

Title : NORMOVOLEMIC HEMODILUTION IN PATIENTS WITH CORONARY ARTERY DISEASE : HEMODYNAMIC AND METABOLIC RESPONSES TO RECOVERY.

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INTRODUCTION; During vascular surgery, normovolemic hemodilution (NVH) might be well suited to blood management. However, the high incidence of coronary artery disease (CAD) in such a population must be considered. Therefore, during recovery from general anesthesia, increased global metabolic demand may be not satisfied particularly when the decrease in arterial O₂ content due to NVH is associated with an impairment in left ventricular performance. On the other hand, it has been argued that NVH induces a more homogenous flow distribution (1), which may be beneficial even in patients with CAD (2). Accordingly, we investigated hemodynamic and metabolic adaptations to recovery in patients with CAD randomly assigned to a preoperative NVH or not.

METHODS. Fifteen patients with CAD, aged 58 ± 10 years (mean \pm SD), scheduled for abdominal aortic surgery were included in this randomized study. All gave informed consent for the study after approval by our Ethics Committee. On preoperative myocardial thallium scintigraphy, all had at least one defect on initial scans with redistribution on delayed scans. Their left ventricular (LV) ejection fraction determined by gated radionuclide angiography was above 0.5 (mean 0.57 ± 0.077). Under premedication (morphine 5 mg, scopolamine 0.5 mg), a radial artery and a thermodilution Swan-Ganz catheter was positioned while EKG (lead CM5) was continuously recorded (Holter method). General anesthesia was induced using flunitrazepam, fentanyl and pancuronium bromide and maintained with increments of drugs while under controlled ventilation. Patients were randomly assigned to a hemodiluted group (group H, n = 7) or to a non-hemodiluted (group NH, n = 8). In group H, to achieve a final hematocrit (Hct) of 30%, blood was withdrawn and simultaneously replaced by the same volume of colloids. During the intraoperative period, Hct was maintained at 30 % in group H with autologous and then heterologous transfusion. In group NH, Hct was maintained at its initial value by heterologous transfusion. At the end of surgery, a first set of measurements was performed in the operating room (END of SURGERY). A second set of measurements was carried out in the recovery room before rewarming (BEFORE REWARMING). The last set of measurements was obtained after a 90 minute rewarming period under narcotic sedation (AFTER REWARMING). Measurements included : hemodynamic parameters, arterial and mixed venous O₂ content (CaO₂, CvO₂). Systemic O₂ transport (SO₂T) and global O₂ consumption (VO₂) were calculated. The holter tapes were examined retrospectively for evidence of myocardial ischemia (ST-T segment depression greater than 1 mm for more than 10 beats). Data were analysed using analysis of variance and expressed as means \pm SD.

RESULTS. In group H, patients received a significantly lower volume of heterologous red blood cells (1.9 ± 2.1 vs 6.6 ± 3.9 units, $p < 0.01$) during surgery. After rewarming, SO₂T increased in both groups. VO₂ largely increased in group H while slightly but

not significantly increased in group NH. CvO₂ significantly decreased in group H and was significantly lower than in group NH. Lactate concentration remained unchanged in both groups. Continuous EKG recording revealed episodes of myocardial ischemia in 2 patients in group H and in 4 patients in group NH. A postoperative myocardial infarction was detected in 1 patient of group NH.

DISCUSSION. After the same rewarming period, the larger increase in VO₂ in group H than in group NH may suggest an earlier recovery due to NVH. After rewarming, metabolic needs were satisfied, since no increase in lactate concentration was observed. This was achieved in relation to both an increased SO₂T and a decreased CvO₂. It is concluded that after an intraoperative NVH achieving a Hct of 30 %, metabolic requirements of recovery from general anesthesia are satisfied, even in patients with CAD and normal LV function. In addition, intra and postoperative risk of myocardial ischemia does not appear to be increased by NVH.

REFERENCES

1. VICAUT E. et al. Int J Microcirc Clin Exp. 4 : 351-362, 1985.
2. NIINIKOSKI J. et al. Ann Thor Surg. 31 : 134-143, 1981.

TABLE

		End of surgery	Before rewarming	After rewarming
Hct %	H	32 \pm 2	33 \pm 2	32 \pm 2
	NH	41 \pm 5	42 \pm 5	46 \pm 6
MAP mmHg	H	88 \pm 14	112 \pm 9**	85 \pm 13££
	NH	85 \pm 8	102 \pm 19*	93 \pm 13
PCWP mmHg	H	9.1 \pm 2.1	9.6 \pm 2.9	11.3 \pm 3.7
	NH	10.1 \pm 3.6	10.5 \pm 5.2	9.6 \pm 4.2
CI l/min/m ²	H	4.0 \pm 1.5	3.9 \pm 0.9	5.8 \pm 1.7**££
	NH	3.9 \pm 1.2	3.8 \pm 1.0	4.7 \pm 1.4£
SO ₂ T ml/min/m ²	H	582 \pm 267	653 \pm 145	848 \pm 279*
	NH	687 \pm 243	715 \pm 292	911 \pm 395*
CvO ₂ ml/100ml	H	10.9 \pm 0.8	12.0 \pm 1.1	10.4 \pm 1.5£
	NH	14.5 \pm 2.8	14.9 \pm 3.6	14.8 \pm 4.1
VO ₂ ml/min/m ²	H	126 \pm 25	143 \pm 40	228 \pm 69**££
	NH	119 \pm 61	154 \pm 76	164 \pm 70
Lactate mmole/l	H	2.4 \pm 0.9	2.4 \pm 0.7	2.1 \pm 0.5
	NH	3.4 \pm 1.4	2.9 \pm 1.1	2.8 \pm 0.8

* p < 0.05 , ** p < 0.01 vs end of surgery.

£ p < 0.05 , ££ p < 0.01 vs before rewarming

● p < 0.05 , ●● p < 0.01 H vs NH