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A234

TITLE: RELATIONSHIP BETWEEN OXYGEN DELIVERY (DO_2) AND MIXED VENOUS OXYGEN SATURATION (SVO_2) DURING SEPTIC SHOCK

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INTRODUCTION: The aim of this study is to evaluate if continuous monitoring of SvO_2 during septic shock, where oxygen uptake (VO_2) is dependent on DO_2, remains a reliable predictor of delivery.
METHOD: Institutional approval and informed consent were obtained prior to the study. 62 measurements (n=62) were performed on 5 patients (age 49±11 years; mean±SD) during septic shock confirmed by hemodynamic and bacteriological parameters. They were all mechanically ventilated (FiO_2 = 0.3 to 0.6) and sedated with continuous infusion of fentanyl and midazolam. SvO_2 monitoring was insured by a fiberoptic pulmonary artery catheter (Opticath- Oxymetrix®. Abbott) and VO_2 by a metabolic monitor (Deltatrac®. Datex). Blood oxygen saturation and haemoglobin concentration were measured by spectrophotometry (Corning 2500- CO-oxymeter) and cardiac output by thermodilution.
DO_2 variations were induced by catecholamine infusion, blood transfusion or fluid loading depending upon therapeutic needs. Measurements of DO_2, VO_2 and SvO_2 were performed at 2-hourly intervals for 24 hours.
Statistical analysis was performed using linear regression (least squares method). $p<0.05$ was considered as significative.
RESULTS: A relationship exists between the change in DO_2 and VO_2 (fig. 1) (n=57, r=0.71, $p<0.0001$) and also between the change in DO_2 and SvO_2 (fig. 2) (n=57, r=0.61, $p<0.0005$). This relationship is stronger in the patient who survived (n=11, r=0.87, $p<0.0005$) than in the patients who died (n=46, r=0.36, $p<0.05$).

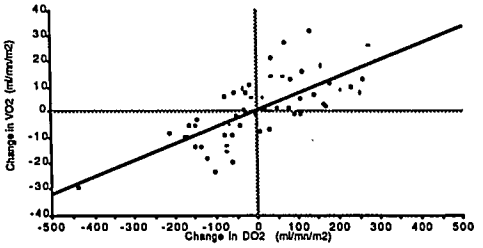

Fig. 1

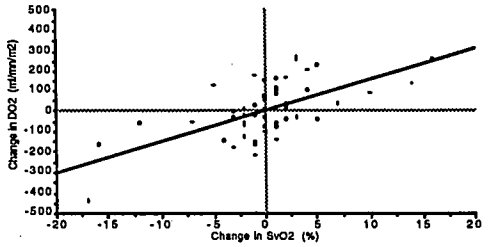

Fig.2

DISCUSSION: As a relationship between DO_2 and SvO_2 persists during septic shock, oxygen extraction is still able to rise when DO_2 decreases. This seems to be paradoxical in a situation of tissue oxygen debt confirmed by a dependence of VO_2 on DO_2. Septic shock is probably characterized by coexistence of hypoxic and non hypoxic tissues. The relationship DO_2/VO_2 refers to the hypoxic tissues[1] whereas the relationship SvO_2/DO_2 is dependent on the non hypoxic areas.This could explain why the surviving patient in our study had a stronger relationship between DO_2 and SvO_2 than the patients who died.

Reference
1. Crit Care Med 1: S70-S74, 1990

A235

TITLE: HYPOCAPNIA AND HYPERCAPNIA INCREASE $\dot{V}A/\dot{Q}$ HETEROGENEITY IN CANINE OLEIC ACID LUNG INJURY.

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Hypocapnia may increase pulmonary shunting in anesthetized, obese patients(1). In contrast, increasing $PaCO_2$ by inspiration of CO_2 may improve arterial oxygenation in pneumonia(2). We studied the effects of changes in $PaCO_2$ on the matching of ventilation ($\dot{V}A$) and perfusion ($\dot{Q}$) in dogs with oleic acid-induced permeability edema, using the multiple inert gas elimination technique. We hypothesized that hypocapnia would impair and hypercapnia would enhance $\dot{V}A/\dot{Q}$ matching.
Methods: 8 pentobarbital-anesthetized, closed-chested dogs were administered 0.06 ml/kg of oleic acid at least 2 hours prior to study. They were ventilated with 90% O_2 at 35 breaths/min with a tidal volume of 20 ml/kg. Inspired CO_2 was added to change $PaCO_2$ to 25, 38, and 50 mmHg in a randomized order. A dilute solution of six inert gases (SF_6, ethane, cyclopropane, halothane, diethyl ether, and acetone) was infused to assess gas exchange. Arterial and mixed venous blood gases and inert gases, mixed expired inert gases, and hemodynamics were measured. $\dot{V}A/\dot{Q}$ mismatch (heterogeneity) was assessed by true shunt, dead space ($\dot{V}D/VT$), log standard deviation of perfusion (log $SD\dot{Q}$) and ventilation (log $SD\dot{V}$) distributions and arterial-alveolar difference ([a-A]D) area. Data were analyzed by a two-factor within subjects analysis of variance and Duncan test.
Results: $\dot{Q}T$, Ppa, true shunt, $\dot{V}D/VT$ and log $SD_{\dot{Q}}$ during hypocapnia and hypercapnia did not differ compared to normal $PaCO_2$ (see table). PaO_2 was lower with hypocapnia and higher with hypercapnia. Both hypocapnia and hypercapnia increased $\dot{V}A/\dot{Q}$ heterogeneity, indicated by increases in log $SD_{\dot{V}}$ and (a-A)D area compared to normal $PaCO_2$.

Table: Gas Exchange Measurements

	Normal $PaCO_2$	Low $PaCO_2$	High $PaCO_2$
Mean Ppa(mmHg)	25 ± 1	24 ± 1	28 ± 2
$\dot{Q}T$(l/min)	4.1 ± 0.4	3.8 ± 0.3	4.2 ± 0.4
PaO_2(mmHg)	221 ± 35	181 ± 33*	250 ± 36*
True shunt(%)	22 ± 3	23 ± 3	21 ± 3
$\dot{V}D/VT$(%)	38 ± 4	37 ± 4	35 ± 4
Log $SD_{\dot{Q}}$	1.35 ± 0.19	1.61 ± 0.15	1.61 ± 0.16
Log $SD_{\dot{V}}$	0.97 ± 0.12	1.12 ± 0.12*	1.13 ± 0.10*
(a-A)D area	0.50 ± 0.09	0.63 ± 0.09	0.63 ± 0.11*

Means ± SE are presented. *$p < 0.05$ versus normal $PaCO_2$

Conclusions: Hypocapnia increased $\dot{V}A/\dot{Q}$ mismatch and worsened arterial oxygenation in canine oleic acid-pulmonary edema. Inspiration of CO_2 to 50 mmHg also increased $\dot{V}A/\dot{Q}$ heterogeneity, although PaO_2 was increased, due to the Bohr effect. The results suggest that hyperventilation to reduce $PaCO_2$ may increase arterial hypoxemia in patients with significant lung disease.
References: 1. *Anesthesiology* 63:A520, 1985; 2. *Am Rev Respir Dis* 137:A142, 1988. Supported by B.B. Sankey Anesthesia Advancement Award, NHLBI Clinical Investigator Award (#HL02507), and HL12174.