anesthesia. It did not change with sternotomy, but five minutes after induction of cardiopulmonary bypass, NE levels had risen to  $578 \pm 140$  ng/l ( $p \leq 0.05$ ). They remained elevated throughout bypass and at 5 and 30 minutes after termination of bypass.

**Discussion:**

Children undergoing open-heart surgery manifest changes in serum catecholamine levels associated with cardiopulmonary bypass. They are related to variations in the degree of stress during the surgical procedure. Catecholamine levels did not change significantly with sternotomy. Institution of cardiopulmonary bypass was associated with a significant rise in E and NE levels, which remained significantly elevated at 30 minutes after termination of bypass. It has been suggested that there is an association between intraoperative stress and postoperative complications (2). Therefore the stress of cardiopulmonary bypass in pediatric open-heart procedures must be minimized and a further evaluation of anesthetic techniques is needed.

**References:**

- 1) Tan, C., et al. J. Thoracic Cardiovasc. Surg., 71: 298, 1976.
- 2) Roizen, M.F., et al. Anesthesiology, 67: A1, 1987.

TITLE: SMALL VOLUME HYPERTONIC NaCl RESUSCITATION IN A PEDIATRIC HEMORRHAGE MODEL  
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**INTRODUCTION:** Small volumes of 7.5% NaCl effectively resuscitated adult dogs from hemorrhagic hypotension<sup>1</sup>. This has not been studied in small animals. We evaluated the cardiovascular functions and extracellular fluid (ECF) response to 4ml/kg of 7.5% NaCl in 6% Dextran70(NaCl-D) in a pediatric hemorrhage model<sup>2</sup>.

**METHOD:**Six puppies (8-12 wks) weighing 4.5-6.0 kg were given 30 mg/kg IV sodium pentobarbital initially and 2mg/kg/hr thereafter. Animals were intubated and mechanically ventilated. Under local anesthesia, catheters were placed in femoral and pulmonary arteries. Splenectomy was performed. Animals were hydrated at 4ml/kg/hr. Baseline (pre H) mean arterial pressure (MAP),cardiac output (CO) and central venous pressure (CVP) were measured. Twenty percent of blood volume was removed via the femoral catheter.Data was collected one hour after H.Then animals were resuscitated (R) with NaCl-D (4ml/kg). Hemodynamic data was collected.(ECF) volume was measured pre and post-H and post-R with Na Radiosulfate (<sup>35</sup>S).Data were analyzed using ANOVA.

**RESULTS:** MEAN  $\pm$  SEM

	PRE H	POST H	POST RESUSCITATION		
			5 MIN	15 MIN	60 MIN
HCT	32.00 $\pm$ 1.30	29 $\pm$ 1.16*	23.3 $\pm$ 1.00**	226 $\pm$ 8.00	23.2 $\pm$ .90**
HR	222.0 $\pm$ 11.00	235 $\pm$ 7.80	220 $\pm$ 6 70	223 $\pm$ 7.00	223 $\pm$ 7.00
MAP	98.0 $\pm$ 5.80	73 $\pm$ 10.00*	78.3 $\pm$ 6 40	79.2 $\pm$ 6.00	78.3 $\pm$ 6.00
CVP	1.8 $\pm$ 0.30	0.01 $\pm$ 0 .40*	1.0 $\pm$ 0.50 +	1.75 $\pm$ .25+	00.83 $\pm$ .30 +
CO	0.88 $\pm$ 0.08	0.72 $\pm$ 0.09*	1.1 $\pm$ .07 +	1.05 $\pm$ .10+	00.99 $\pm$ .08 +
SVR	113.00 $\pm$ 0.90	108 $\pm$ 0.12	71 $\pm$ .67**	66 $\pm$ .55**	81 $\pm$ .10**
Na+	148.00 $\pm$ 1.10	148 $\pm$ 1.80	154 $\pm$ 2.00**		153 $\pm$ 1.50**
SOsm	337.00 $\pm$ 24.00	355 $\pm$ 35.00			353 $\pm$ 23.00
ECF	853.00 $\pm$ 66.00	816 $\pm$ 67.00			1053 $\pm$ 100 **

\* = P<0.05 From Pre H; + = P<0.05 from Post H;

**DISCUSSION:** 4ml/kg of NaCl-D resulted in sustained hemodynamic improvement and an increase in ECF 25% above baseline in this study of controlled hemorrhage. The failure of the MAP to increase could be due to hemodilution or the hypertonic solution induced vasodilatation.<sup>3</sup> Although the serum Na increased, the osmolality did not. NaCl-D used during initial resuscitation could decrease the total volume of fluid infused. This may be important in certain clinical situations like head trauma.

**REFERENCES:**

1. Velasco, I.T., et al: American J. Physiol. 239:4664, 1980.
2. Bergman, K.S., et al: J. of Ped. Surg. 23:12, 1190-1192, 1988.
3. Smith, G.J.S., et al: J. of Surg. Res. 39, 517-528, 1985.