Intensive Care Med (1990) 16:137–139

Intensive Care Medicine

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Correspondence

Cardiac index and oxygen consumption during weaning in patients who need inotropic support

Dear Sir,

It is relatively common for patients to need inotropic support after open heart surgery in order to maintain satisfactory hemodynamics. In most cases, infusions of inotropics agents may be withdrawn within the first 4–6 h and so do not interfere with weaning from controlled mechanical ventilation (CMV). In those cases in which inotropic agents are required for several days, it is generally agreed that CMV should not be discontinued until myocardial function improves, as the increase in the oxygen cost of breathing may disrupt the delicate balance between oxygen transport and consumption. Although these patients can be extubated with relatively few risks or adverse effects if no other complications arise, the cardio-respiratory repercussions of withdrawing CMV are unknown. We have analyzed the changes in cardiac index (CI), oxygen consumption ($\dot{V}O_2$) and other cardiorespiratory parameters (see Table 1) in 23 patients, who were transferred from CMV to spontaneous breathing (SB). Subjects were divided into two groups, depending on whether they were receiving inotropics or not, at the time of withdrawing CMV.

Group 1 consisted of 12 patients (11 valvular and 1 left ventricular aneurismectomy plus coronary artery bypass graft), none of whom needed inotropic support. Group 2 was made up of 11 patients (10 valvular and 1 left ventricular aneurismectomy plus coronary artery bypass graft) who received dopamine at doses ranging from 8–15 μg/kg/min (mean±SD: 11.0±2.4). Four of these patients were also given oral or intravenous vasodilator therapy.

When patients satisfied criteria for weaning, all the above mentioned parameters were measured during CMV, after which patients were transferred to SB via the circuit of an Engström ERICA ventilator. Repeat analyses were performed 20–30 min after setting the apparatus for spontaneous breathing. All patients were monitored by a pulmonary artery catheter with a thermistor. Cardiac output was determined by thermodilution and $\dot{V}O_2$ was calculated with the Fick equation. Results are presented in Table 1.

Of interest, CI and $\dot{V}O_2$ behaved differently in the two groups. As previously reported withdrawal of CMV in group 1 significantly raised both parameters [1]. In contrast, in group 2 no change was seen in either CI or $\dot{V}O_2$ when CMV was discountinued. What is even more surprising is that $\dot{V}O_2$ failed to increase during SB (Fig. 1). This finding may be related to the (almost critically) low level of oxygen delivery (DO_2)

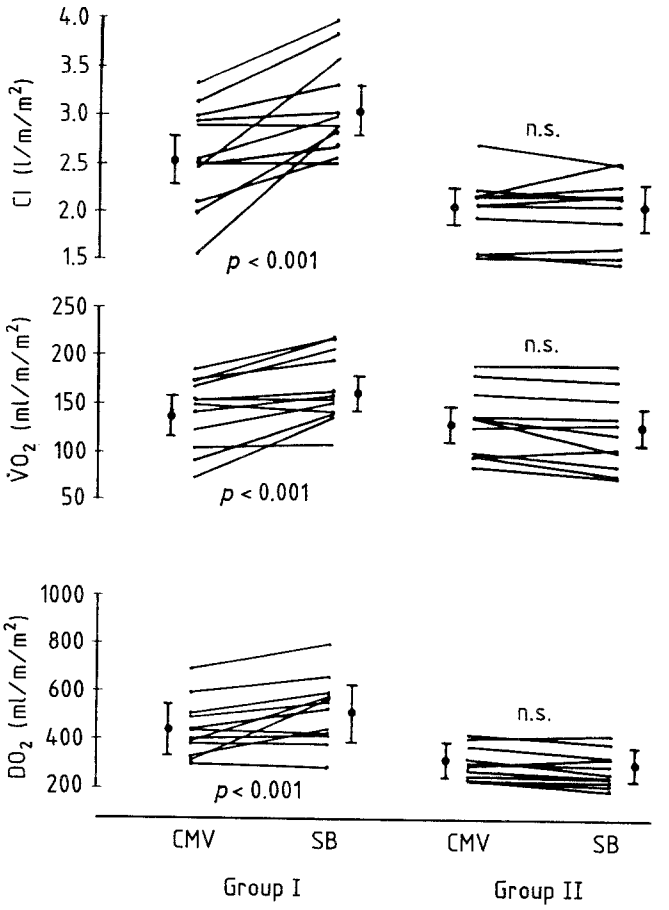

Fig. 1. Variations in the cardiac index, $\dot{V}O_2$ and DO_2 in patients not receiving dopamine (Group 1) and patients requiring doses of 8–15 μg/min (Group 2) during weaning from mechanical ventilation. Note that in Group 2, no change appeared in any of the three parameters upon withdrawal of mechanical ventilation

Table 1. Changes in cardiorespiratory parameters upon changing patients from CMV to SB

	Group 1		Group 2	
	CMV	SB	CMV	SB
CI (L/m/M2)	2.57± 0.49 (a)	3.05± 0.5 (b)	2.09± 0.37	2.1± 0.4
VO2 (ml/m/M2)	141 ± 35	166 ± 33 (b)	134 ±27	132 ±31
DO2 (ml/m/M2)	440 ±112	525 ±135 (b)	351 ±64	354 ±65
MAP (mmHg)	83 ± 9	87 ± 9	75 ± 7	82 ± 6 (c)
MPAP (mmHg)	21 ± 5	25 ± 7	26 ±10	34 ±17 (c)
PWP (mmHg)	11 ± 4	13 ± 5 (c)	15 ± 7	18 ± 8 (c)
CPV (mmHg)	9 ± 3	12 ± 4 (c)	11 ± 5	14 ± 5 (c)
PaO2 (torr)	116 ± 36	112 ± 24	100 ±23	100 ±26
PaCO2 (torr)	33 ± 6	42 ± 6 (c)	33 ± 6	41 ± 7 (c)

Key: (a) = $p<0.05$ compared with CI during CMV group 2. (b) = $p<0.001$ compared with CMV in the same group. (c) = $p<0.05$ compared with CMV in the same group. DO2 = oxygen delivery. MAP = mean arterial pressure. MPAP = mean pulmonary artery pressure. PWP = pulmonary wedge pressure. CPV = central venous pressure

in group 2 patients [2]. Under these circumstances, any increase in $\dot{V}O_2$ would normally be preceded by a rise in DO_2; however, our patients failed to show such a rise, having possibly reached their maximum level of cardiac output. Similar results were reported by Beach and colleagues [3], who found falls in CI and $\dot{V}O_2$ upon switching over from CMV to SB in patients with low cardiac output. Many patients evolved favorably after extubation in both this study and in ours.

Yours sincerely,

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Acute diaphragmatic paralysis after chest tube placement

Dear Sir,

Unilateral and reversible phrenic palsy is a very uncommon complication in the course of a chest tube placement, specially in the pediatric age group [1]. The most likely cause is an injury to the intrathoracic segment of the phrenic nerve which runs close to the mediastinal pleura. Recently, we observed a case of iatrogenic diaphragmatic palsy following the placement of a chest tube. Diaphragm function reversed "ad integrum" shortly after tube withdrawal. The patient was a girl, 26 month-old with no past medical or family history, referred to our center from another hospital because of multiple trauma following a road traffic accident. She required mechanical ventilation. After a subclavian puncture physical examination showed hypoventilation of the right hemithorax, and the chest X-ray showed a right pneumothorax. This was treated by means of the insertion of a chest tube (Pleurcocath®) introduced through mid-axillary line at the level of the 5th intercostal space. The patient's condition improved and she was weaned from the ventilator eight hours after the admission. Twenty-four hours later, a repeat chest-x-ray demonstrated resolution of the pneumothorax but there was elevation of the right hemidiaphragm which was immobile on screening with fluoroscopy. The chest tube had formed a loop at the right costophrenic angle. After the chest tube was removed 30 h after insertion, the elevation of the right hemidiaphragm disappeared and respiratory motion recovered.

Phrenic unilateral injury has been well documented in association with several pleural disorders and lung diseases with pleural involvement (pneumonia, viral infections, trauma). In our patient, a clear time-sequence followed from the insertion of the chest tube and the presence of unilateral diaphragmatic palsy. Likewise, when the chest tube was removed, the palsy rapidly resolved. It is likely that a direct irritation of the phrenic nerve by the chest tube was responsive.

We have found only one previous report of isolated hemidiaphragmatic palsy associated with the insertion of a chest tube in a newborn baby [1]. Four cases have been reported with diaphragmatic palsy occurring after the insertion of a chest tube, requiring plication of diaphragm [2, 3, 4]. A review of a pediatric series by Greene [5] did not report similar complications to ours.

This case illustrates that a reversible hemidiaphragmatic palsy may occur as a consequence of the placement of a chest tube. This complication must also be considered in patients under pleural drainage who have an elevated or motionless hemidiaphragm. The case also reinforces the point that any chest tube must be pulled back and removed as soon as possible when no longer needed.

Yours sincerely,

A. Palomeque, D. Canadell and X. Pastor

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Delivering CPAP with a Siemens Servo 900B ventilator

Dear Sir,

The Servo 900B ventilator is thought to have too high an internal resistance to permit spontaneous respiration without a deleterious increase in the work of breathing. The machine may be employed as a flow generator to drive a CPAP circuit, either with an underwater "blow

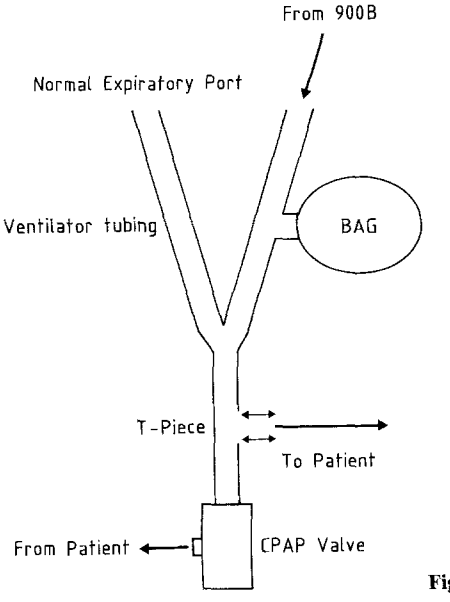

Fig. 1. CPAP via 900B