Synchronized Intermittent Mandatory Ventilation With and Without Pressure Support Ventilation in Weaning Patients With COPD From Mechanical Ventilation*

Vincent Jouventoux, M.D.; Alain Duran, M.D.; and Pierre Levi-Valensi, M.D., F.C.C.P.

This prospective study compared two weaning modalities in COPD patients requiring mechanical ventilation (MV) for acute respiratory failure. Nineteen patients with COPD were studied when their precipitating illness was controlled. Although they satisfied the conventional bedside weaning criteria, they could not tolerate any reduction in the respirator rate below 10 cycles/min. At this time, patients were randomized into two groups receiving either synchronized intermittent mandatory ventilation (SIMV) with pressure support ventilation (PSV) (group 1) or SIMV alone (group 2). The volumetric support of ventilation (SIMV rate) was progressively decreased in both groups according to the patient's tolerance with a concurrent decrease in the barometric support of ventilation (PSV levels from 15 cm H₂O to 6 cm H₂O). At each step of SIMV rate, we found no difference between group 1 and group 2 in arterial blood gases, blood pressure, heart rate, airway occlusion pressure, maximal inspiratory pressure, and oxygen cost of breathing (OCB). At each step, however, group 1 patients showed significantly higher spontaneous tidal volume and lower spontaneous breathing frequency than did group 2 patients. We found a slight but not significant tendency to a shorter weaning period with than without PSV, but no difference in the weaning success. We concluded that (1) conventional weaning criteria might be inaccurate in COPD patients, (2) SIMV appeared very useful in weaning COPD patients from MV, (3) PSV marginally reduced the weaning period when added to SIMV, and (4) the OCB was not significantly improved with PSV.

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ARF=acute respiratory failure; IMV=intermittent mandatory ventilation; MIF=maximal inspiratory force; MV=mechanical ventilation; OCB=oxygen cost of breathing; PEEP=positive end-expiratory pressure; P0.1=airway occlusion pressure; PSV pressure support ventilation; SB=spontaneous breathing; SBF=systolic blood pressure; SI=spontaneous breathing frequency; SIMV=synchronized intermittent mandatory ventilation; sVE=spontaneous minute ventilation; sVT=spontaneous tidal volume; V̇E=minute ventilation; Vo2=oxygen consumption; Vo2resp=oxygen consumption of the respiratory muscles; Vo2tot=total oxygen consumption

The most critical time for patients with chronic obstructive pulmonary disease (COPD) mechanically ventilated for acute respiratory failure (ARF) is the weaning period. Patients with hyperinflation and/or bad nutritional status are obviously exposed to difficulties in recovering sustained spontaneous breathing. Indeed, patients with COPD often do not tolerate discontinuation of mechanical ventilation (MV) due to the combination of a number of factors. During ARF, the increase in both inspiratory and expiratory flow resistances results in an increased mechanical load for the respiratory muscles, and leads to intrinsic positive end-expiratory pressure (PEEP) which acts as an inspiratory threshold load. Concurrently, the hyperinflation induces a flattening of the diaphragm which then operates on a less efficient portion of its force-length curve. So, COPD patients in ARF have to cope with an increased work of breathing that has to be overcome by respiratory muscles which are in a disadvantageous position. Furthermore, MV itself may aggravate intrinsic PEEP, may increase the mechanical load by the resistances of endotracheal tube and respirator circuitry, and can be so considered as an additional burden for the respiratory muscles.

There is actually no gold standard procedure to wean COPD patients from MV. Several ventilatory modalities have been proposed to facilitate the recovery from MV and to reduce the weaning period. Spontaneous breathing trials via a T piece are still used under close monitoring. Minute mandatory ventilation is a volume-assisted ventilatory mode that did not appear to be well tolerated by patients suffering from airflow limitation. The as-

sist mode and the intermittent mandatory ventilation (IMV) mode are demand systems based on a one-way valve trigger that opens when a given negative pressure is generated during the patient’s inspiratory effort. It has been shown that such systems may have a deleterious effect on the mechanics of breathing and may impair the recovery of patients and thereby limit weaning success.9,10 Nevertheless, IMV, and especially “synchronized” IMV (SIMV), remains largely employed for weaning patients who fail to come off the respirator.11

Some other ventilatory modalities are now available on “new-generation” respirators despite the lack of scientific studies on their potential clinical benefits in humans. Pressure support ventilation (PSV) is a recent mode used alone or in association with other modes in patients requiring a ventilatory assistance. PSV acts by maintaining through the respirator circuitry a constant preset positive airway pressure during spontaneous inspiration. As in IMV, spontaneous breathing with PSV requires the patient to open the demand valve which might increase the work of breathing.12 However, Brochard and coworkers13 have shown that PSV reduces significantly the work imposed on the respiratory muscles. Therefore, an association of PSV and SIMV could be of some interest in weaning COPD patients. The aim of this work was to compare in such patients the effects of two weaning modalities—SIMV alone vs PSV added to SIMV—on the following: (1) the duration of the weaning period; (2) the oxygen cost of breathing; and (3) the respiratory pattern.

METHODS

Patients

This prospective study was designed for male COPD patients, intubated and mechanically ventilated because of an acute exacerbation of their disease. All patients exhibited clinically a chronic bronchitis defined as a productive cough with sputum production for 3 months per year for a 2-consecutive-year period (American Lung Association criteria14 and an irreversible chronic airflow limitation on spirometric data obtained from a previous clinically stable period: FEV1/VC ratio less than 60 percent of predicted, and a chronic hyperinflation with a RV/TLC ratio of more than 150 percent of predicted. Asthmatic patients were excluded. We also excluded COPD patients with confounding medical or surgical problems (unstable cardiovascular disease, liver disease, diabetes, malignant disease, or recent surgery).

Patients with COPD in ARB were intubated (orotracheally or nasotracheally) with a tube with an internal diameter of more than 8 mm and started on MV in the control mode for at least 48 h (tidal volume of 10 ml/kg and a respirator rate that did not result in respiratory alkalosis). Then patients were placed under SIMV mode until the following criteria were satisfied: (1) cause of the exacerbation controlled; (2) SIMV rate ≤12 cycles/min; (3) spontaneous tidal volume (sVT) ≥5 ml/kg of body weight; (4) arterial oxygen saturation above 90 percent with FIO2 ≤0.40; (5) pH ≥7.38; (6) maximal inspiratory force (MIF) ≤−20 cm H2O; and (7) airway occlusion pressure (P0.1) less than 5 cm H2O.15,16

Patients who appeared unable to tolerate discontinuation of MV at this time (respiratory acidosis for an SIMV rate <10 cycles/min) were submitted to a randomization between SIMV/PSV (group 1) or SIMV (group 2) modes. Informed oral consent was obtained from the patient or the next of kin. A standard procedure was followed in both groups; the SIMV rate was reduced in steps of 2 cycles/min once or twice a day according to the patient’s tolerance (see further). When the SIMV rate had reached the 6 cycles/min step, short spontaneous breathing periods of 1 h were performed through the respirator circuitry (periods off machine-cycled breathing). If those spontaneous breathing trials (SBT) appeared clinically well tolerated, a spontaneous breathing period (SB) of at least 10 h was performed. When patients with COPD had successfully undergone this procedure, they were extubated.

In group 1, PSV was added throughout the weaning period and four decreasing levels, arbitrarily chosen, were used concurrently with the decrease in SIMV rate: 15 cm H2O at 10 cycles/min step; 12 cm H2O at 8 cycles/min step; 9 cm H2O at 6 cycles/min step; and 6 cm H2O during SBT and SB until the extubation. The SIMV and SIMV/PSV modes were always provided by a specific respirator (Puritan Benett 7200). With this respirator, the PSV delivery is ended when the patient’s inspiratory flow rate is less than 5 L/min or when the airways pressure exceeds the PSV level by 1.5 cm H2O. In both groups, appearance of clinical signs of respiratory muscle fatigue (increased in spontaneous breathing frequency [SI], alternating abdominal and rib cage breathing, paradoxical inspiratory inward motion of the anterior wall of the abdomen, or sweats),17 and/or blood gases deterioration (respiratory acidosis with pH ≤7.35) led to return to the precedent ventilatory step. All patients were placed under a SIMV rate of 12 cycles/min during the night (10 PM to 5 AM), group 1 with PSV and group 2 without PSV. The PEEP was never used and the level of the eletronov trigger was set at its minimal sensibility (0.4 cm H2O). No sedative, narcotic, or analeptic drugs were administered.

Measurements

At each step of SIMV rate (ie, at each 2 cycles/min decrease), several measurements were performed when a ventilatory steady state was achieved on semirecumbent position: average systolic blood pressure (SBP) and heart rate (HR) from repeated measurements, spontaneous tidal volume (sVT), total and spontaneous minute ventilation (VE and sVE), tidal volume, peak inspiratory pressure, respiratory rate, and oxygen saturation were measured during the steady state. The ventilatory parameters were measured via the electronic spirometer of the respirator (Puritan Benett 7200) (accuracy ±4.5 ml/min, internal calibration performed twice a day). Thus, average values of SI, sVT, VE, and sVE were evaluated and arterial blood gases were sampled when the steady state was achieved for the step.

The oxygen cost of breathing (O CB) was concurrently determined by a technique of indirect calorimetry similar to that of Harpin and coworkers.18 Inspired and expired gas samples were taken, respectively, from the inspiratory and expiratory lines of the respirator. Oxygen and carbon dioxide levels were continuously measured using, respectively, a polarographic and an infrared gas analyzer (Ergotest Jager with sensitivity of ±0.02 percent, two-point gas calibration done before each run) during two periods of 5 min and average values calculated. All volumes were corrected to STPD conditions. Oxygen consumption (VO2) was evaluated using the following equation:

\[ \text{VO}_2 = \text{VE} \times \left[ \frac{\text{FIO}_2 (1 - \text{FEO}_2 - \text{FCO}_2)}{\text{FIO}_2 - \text{FCO}_2} \right] \]

where FEo2 and FEo2 are expired oxygen and carbon dioxide.
Table 1—Characteristics of the 19 COPD Patients*

<table>
<thead>
<tr>
<th></th>
<th>Group 1 SIMV/PSV n=10</th>
<th>Group 2 SIMV n=9</th>
<th>p</th>
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<tbody>
<tr>
<td>Age, yr</td>
<td>67.1 ±8.3 (50-78)</td>
<td>67.2 ±8.4 (51-79)</td>
<td>NS</td>
</tr>
<tr>
<td>Weight, %pred</td>
<td>82.1 ±9.4 (65-91)</td>
<td>82.1 ±9.7 (65-92)</td>
<td>NS</td>
</tr>
<tr>
<td>Smoking, pack-years</td>
<td>38.6 ±12.8 (16-60)</td>
<td>43.0 ±13.8 (9-55)</td>
<td>NS</td>
</tr>
<tr>
<td>FEV1, ml</td>
<td>846 ±300 (529-1,500)</td>
<td>873 ±278 (640-1,500)</td>
<td>NS</td>
</tr>
<tr>
<td>FEV1, %pred</td>
<td>32.2 ±9.7 (23-50)</td>
<td>33.8 ±9.9 (24-50)</td>
<td>NS</td>
</tr>
<tr>
<td>FEV1/VC, %pred</td>
<td>53.6 ±10.0 (31-65)</td>
<td>49.9 ±11.7 (36-68)</td>
<td>NS</td>
</tr>
<tr>
<td>TLC, %pred</td>
<td>96.8 ±26.2 (62-140)</td>
<td>94.3 ±14.6 (66-114)</td>
<td>NS</td>
</tr>
<tr>
<td>RV/TLC, %pred</td>
<td>162.7 ±29.5 (133-216)</td>
<td>154.8 ±21.5 (131-200)</td>
<td>NS</td>
</tr>
<tr>
<td>Baseline PaO2,</td>
<td>54.4 ±10.0 (41-67)</td>
<td>58.0 ±10.1 (49-75)</td>
<td>NS</td>
</tr>
<tr>
<td>mm Hg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline PaCO2,</td>
<td>49.1±14.0 (43-75)</td>
<td>49.0±7.5 (40-60)</td>
<td>NS</td>
</tr>
<tr>
<td>mm Hg</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Baseline pH</td>
<td>7.42±0.04 (7.37-7.50)</td>
<td>7.43±0.03 (7.40-7.48)</td>
<td>NS</td>
</tr>
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*Pulmonary function data and baseline blood gases were obtained in steady-state on occasion of a previous visit. Data are presented as mean±SD, range in parentheses.

Table 2—Blood Gas Values*

<table>
<thead>
<tr>
<th></th>
<th>Group 1 SIMV/PSV n=10</th>
<th>Group 2 SIMV n=9</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>PaO2, mm Hg</td>
<td>49.1±14.0 (34-70)</td>
<td>48.6±9.7 (35-60)</td>
<td>NS</td>
</tr>
<tr>
<td>(acute episode)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PaCO2, mm Hg</td>
<td>90.8±24.7 (62-130)</td>
<td>90.1±27.2 (71-149)</td>
<td>NS</td>
</tr>
<tr>
<td>(acute episode)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH (acute episode)</td>
<td>7.21±0.07 (7.10-7.31)</td>
<td>7.20±0.01 (7.09-7.31)</td>
<td>NS</td>
</tr>
<tr>
<td>Mean PAP, mm Hg</td>
<td>28.5±11.7 (18-39)</td>
<td>27.0±4.4 (23-34)</td>
<td>NS</td>
</tr>
<tr>
<td>PCWP, mm Hg</td>
<td>9.3±4.2 (4-15)</td>
<td>10.0±2.6 (7-15)</td>
<td>NS</td>
</tr>
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</table>

*Acute episode blood gases were sampled prior to the intubation for mechanical ventilation. Right heart catheterization was performed during the ICU hospitalization. PAP=pulmonary artery pressure; PCWP=pulmonary capillary wedge pressure.

Data are presented as mean±SD, range in parentheses.

Characteristics of the 19 studied patients are given in Table 1. Group 1 and group 2 patients were all cigarette smokers with obstructive lung disease documented by their pulmonary function test data and blood gas analysis (hypoxemia and hypercapnia) performed in steady state and at rest (Table 1). During the ARF, both hypercapnia and hypoxemia were worsened with respiratory acidosis (Table 2), and right heart catheterization data obtained during the weaning period showed precapillary pulmonary hypertension (Table 2).

The time of MV preceding the beginning of the weaning procedure was similar for the two groups: 3.2±1.1 days in group 1 vs 5.7±3.5 days in group 2. For all steps, patients with COPD under SIMV/PSV mode had significantly higher SVT and significantly lower SF than did group 2 patients (Fig 1 and 2).

![Figure 1. Comparison of the spontaneous tidal volume (SVT) during the weaning in SIMV mode with and without PSV. Data are expressed as mean (bars) ± SD. There was a significant difference between the two groups at each step of SIMV rate, throughout the weaning period. Open diamonds=p<0.01, SIMV/PSV vs SIMV, at each step of SIMV rate.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21693/ on 06/25/2017)

**RESULTS**

Ten patients were randomized to receive SIMV/PSV (group 1) and nine were randomized to receive SIMV alone (group 2). The clinical and physical

**Statistical Analysis**

All data are presented as mean±standard deviation. At each step of SIMV rate, differences between the two groups were detected using nonparametric Mann-Whitney U test. In each group, comparisons between each steps were performed with nonparametric Wilcoxon test. Intergroup comparison of successful weaning attempts was performed by Fisher's exact test. A probability value of less than 0.05 was considered as significant.

**RESULTS**

Ten patients were randomized to receive SIMV/PSV (group 1) and nine were randomized to receive SIMV alone (group 2). The clinical and physical
Spontaneous total minute ventilation appeared significantly lower in group 1 than in group 2 for PSV \( \geq 12 \) cm H\(_2\)O (F.10 step: 5.8±0.8 L/min vs 7.4±1.6 L/min, \( p < 0.03 \); F.8 step: 6.7±0.9 L/min vs 8.1±1.4 L/min, \( p < 0.05 \)) without any difference in blood gases, but was similar to group 2 for PSV \( \leq 9 \) cm H\(_2\)O (F.6 step, SBT and SB periods). For any of the steps, there was no difference between both groups in HR, SBP, P.01, MIF, PaO\(_2\), PaCO\(_2\), and pH. Of course, from the beginning (F.10 step) to the end of the weaning period (SB period), \( \phi \) and \( SV \) significantly increased in both groups concurrently to the recovery in respiratory autonomy (Fig 2). In the SIMV/PSV group, \( SV \) remained constant throughout the study despite decreasing levels of PSV (Fig 1) and no correlation was found between the PSV levels and \( SV \). In group 2 patients, \( SV \) did not change throughout the weaning period (Fig 1).

The \( VO_2 \) did not change during weaning in either group. At any step of SIMV, no significant difference was observed between SIMV/PSV and SIMV groups in the OCB (\( VO_2 \) and \( VO_2 \) percent, Fig 3). Of course, the OCB significantly increased in both groups from F.10 step to SB step concurrently to the increase of the spontaneous ventilation (Fig 3). When the \( VO_2 \) is expressed per liter of ventilation, it significantly increased from F.10 step to SB step in patients without PSV, whereas it decreased in patients with PSV (Table 3 and Fig 4).

At the end of this study, all patients with COPD were extubated as they had undergone long periods of SB without clinical or and blood gas value dete-
reintubation. No significant difference was found in the need for reintubation between the two groups.

**DISCUSSION**

This study compares two modes of mechanical ventilation: SIMV/PSV vs SIMV for weaning 19 patients with COPD. Whereas our patients satisfied the widely accepted criteria for weaning success, they could not tolerate any reduction in SIMV rate without clinical and/or blood gas value deterioration. This is not surprising since it has been shown previously that conventional bedside weaning criteria have poor predictive capacity in patients requiring prolonged MV (>24 h). Multiple weaning criteria have been proposed and evaluated but no one has proved useful enough to obtain wide consensus.

Indeed, Morganroth and coworkers have shown that conventional parameters did not significantly change when patients requiring long-term MV progressed from a period of respirator dependence to a period of successful weaning. Tobin has recently predicted that three factors could account for the poor performance of these conventional predictors: (1) populations and their derived weaning criteria may differ from one study to another; (2) the method of making the measurements may differ between studies; and (3) conventional indices might be inaccurate. We did not validate in our hospital the weaning criteria we used. Nevertheless, these criteria are taken from the accepted literature and are widely used in the clinical setting throughout the world. Newer weaning criteria have been proposed since this work was begun. However, even these new criteria have not been independently validated.

Because we had been unable to successfully wean or extubate these patients, we decided to propose a gradual decrease in both the volumetric (SIMV) and barometric (PSV) assistances of ventilation during the weaning period. The SIMV rate was decreased in a standard way, once or twice a day, depending on the patient's tolerance. This was based on published clinical signs of respiratory muscle fatigue (which have been questioned), but also on the concomitant presence of respiratory acidosis, a more objective index of ventilatory failure. Respiratory acidosis alone, even without clinical signs of respiratory muscle fatigue, was enough to return to the previous step. With PSV, the average weaning time showed a tendency to be shorter, but the difference between the two groups did not reach the significance level, which is not surprising given the small number of patients studied. A few prospective studies have assessed the potential benefits of PSV in weaning patients from MV but none were performed exclusively in patients with COPD. The preliminary results of the European multicenter trial have shown in difficult-to-wean patients that duration of successful weaning attempts was shorter with pressure support alone than with SIMV (PSV: 6±4 days in 36 patients vs SIMV; 10±7 days in 42 patients, p<0.05). With SIMV, the weaning duration appeared shorter in our study than in the European multicenter trial (5.3±1.0 days vs 10±7 days), and furthermore, our SIMV/PSV procedure seemed to provide shorter weaning periods than PSV alone (SIMV/PSV: 4.2±0.8 days vs 6±4 days with PSV for the European multicenter trial). It must be noticed that populations and procedures may be different, explaining perhaps these differences. Nevertheless, SIMV provided satisfying weaning durations in our patients with COPD, with a little, but not significant, advantage arising for the SIMV/PSV modality. Our results on the success rate are in agreement with those of Chinski and coworkers who have compared IMV with and without PSV (10 cm H$_2$O throughout the weaning process) in stable patients who fulfilled weaning criteria and have concluded that weaning success was not different between the two groups.

Because the patient's work of breathing is difficult to measure directly and depends on numerous factors, we chose to evaluate it indirectly through the oxygen cost of spontaneous breathing. This is usually less than 5 percent of the VO$_2$tot in normal subjects breathing quietly, but increases in patients with COPD and in patients undergoing artificial ventilation. Indeed, we found high values of OCB...
in COPD patients when breathing spontaneously via the respirator circuitry. The Vo2resp ranged from 50 to 108 ml/min (or from 17.2 to 40 percent of the Vo2tot), with Vo2resp/sVE ranging from 5.5 ml/L to 10.3 ml/L. Although these results agree with those of previous studies performed on patients with COPD, the OCB could have been underestimated as some respiratory muscle activity might have persisted on assisted controlled ventilation, even in the absence of any triggering. Indeed, we did not directly assess the absence of respiratory muscle activity with possible overestimation of the Vo2nonresp.

Our study reassessed in patients with COPD the previously described effects of PSV on the breathing pattern. For PSV levels ≥12 cm H2O, group 1 patients exhibited significant lower sVE and Sf with higher sVT than did group 2 patients. However, despite this difference in sVE, there was no difference in blood gas values between the two groups. Moreover, OCB was similar at these steps between groups 1 and 2. If we considered that OCB is the consequence of the inspiratory work, these results are consistent with those of Fleury and coworkers, who found a poor correlation of inspiratory work per liter with sVE. High levels of PSV ("PSV max") have been defined as the pressure sufficient to provide a tidal volume of 10 to 12 ml/kg. At these levels (above 15 cm H2O), nearly all the respiratory work is performed by the respirator and "PSV max" could be compared with conventional assist mode ventilation with an additional pressure limit. To wean patients from MV, the "best PSV" level must unload the respiratory muscles without inducing atrophy, and must facilitate reconditioning without inducing diaphragmatic fatigue. Thus, "best PSV" is probably lower than "PSV max" but its exact level is actually not known. Brochard and coworkers have defined it as that one that maintained maximal diaphragmatic electrical activity without fatigue (ie, a reduction of the H/L ratio below 80 percent of the initial value of the diaphragmatic surface electromyographic activity). This level was 0 cm H2O for one patient, 10 cm H2O for four patients, and 20 cm H2O for three patients. For all these reasons, we chose to begin with a PSV level of 15 cm H2O. Nevertheless, with mild levels (12 cm H2O or 15 cm H2O), we found no difference in the OCB between group 1 and group 2. These results are not surprising according to Brochard and coworkers’ study, as for the four COPD patients they studied, the optimal PSV level was estimated to be 20 cm H2O in three and 10 cm H2O for the last one. So, in COPD patients, the optimal PSV level could reach "PSV max" as electrical evidence of diaphragmatic fatigue arose for lower levels. This might explain why, in our study, adding mild PSV levels to SIMV did not result in any improvement in COPD patients’ OCB. However, low PSV levels (5 to 8 cm H2O) have been described to improve the OCB by offsetting the work imposed by the resistance of breathing circuits and smaller-than-optimal-size artificial airways. This additional burden is not negligible: Katz and coworkers have shown that the respirator (Puritan Benett 7200) induces an additional inspiratory work ranging from 10 to 40 percent. F asthma and coworkers predicted that a 1-mm decrease in the tube diameter results in a 67 to 100 percent increase in this work. Nevertheless, low PSV level (6 cm H2O or 8 cm H2O) did not significantly decrease the OCB of our patients.

The only objective benefit of PSV appeared when considering Vo2resp/sVE which represents the oxygen cost per liter of spontaneous ventilation and expresses the efficiency of the ventilation. The Vo2resp/sVE significantly decreased across the weaning period in group 1 whereas it significantly increased in group 2 (Table 3 and Fig 4). Pressure support ventilation could improve the efficiency of the ventilation when added to SIMV. As PSV had allowed patients to breathe with larger sVT and lower Sf, the longer expiratory time might have contributed to reduce intrinsic PEEP and accelerated the recovery in lung mechanics. This could explain why sVT remained constant throughout the weaning period despite the depressive PSV levels and the decrease in Vo2resp/sVE. Nevertheless, these suggestions remain speculative as we did not measure the lung mechanics. The interpretation of our results depends to a large extent on the matching of the two groups of patients. It should be noted that the two groups were not only similar in terms of clinical, functional, and blood gas data before the acute exacerbation, but that the deterioration in blood gas values induced by the acute episode was also similar (Tables 1 and 2). Therefore, we believe the two groups were strictly comparable. However, group 2 had been receiving mechanical ventilation longer, but not significantly so, than group 1 before reaching the weaning criteria. This could suggest that their acute disease was somewhat more severe than that of group 1. If this is so, the tendency to an advantage for SIMV/PSV over SIMV in terms of weaning duration could be even less than suggested by our figures.

In summary, this study compared SIMV/PSV with SIMV alone in 19 patients with COPD during the weaning period. First, we found the conventional weaning criteria to be inaccurate in patients with COPD receiving prolonged MV. Second, SIMV appeared very useful clinically, providing a weaning period of 5.3 ± 1.0 days. Third, adding PSV to SIMV marginally reduced the weaning period, without any
improvement in the success rate. Finally, no difference in the OCB was found with or without PSV, at any PSV levels.

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Weaning from Mechanical Ventilation (Jonniesa, Duras, Levi-Valens)