10.

RELATIONSHIP BETWEEN CARBON DIOXIDE ELIMINATION KINETICS AND METABOLIC CORRELATES OF OXYGEN DEBT IN SEPTIC PATIENTS

Renzo Zatelli *

1. INTRODUCTION

Many clinical situations cause inadequate tissue oxygenation: sepsis is the most serious of them, since an imbalance between oxygen delivery to peripheral tissue and oxygen need is the most important factor in the development of multiple system organ failure and mortality [1].

Oxygen debt develops in the presence of an abnormal ratio between O_2 supply and O_2 demand, inducing increased anaerobic metabolism and tissue and blood lactate concentration. Since O_2 demand is neither measurable, nor calculable [2], in order to evaluate O_2 debt we must use markers of impaired O_2 utilization: elevated arterial base deficit and abnormal lactate concentration [3].

O_2 kinetics in sepsis have been widely studied; in contrast, CO_2 kinetics in the same condition is poorly investigated. The purpose of our study was to verify the hypothesis that CO_2 elimination kinetics is different in sepsis versus in non septic conditions, and that in these circumstances this parameter could have a relationship with lactate increase.

This relationship would indicate CO_2 kinetics as an useful parameter to assess the wearing off of the septic condition during clinical course, because the latter would indeed be the first parameter to get back to normal, due to CO_2 large diffusibility.

* Renzo Zatelli, Dept. of Anesthesia and Intensive Care, University of Ferrara, 44100 Ferrara, Italy

2. PATIENTS AND METHODS

We studied 55 patients admitted during six months to our Intensive Care Unit suffering from different diseases and monitored with a pulmonary artery catheter. Measurements of arterial and mixed venous acid-base and hemodynamic parameters, arterial lactate and base deficit were serially performed, as well as O_2 consumption, CO_2 production and respiratory quotient by means of an indirect calorimetric device. We then determined CO_2 elimination kinetics: exhaled CO_2, mixed venous CO_2 content, CO_2 clearance and calculated O_2 debt according to clinical techniques [4]. We then divided patients into a "non septic" group and a "septic" group.

Eleven patients met sepsis criteria with at least five of the following: body temperature > 38.5° or < 36°C, white blood cell count > 12,000 or < 3,500 / mL, heart rate > 100 beats/min, respiration rate > 28 breath/min or FIO_2 > 0.21, mean arterial pressure < 75 torr, cardiac index > 4.5 L/min/m^2 , thrombocytes < 100,000 cells/mL, positive blood culture, systemic vascular resistance < 0.08 kPa· s· cm^{-3}, clinical evidence for sepsis (surgical or invasive procedure during the preceding 48 h or presence of an obvious primary septic site) [5].

After an adequate resuscitation, when the hemodynamic and ventilatory situation was stable, from these patients fifty-seven data sets were obtained and compared with the data of non septic patients, using an unpaired t - test. Correlations were performed using Pearson correlation with Bonferroni correction. A $p< 0.05$ was considered statistically significant. All values were reported as mean ± SEM.

3. RESULTS

There was no significant difference between septic and non septic patients in age (62.6 ± 3.3 vs. 53.7 ± 2.9 y), weight (69.4 ± 3.8 vs. 69.8 ± 2.0 Kg), sex distribution (M:F 7/4 vs. 27/17) and APACHE II score (22.1 ± 0.9 vs. 21.1 ± 0.4).

Table 1. Main hemodynamic and O_2 / CO_2 transport data

variable	septic	non septic	P value
O_2 consumption index (mmol/min/m^2)	5.58 ± 0.21	5.36 ± 0.11	0.3256
base excess (mEq/L)	-6.15 ± 0.05	2.04 ± 0.18	<.0001
arterial lactate (mmol/L)	5.18 ± 0.38	1.42 ± 0.05	<.0001
O_2 debt (mmol/min/m^2)	0.96 ± 0.22	1.00 ± 0.11	0.8456
cardiac index (L/min/m^2)	4.21 ± 0.20	4.31 ± 0.08	0.6049
syst. vascular resistance (kPa· s· cm^{-3})	0.1272 ± 0.0094	0.1590 ± 0.0046	0.0015
mean pulm. arterial pressure (kPa)	3.76 ± 0.13	3.19 ± 0.05	<.0001
pulm. vascular resistance (kPa· s· cm^{-3})	0.0215± 0.0018	0.0183 ± 0.0006	0.0252
P_x (kPa)	5.77 ± 0.28	6.44 ± 0.12	0.0120
CO_2 elimination (mmol/min/m^2)	5.72 ± 0.23	6.05 ± 0.13	0.2126
mean venous CO_2 concentr. (mmol/L)	20.3 ± 0.46	26.7 ± 0.24	<.0001
CO_2 clearance (L/min/m^2)	0.30 ± 0.02	0.23 ± 0.01	<.0001

All patients were ventilated for similar periods of time.