

TITLE: INFRA-RENAL AORTIC CROSS-CLAMPING: PULMONARY CHANGES

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The cardiovascular changes associated with infra-renal aortic cross-clamping and unclamping have been described by a number of authors.<sup>1-5</sup> The data show variable changes depending on the management technique<sup>4</sup> and the myocardial pathology of the patient.<sup>5</sup> One may anticipate that pulmonary function might vary depending upon the cardiovascular changes and degree of pulmonary congestion. Other factors also influencing pulmonary function in these patients might be the effects of the anesthetic agents, the anesthesia technique itself, including IPPB, and the effects of surgical manipulation and epigastric retraction.

We have, therefore, undertaken a prospective, controlled clinical study to evaluate physiologic deadspace (expressed as the ratio of physiologic deadspace to tidal volume ratio,  $V_D/V_T$ ) and venous admixture (expressed as venous admixture to cardiac output ratio,  $\dot{Q}_{VA}/\dot{Q}_T$ ) associated with infra-renal aortic cross-clamping using several anesthetic techniques.

Fifteen patients, between the ages of 46 and 75 years, of one surgeon (BR) for aortic cross-clamp procedures were randomly selected, interviewed by one of the members of the research team, and informed consent was obtained. All patients received a standard pre-anesthetic medication (morphine, 0.12 mg/kg; scopolamine, .007 mg/kg) 1 hour preoperatively and, after all monitoring lines were placed (arterial, pulmonary artery, peripheral, I.V.), received a standard induction sequence (curare, 3 mg, for defasciculation, then pentothal, 5 mg/kg, succinylcholine, 1-2 mg/kg, and endotracheal intubation). Patients were then ventilated at 100 ml/kg/min with oxygen and nitrous oxide. The inspired oxygen tension was measured with an oxygen electrode, and the inspired fraction thus accurately calculated. Supplement was given according to the protocol, being pancuronium and either narcotic, halothane, or Ethrane. Fluid management was standard for all patients, and the systemic blood pressure was kept below a mean value of 110 mmHg using boluses of arfonad.

Arterial and mixed venous blood, as well as mixed expired gas samples were taken for assessment of pulmonary venous admixture and deadspace. Simultaneous cardiovascular measurements were made at the following times: I) 10 minutes post-induction; II) 10 minutes post-incision; III) 2 minutes after intestines in Lahey bag; IV) 5 minutes after aortic cross-clamp; V) 20 minutes after aortic cross-clamp; VI) 5 minutes after release of first limb; VII) 5 minutes after release of second limb. All calculations use standard formulae, and the results are shown in the Table.

All values for venous admixture and deadspace are higher than normal. There are no significant differences between the values for venous admixture ( $\dot{Q}_{VA}/\dot{Q}_T$ ) or for deadspace ( $V_D/V_T$ ) at the times of sampling. Therefore, taking the first series of measurements as control, no consistent change of pulmonary function was identified in this group of

patients at the subsequent times nominated. There are wide variations from patient to patient in any given phase however, particularly for the values of venous admixture.

We tested for correlation between the changes of venous admixture and changes of pulmonary wedge pressure, CVP, and cardiac index. There is, however, no correlation. Also, patients with a history of myocardial disease do not appear to be predictably more likely to develop high venous admixtures during this procedure.

We conclude that: a) there is no predictable change of pulmonary venous admixture or physiologic deadspace during surgery involving infra-renal aortic cross-clamping, and b) changes of pulmonary venous admixture do not correlate with changes of cardiovascular pressures or cardiac index.

#### REFERENCES

1. Askitopolou H, Young CA, Morgan M, et al: Some cardio-pulmonary effects of infra-renal clamping of the abdominal aorta. *Anaesth Intens Care* 6: 44, 1978.
2. Carroll RM, Laravuso RB, Schauble JF: Left ventricular function during aortic surgery. *Arch Surg* 111: 740, 1976.
3. Dunn E, Prager RL, Fry W, et al: The effect of abdominal aortic cross-clamping on myocardial function. *J Surg Res* 22: 463, 1977.
4. Bush HL, LoGerfo FW, Weisel RD, et al: Assessment of myocardial performance and optimal volume loading during elective abdominal aortic aneurysm resection. *Arch Surg* 112: 1301, 1977.
5. Attia RR, Murphy JD, Snider M, et al: Myocardial ischemia due to infrarenal aortic cross-clamping during aortic surgery in patients with severe coronary artery disease. *Circulation* 53: 961, 1976.

TABLE

PHASE	$\dot{Q}_{VA}/\dot{Q}_T$		$V_D/V_T$	
	$\bar{X}$	SE	$\bar{X}$	SE
I	.20	.013	0.47	0.03
II	.20	.025	0.48	0.03
III	.23	.023	0.50	0.03
IV	.24	.030	0.53	0.02
V	.23	.024	0.53	0.03
VI	.18	.022	0.50	0.03
VII	.21	.018	0.52	0.02