Title : IS DEPENDENT-LUNG $PETCO_2$ MONITORING A RELIABLE METHOD TO ASSESS $PaCO_2$ DURING SELECTIVE 2-LUNG-VENTILATION IN PATIENTS UNDERGOING THORACO-ABDOMINAL ANEURYSM SURGERY ?

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INTRODUCTION. Impaired oxygenation and CO2 elimination is seen in patients undergoing surgical resection of thoracic aortic aneurysms (TAA), because of a lateral decubitus position, the collapse and retraction of the left dependent lung and the use of vasodilatators inhibiting hypoxic pulmonary vasoconstriction during aortic clamping. Thus, intraoperative measurement of parameters reflecting arterial PCO2 may be of special value in this setting. Selective left lung high frequency jet ventilation (HFJV) improves oxygenation during resection of TAA (1). Although an excellent correlation between arterial and end-tidal PCO2 has been shown under controlled ventilation (2), no study has focused on the possible differences between arterial and mean end-tidal PCO2 (PETCO2) of the dependent lung when HFJV is applied to the non-dependent lung. The aim of this study was to determine whether it is clinically acceptable to monitor PETCO2 as an index of PaCO2 in patients undergoing TAA resection under one lung ventilation while HFJV is applied to the non-dependent lung.

METHODS. Patients. After informed consent and approval of our Ethics Committee, eleven consecutive patients (mean age 54 yrs) scheduled for surgical resection of TAA in the right lateral decubitus position were selected for the study. Six patients were considered ASA Class III, 7 had a past history of COPD. The surgical procedure consisted of graft replacement of the diseased aorta via a left thoracic or thoracoabdominal incision without use of cardio-pulmonary bypass or a shunting technique.

Patients were selectively intubated with a Carlens tube so as to collapse the left non-dependent lung and facilitate the surgical procedure. HFJV was administered to the non-dependent lung in order to increase PaO2 during the surgical procedure.

Anesthetic management. Each patient had preoperative insertion of a Swan-Ganz and radial artery catheter. Since the patients were positioned in the lateral decubitus, the PETCO2 was continuously monitored on the right lumen of the Carlens tube using a HP 47210 A capnometer. Anesthesia was induced with fentanyl, a benzodiazepine, pancuronium, and maintained with increments of drugs and volatile agents. Sodium nitroprusside was administered in order to control arterial pressure at the time of thoracic aortic cross-clamping.

Ventilatory equipment. IPPV was administered to both lungs before incision (VT 10 ml.kg-1, F 16 min-1, FIO2 1). After incision, IPPV was administered on the dependent lung (VT 8 ml.kg-1, F 16 min, FIO2 1) and HFJV was applied to the non-dependent lung by fixing to the left channel of the Carlens tube a small injector cannula to an Acutronic VS 600 S ventilation (N 250 b.min-1, I/E ratio 0.30, DP 1.7 psi, Paw 8 mmHg). Mean airway pressure of the non-dependent lung was measured by a catheter advanced into the left bronchus.

Procedures. Hemodynamic and respiratory measurements were performed at the following times :
- T0 : before incision, the anesthetized patient being in the right lateral decubitus with IPPV applied to both lungs ;
- T1 : the patient being with HFJV applied to the non-dependent lung and IPPV to the dependent lung, 2 minutes after thoracic aortic cross clamping ;
- T2 : 2 minutes after thoracic aortic unclamping.

All data were expressed as mean $\pm$ SEM and were compared using a two-way analysis of variance.

PETCO2 and PaCO2 determined at T0, T1 and T2 were compared using a linear regression analysis.

RESULTS. Pertinent data are reported in the table. Under controlled ventilation (T0), a good correlation was found between PETCO2 and PaCO2 (PaCO2 = 1 x PETCO2 + 7.4 ; r = 0.85 ; $p<0.01$). At aortic cross-clamping, although blood pressure and cardiac index were controlled, we noted a significant decrease in global O2 consumption (VO2) and an increased Qs/Qt. An adequate correlation between PETCO2 and PaCO2 persisted at the time of cross-clamping (PaCO2 = 1.25 x PETCO2 + 1.6 ; r = 0.73 ; $p<0.05$) and at declamping (PaCO2 = 1.7 x PETCO2 - 7.6 r = 0.76 ; $p<0.01$). These results reflect an increased difference between PETCO2 and PaCO2 (D(A-a)CO2).

DISCUSSION. Although our usual high incidence of COPD was present in the patients studied, we found a good correlation between PETCO2 and PaCO2 under controlled ventilation. Furthermore, when HFJV is applied to the non-dependent lung and a stressful surgical situation is present (aortic XC and declamping) an adequate correlation persist. However, the difference between PETCO2 and PaCO2 increased from 5.8 to 8.2 mmHg under HFJV, which must be taken into account when interpreting PETCO2 in this setting.

We concluded therefore that monitoring of PETCO2 on the dependent lung is a valuable and reliable tool to continuously assess PaCO2 in patients undergoing TAA resection with selective non-dependent lung HFJV.

Table	T0	T1	T2
PaCO2 mmHg	33.4±1.3	30.8±1.6	38.8±3.2*
PETCO2 mmHg	29±1.2	22.6±1.7*	29.4±2.7
D(A-a)CO2 mmHg	5.8±0.6	8.2±1.2*	8.5±1.5
Temperature °C	35.6±0.2	33.9±0.3*	33.1±0.3*
PAP mmHg	24±3	28±3	28±2
IC l.min-1.m-2	4.2±0.5	3.5±0.5	5±0.7
PVO2 mmHg	38±2	64±7*	45±6
VO2 mmHg	148±16	64±13*	152±24
Qs/Qt %	29±4	37±4*	32±3

* $p < 0.01$ vs T0

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