Title : RESPIRATORY RESISTANCE DURING AORTIC CLAMPING.

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Introduction. General anesthesia is accompanied by reduction of FRC, decrease of static respiratory compliance (C_T) and increase in respiratory resistance (R_T).[1] In addition, surgical invasion of the abdominal cavity may contribute further to the impairment of respiratory mechanics. In order to quantify this last factor, we measured C_T and R_T after induction of anesthesia and paralysis and at various times during surgery.

Methods. 38 adult patients gave informed consent for the study approved by the institutional Clinical Investigation Committee (22 males and 16 females). They were anesthetized, intubated and paralyzed in the supine position. Normocapnia was maintained with controlled ventilation with V_T = 12 ml/kg. Patients in group 1 (EXT,N) had a surgical procedure on the extremities; in group 2 and 3 had an intra-abdominal procedure (ABD,N and ABD, COPD) and in group 4 and 5 had resection and grafting of an abdominal aortic aneurysm (AAA,N, and AAA, COPD). COPD patients were suffering from chronic obstructive pulmonary disease, while N identifies patients with normal lungs. C_T and R_T were measured with standard techniques 3 to 15 times during each period: after anesthesia and paralysis (period A); at 30 and 60 min after surgery started (periods B and C) and before closure of the peritoneum (period D, at 120 min for EXT,N). In AAA patients, period C is coincidental with the cross-clamping of infrarenal abdominal aorta.

Results. For all patient's group, mean values for C_T (ml (BTPS)/cm H_2O), and R_T (cm H_2O/L/sec) are presented in the table during period A. The values during periods B,C and D are indicated as percent change of period A (Δ%).

Group #		1 EXT.N.	2 ABD.N.	3 ABD. COPD	4 AAA.N.	5 AAA COPD
Mean Age		33.3	50.2	53.8	60.7	63.0
n =		8	13	6	7	4
A Before Surgery	CT	71.0	74.0	67.0	85.3	77.5
	RT	5.3	5.9	11.9	6.0	11.5
B,Δ% of A @ 30 min	CT	-11.3	-16.5	-20.0	-25.5	-22.5
	RT	3.9	24.0	20.9	34.7	37.9
C,Δ% of A @ 60 min	CT	-11.1	-18.1	-22.8	-30.0	-35.5
	RT	4.7	30.5	18.8	58.7	95.2
D,Δ% of A @ closure	CT	-10.9	-15.9	-17.2	-26.1	-20.9
	RT	5.5	12.4	7.8	22.3	28.4

The repeatability of the measurements within each period were 3% for C_T and 5.5% for R_T (coefficient of variation). The results were evaluated between periods with paired t-test and between groups with multiple analysis of variance and Student's t test.

Discussion. C_T values were not statistically different between groups during the control period A: they decreased significantly during period B in all groups; decreased further significantly in period C only in group 5; increased significantly again during period D (with exception of group 1), but were still significantly lower in all groups at the end of surgery (D) compared with period A, before surgery. C_T values were significantly lower in female patients than in male patients during all periods. The patients with aneurysms (groups 4 and 5) underwent a more pronounced reduction of C_T during surgery compared to all the other groups.

R_T values were not different between males and females, were significantly elevated in COPD patients during period A, and were not altered by surgery on the extremities (group 1, EXT.N): R_T instead increased significantly at the beginning of the invasion of the abdominal cavity (groups 2,3,4 and 5); and increased further during period C (aortic cross-clamping) only in groups 4 and 5, and in group 5 significantly more than in group 4. During period D, R_T decreased significantly in all groups (2,3,4 and 5), but absolute values were still significantly higher than during period A before surgery. Overall the operation imposed a significant larger increase of R_T to the patients of group 4 and especially 5 in comparison to groups 2 and 3. These changes were accompanied by a decrease in FRC, as measured in 6 patients of group 3 and 5, especially during period C in group 5.

In conclusion, a non-reversible increase in R_T and decrease in C_T were demonstrated during surgery, concomitantly with the type of operation, the degree of invasion of the abdominal cavity, and the pulmonary status of the patient. Despite the mean age differences between groups in this study, age alone could not be correlated with a significant impairment of the respiratory system during surgery. Cross clamping of the aorta, during correction of abdominal aneurysm (groups 4 and 5) was associated with a pronounced increase in respiratory system resistance, and with a significant decrease in arterial oxygenation (mean Pa_{O_2} decreased from 140 Torr before clamping, in period B, to 99 Torr during cross-clamping, in period C) without alteration of ventilatory parameters.

Reference. 1. H. Don: The mechanical properties of the respiratory system during anesthesia. International Anesthesiology Clinics, 15 No. 2: 113-136, 1977.