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TITLE: RENAL FUNCTION IS NOT INFLUENCED BY DIFFERENCES IN PH MANAGEMENT AND PULSATILE/NON-PULSATILE PERFUSION DURING CARDIOPULMONARY BYPASS

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INTRODUCTION: Recent studies have reported improved renal function during cardiopulmonary bypass (CPB) with pulsatile vs nonpulsatile perfusion[1], and alpha-stat vs pH-stat pH management[2] when these parameters were compared independently. Our preliminary results showed no difference between these two factors when compared simultaneously.[3] We would like to report the final results from 100 patients.

METHODS: After institutional approval and following written informed consent, 100 patients undergoing elective coronary artery bypass surgery were randomly assigned to receive either pH-stat or alpha-stat pH management and either pulsatile or nonpulsatile perfusion during CPB. Patients with preexisting renal dysfunction (BUN > 12.1 mmol/L or creatinine > 168 µmol/L) or those having received diuretics on the operative day were excluded.

Patients recieved a narcotic general anesthetic. Acid-base balance was measured both on-line and by radial arterial sampling. Pulsatile perfusion was created during the hypothermic phase of CPB using a Cobe pulsatile perfusion module which created a pulse pressure (PP) of 10-20 mm Hg with a frequency (rate) of 60-80 pulse/minute. Urine output (U/O) was measured by an indwelling Foley catheter. Determinations of fractional excretion of sodium (FeNa) or potassium (FeK) as well as renal failure index (RFI) were made prebypass, during CPB, and following discontinuation of CPB.

RESULTS: There were no statistically significant differences amongst the four groups with respect to patient demographics, pathology, hemodynamics before or after CPB, as well as surgical approach and/or time. The hypothermic CPB parameters are shown in table 1. The mean CPB duration was 94.7±5.7 min, of which 51.2% was hypothermic. There were no statistically significant differences in U/O, FeNa, FeK or RFI before, during or after CPB amongst the four groups (see table 2 for CPB results). There was also no difference in pre and postoperative renal function between the four groups.

Hypothermic	pulsatile		non-pulsatile	
Parameters	alpha-stat	pH-stat	alpha-stat	pH-stat
n	27	22	26	25
time	47.3±3.6	52.5±3.3	47.3±3.3	46.9±3.1
PP	18.6±1.6*	17.3±1.4*	2.0±0.4	1.7±0.3
rate	67.3±1.8*	66.8±1.4*	167.5±9.6	191.7±6.4
pH^+	7.43±.01	7.26±.01*	7.42±.01	7.25±.01*
pCO_2^+	37.0±0.7	59.9±1.8*	37.1±1.0	61.2±1.5*

Table 1. means ± SEM,+ as measured at 37° C,* $p < .001$.

Renal	pulsatile		non-pulsatile	
Function	alpha-stat	pH-stat	alpha-stat	pH-stat
U/O	312±59	289±65	375±53	406±78
FeNa	1.24±0.51	1.89±0.71	2.60±0.82	2.6±1.1
FeK	18.8±2.7	18.3±3.6	21.5±2.9	18.4±3.1
RFI	1.78±0.7	2.7±1.0	3.6±1.1	3.7±1.6

Table 2. values are mean ± SEM, NS differences.

DISCUSSION: No discernable difference in renal function during CPB was detected when using pulsatile/non-pulsatile perfusion or pH-stat/alpha-stat pH management. This may have been due to the fact that these parameters were limited to hypothermic CPB.

REFERENCES: 1. J Cardiothoracic Anesth 4:S3:28, 1990
2. J Cardiothoracic Anesth 3:S1:57, 1989
3. Anesth Analg 72:S7, 1991

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Title: RELATIONSHIP BETWEEN OXYGEN DELIVERY($\dot{D}O_2$) AND CONSUMPTION($\dot{V}O_2$) DURING AND FOLLOWING CARDIOPULMONARY BYPASS(CPB)

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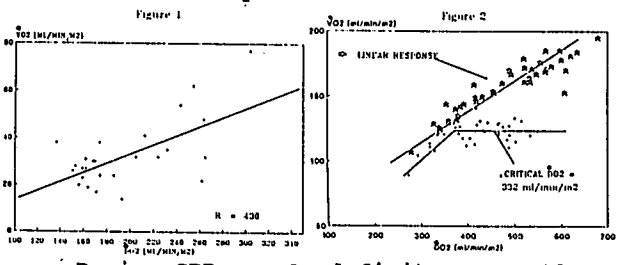
$\dot{V}O_2$-$\dot{D}O_2$ relationships have not been fully defined during CPB. We have explored CPB $\dot{V}O_2$-$\dot{D}O_2$ relationships with respect to the post-CPB perfusion state.

Six patients having coronary artery bypass surgery were studied prospectively. CPB was non-pulsatile. Serum lactate levels were determined just prior to the beginning and end of CPB. While on CPB, $\dot{V}O_2$ and $\dot{D}O_2$ were determined every 30-45 mins using simultaneous flow rate, and venous and arterial O_2 content determinations. Following CPB, $\dot{V}O_2$ and $\dot{D}O_2$ were determined on a minute by minute basis using a computer integrated system which collects information from indirect calorimetry and dual oximetry automatically, and from manually entered Hgb and PaO_2 values.

The following values are reported as mean±SD[range]; CPB time 163±40 mins[117-224], pre-CPB lactate 1.52±0.6 mmoles/L [0.64-2.16], CPB lactate 3.54±0.6 mmoles/L [2.80-4.34]. Figure 1 combines data from all 6 patients and shows a regression of the $\dot{V}O_2$-$\dot{D}O_2$ plot during CPB with a slope of 0.207. In the post-CPB period, 2/6 patients demonstrated a critical $\dot{D}O_2$ (332 & 369 ml /min/m^2). In the remaining 4 patients a linear response in $\dot{V}O_2$-$\dot{D}O_2$ was observed despite maximal $\dot{D}O_2$'s of 378 to 705 ml/min/m^2. Figure 2 shows examples of two patients, one with a critical $\dot{D}O_2$ and one with a linear response.



During CPB, an O_2 deficit apparantly occurs at commonly employed Hgb levels and CPB flow rates. Further, the low O_2 extraction rates, in the presence of an O_2 deficit, imply an impaired extraction ability while on CPB, the nature of which remains unclear. This O_2 deficit appears to result in a post-CPB oxygen demand that is not readily met in post-CPB intraoperative setting. Further work is required to determine critical $\dot{D}O_2$ during CPB and its determinants, as well as the impact of CPB O_2 deficit on outcome.