"Pseudo Auto-PEEP"?
A New Cause for Discrepancy Between the End-Expiratory Occlusion Plateau Pressure and Airway Opening Pressure

Ziya Bilen, M.D.;† and Ian L. Cohen, M.D., F.C.C.P.

The purpose of this study is to describe an unexpected degree of differences between expiratory occlusion plateau pressure (EPO) and airway opening pressure (Pawo) measured level of intrinsic positive end-expiratory pressure above externally applied (auto-PEEP) that was found in six critically ill patients. In six patients (ten studies), the presence and degree of auto-PEEP found during the EPO maneuvers was not confirmed by Pawo measurements. In five studies, flow tracings showed prolonged near zero flow toward end expiration and a slow rise to plateau during the EPO maneuver. Because of the static nature of the EPO determination, a rise in pressure could conceivably be caused by the presence of subcutaneous or mediastinal emphysema and retrograde flow across the airway defect during exhalation. We suggest another cause for auto-PEEP-dynamic hyperinflation from extrapulmonary flow limitation. (Chest 1993; 103:1489-94)

ARDS = adult respiratory distress syndrome; auto-PEEP = level of intrinsic positive end-expiratory pressure above externally applied PEEP (TEEP = externally applied PEEP + auto-PEEP); Cbar = static compliance of the respiratory system; EPO = end-expiratory port occlusion plateau airway pressure; OAD = obstructive airways disease; Pawo = pulmonary airway pressure; Pawo = airway opening pressure

The presence of a level of intrinsic positive end-expiratory pressure above externally applied positive end-expiratory pressure (auto-PEEP) reflects dynamic hyperinflation of the lungs. It may be found in the presence or absence of flow limitation.1 Because of its prevalence and implications in patients both on and off mechanical ventilation, auto-PEEP also known as intrinsic PEEP,3 has generated a great deal of interest. The recognition of auto-PEEP in a patient on mechanical ventilation is important for a number of reasons, particularly for optimizing respiratory muscle function and gas exchange while minimizing adverse cardiorespiratory effects.2 Auto-PEEP can be innocuous, detrimental, or even therapeutic depending on the clinical circumstances. Consequently, the approach to dealing with auto-PEEP will vary from patient to patient. In any case, both the diagnosis and the exact measurement of auto-PEEP are important.

Depending on the pattern of respiration and mode of mechanical ventilation, there are different established diagnostic and measurement methods for determining auto-PEEP.2,3,10,11 Of these, end-expiratory port occlusion plateau airway pressure (EPO) and airway opening pressures at the onset of inspiratory flow (Pawo), as described by Pepe and Marin2 and by Rossi et al.,3 respectively, are used commonly in the patients on a control mode of ventilation. The EPO method probably is the most popular because it can be determined easily on most ventilators without additional technology; therefore, the EPO results for auto-PEEP are frequently used for clinical decision-making at the bedside.

There are accepted discrepancies between these two methods, but the sensitivity and specificity of each method has not been clearly established. The Pawo is a dynamic measurement subject to viscoelastor properties of the lung and regional time constant inequalities.4,11-13 Consequently, the Pawo method tends to underestimate EPO-measured auto-PEEP.3,11-13 Herein, we describe six patients, four with clinically detectable barotrauma, in whom the EPO maneuver revealed significant auto-PEEP, but the Pawo showed negligible auto-PEEP; evidence is presented supporting the premise that an extrapulmonary mechanism may be responsible.

METHODS AND MATERIALS

This study was performed in the surgical ICU at Albany Medical Center Hospital during the months of May through July of 1990 with the approval of our institutional review board: All patients discussed in this study were on controlled mode ventilation (ie, no spontaneous inspiratory triggering of the ventilator and no end-expiratory patient effort—judged both clinically and with the guide of airway flow and pressure tracings). Those requiring mechanical ventilation were routinely screened for the presence of auto-PEEP. During these screenings, a manual EPO maneuver was performed.
just before the next inhalation as described by Pepe and Marini. If the patient was on a Siemens 900C ventilator, the end-respiratory occlusion button was used for the EPO maneuver. If the EPO was positive, patients were enrolled in a second phase of the study. In this phase, a portable respiratory mechanics cart was employed that included a respiratory mechanics module with an adapter (RPM, Medical Graphics Corporation/Hans Rudolph, Inc.) to measure airway flow and pulmonary airway pressure (Paw), the adapter contained a pneumotachograph (Hans Rudolph 3700 series), and air sampling site. Estimation of airway occlusion pressures were possible in the respiratory mechanics module with the aid of an inflatable balloon located proximal to the pneumotachograph and the Paw measurement site in the adapter, which was placed between the endotracheal tube and the Y-junction of the ventilator tubing. Digital signals from the module were fed into a personal computer (Siemens). The software program (PFT system 1070/DTD Respiratory Pressure Module, Medical Graphics Corporation) provided graphic flow and Paw tracings on a color monitor (NEC), and printer (Epson LQ 800) recordings of the tracings. Tidal volume was obtained by the software electronic integration of the flow signal. Simultaneous numerical value of Paw at the point of interest on the flow tracing was possible with the software; this respiratory mechanics module option was used for the determination of Paw in all cases.

Pneumotachograph and pressure transducers were calibrated with a super-syringe and a water column, prior to each study. Analog signals of flow and Paw from respiratory mechanics module were simultaneously recorded on a multichannel recorder (Mingograph 7, Siemens), except on two occasions when the printer graphic format was used for recording of the tracings. Both Paw and EPO methods were performed during a passive unassisted mechanical inflation. For each method an average of three values with less than 1 cm H2O variation measured by respiratory mechanics module numerical readout were used and confirmed by visual readings from the recorded tracings. End-expiratory occlusions were performed by the respiratory mechanics module inflatable occlusive balloon, guided by flow tracings for exact timing and repeated for reproducibility. Wherever values of auto-PEEP are expressed, by either the EPO or Paw methods, they are understood to refer to airway pressure minus ventilator or externally applied positive end-expiratory pressure (PEEP).

In order to calculate the static compliance of total respiratory system (Cst,static), end-inspiratory plateau pressures were measured in 4 cases using either the end-inspiratory occlusion button of the Siemens Servo 900C ventilator or respiratory mechanics module inflatable balloons. The corrected Cst,static as described by Rossi et al. was calculated thus:

\[ C_{\text{st,static}} = V \times \text{tidal volume} / \left( \text{static pressure} - [(\text{externally applied } P\text{EEP}) + \text{auto-PEEP}] \right) \]

This calculation was first performed using auto-PEEP measured by Paw, and again by the EPO method. During the second phase of the study, no neurolizer therapy was given. Arterial, central venous, pulmonary artery, and pulmonary artery wedge pressure tracings also were recorded when available during controlled mode ventilation and when possible during a brief (1 min) continuous positive airway pressure period, while there was no spontaneous respiration. Statistically significant differences between the two methods were assessed with a paired t test. All studies were performed by one of the authors (Z.B.), who was not involved in direct patient care and management decisions.

**RESULTS**

During the study period, a total of 57 patients were screened. Of 16 patients tested positive for auto-PEEP by the initial EPO screening, six were discovered in whom the Paw method revealed negligible auto-PEEP. Three of these patients had clinically significant subcutaneous emphysema (patients 1 through 3), and one had mediastinal emphysema (patient 4). In two patients, no evidence of mediastinal or subcutaneous emphysema was evident by clinical examination or chest roentgenogram. There were two patients with subcutaneous emphysema in the study population who had no auto-PEEP by initial EPO screening. Each of the six cases is briefly described later. Table 1 summarizes their demographic features. Pertinent individual measurements of ten studies in six patients are reported in Table 2; the six cases are described below.

**Case 1**

A previously healthy man was placed on mechanical ventilation for the management of head injury, and adult respiratory distress syndrome (ARDS). The PaCO2 level was intentionally lowered to reduce intracranial pressure. The EPO screenings were negative until the fourth day when 1 cm H2O of auto-PEEP was noted; tense subcutaneous emphysema extending to the scrotum had developed. On the same day, bronchoscopy was performed that revealed no visible tear, airway edema, or narrowing. On physical examination, good air entry was noted without evidence of wheezing, a chest roentgenogram was consistent with ARDS and subcutaneous emphysema.

**Case 2**

This elderly woman was admitted to the ICU following repair of a ruptured abdominal aortic aneurysm. There was no prior history of smoking or pulmonary disease. On the morning of admission to the ICU, a manual EPO screening was positive for auto-PEEP. Tense and diffuse subcutaneous emphysema was present and a chest roentgenogram disclosed no abnormalities except for subcutaneous emphysema.

**Table 1—Demographics of the Six Patients With Large Discrepancies Between the EPO and Paw Methods of Measuring Auto-PEEP**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age, yr</th>
<th>Sex</th>
<th>Diagnoses</th>
<th>Sedation/Neuromuscular Blockade</th>
<th>Outcome</th>
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<tr>
<td>1</td>
<td>25</td>
<td>M</td>
<td>Head injury, ARDS</td>
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<td>Lived</td>
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<tr>
<td>2</td>
<td>90</td>
<td>F</td>
<td>Ruptured abdominal aortic aneurysm, arteriosclerotic heart disease</td>
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<td>Died</td>
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<tr>
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<td>M</td>
<td>Blunt trauma, ARDS</td>
<td>+/+</td>
<td>Lived</td>
</tr>
<tr>
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<td>27</td>
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<td>Burn, smoke inhalation</td>
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<td>Died</td>
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<tr>
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<td>M</td>
<td>Cholecystitis, sepsis</td>
<td>+/−</td>
<td>Lived</td>
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<tr>
<td>6</td>
<td>26</td>
<td>M</td>
<td>Smoke Inhalation, ARDS</td>
<td>+/+</td>
<td>Lived</td>
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Table 2—Summary of Pertinent Data From Ten Studies in Six Patients With Large Discrepancies Between Pawo and EPO Tests for Auto-PEEP

<table>
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<th>St#</th>
<th>Patient</th>
<th>Day*</th>
<th>Mode†</th>
<th>Type</th>
<th>Vent‡</th>
<th>Tidal Volume, m/kg</th>
<th>Minute Ventilation, L</th>
<th>Ventilator Flow Rate, L/min</th>
<th>Externally Applied PEEP</th>
<th>Auto-PEEP Level (cm H₂O)$</th>
<th>Pawo Method</th>
<th>EPO Method</th>
<th>Time to Plateau During EPO, s</th>
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<td>2</td>
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*Day of mechanical ventilation.
†AC = assist control ventilation; SIMV = synchronized intermittent mandatory ventilation; PC = pressure control ventilation.
‡Type of ventilator: 900C = Siemens 900C; 7200 = Puritan Bennett 7200
§Measurements determined from TEEP-externally applied PEEP; TEEP = externally applied PEEP + auto-PEEP.
||Unable to obtain graphic tracing because of recorder difficulties.
§SE = subcutaneous emphysema; ME = mediastinal emphysema.

CASE 3

This 26-year-old man sustained a left lung contusion, multiple left rib fractures, left pneumothorax requiring chest tube placement, left-sided subcutaneous emphysema, left diaphragmatic rupture, and liver and spleen lacerations requiring surgical repair. ARDS developed soon after the admission. His past medical history was significant for mild asthma beginning at 20 years of age. The EPO screening was first performed on day 5 and became positive for auto-PEEP on day 12. At that time, physical examination revealed subcutaneous emphysema and no evidence of bronchospasm, but a chest roentgenogram confirmed subcutaneous emphysema and revealed a left lung interstitial infiltrate.

CASE 4

A previously healthy man who was a nonsmoker sustained facial burns, smoke inhalation, and subsequently ARDS. Routine EPO screenings were negative in the first four days and became positive on day 5 at which point daily chest roentgenography revealed newly developed mediastinal emphysema. Physical examination revealed no detectable subcutaneous emphysema and, except for occasional inspiratory cracks, normal auscultatory findings. Bronchoscopy performed the same day showed airway erythema and charring without airway edema, narrowing, plugging, or bronchial tear. On day 13, a chest roentgenogram revealed a worsening ARDS pattern, but no mediastinal emphysema. A Hamman's crunch and end-expiratory wheezing were detectable by auscultation. His clinical course was complicated by multiple pneumothorax requiring tube thoracostomy; the first was done on day 19. On day 20, another study was performed, and during a 1-min period without evidence of spontaneous breathing (continuous positive airway pressure at level of PEEP), no changes in either arterial blood pressure or central venous pressure were noted; a chest roentgenogram revealed recurrence of mediastinal emphysema.

CASE 5

An elderly man who was a nonsmoker who did not have previous

![Figure 1](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21671/ on 06/26/2017)
pulmonary disease required emergency surgery for a gangrenous gallbladder. On the second postoperative day the first EPO screening was positive for auto-PEEP; physical examination revealed no bronchospasm or subcutaneous emphysema, chest roentgenography showed an elevated right hemidiaphragm, and bronchoscopy was normal. He was successfully weaned from mechanical ventilation that day.

**CASE 6**

This man was admitted with smoke inhalation injury and carbon monoxide poisoning; the past medical history was significant for mild asthma. On day 5, the EPO became positive for auto-PEEP. For clinical reasons, the ventilator settings were changed and the mechanics study repeated. At the time, bronchoscopy revealed tracheal sloughing, erythema and edema to the level of the carina, and a small amount of plugging mucus in the left upper mainstem bronchus; physical examination disclosed no abnormalities, and a chest roentgenogram was normal. By day 6, ARDS became clinically and radiographically evident. During a 1-min continuous positive airway pressure trial there was no change in blood pressure.

A representative tracing of airway flow and pressure during the study (patient 3) is shown in Figure 1. The levels of auto-PEEP determined by both methods of measurement are compared in Figure 2; the mean difference was 5.9 ± 0.9 cm H₂O (0.9 to 19.1 cm H₂O [p < 0.01]). In patients 4 and 6, the auto-PEEP measured by the EPO maneuver was unchanged when occlusions were performed at different time points during near-end exhalation, suggesting that the recoil pressure of the respiratory system was in equilibrium over this time range.

**COMPLIANCE MEASUREMENTS**

Corrected compliance measurements (C_{tr,rs}) were determined on five occasions in four patients (patients 3 through 6, Fig 3). The mean difference was 15.7 ml/cm H₂O (p < 0.01). The EPO method yielded a value exceeding the Pawo method by approximately 33 percent.

**DISCUSSION**

This study describes six ICU patients in whom auto-PEEP was observed with the EPO method. These patients present several unusual features; (1) The difference in auto-PEEP level measured by the EPO and Pawo methods is greater than that reported previously.2 (2) The time to plateau during the EPO maneuver was greater than commonly observed. (3) The auto-PEEP measured by the EPO method was unchanged, even when the timing of the maneuver was intentionally altered. (4) There was no apparent hemodynamic compromise by auto-PEEP as evidenced during continuous positive airway pressure. This discrepancy between the two methods may be coined "pseudo auto-PEEP."

During the EPO maneuver, the airway occlusion creates a pressure plateau reflecting the elastic recoil of the respiratory system. Theoretically, as long as airflow continues in the proximal airway during the EPO maneuver, pressure will continue to rise irrespective of the source of airflow. We suggest that in the presence of subcutaneous or mediastinal emphysema, or both, retrograde flow could occur across the site of the airway leak and back into the airway, thereby resulting in an increase in end-expiratory plateau pressure above the level of externally applied PEEP. This could occur if the pressure in the subcutaneous or mediastinal compartment exceeds airway pressure—the plateau reflecting the pressure equilibrium point between extraluminal airway tree air collection (ie, subcutaneous or mediastinal) and the airway. Interestingly, in patient 4, auto-PEEP, measured by the EPO method, increased as externally applied PEEP the tracheal downstream pressure, decreased; therefore, this possibly increased the pressure gradient for retrograde flow into the lung. The opposite would have been expected if flow limitation within the

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intrapulmonary artery had been present.¹

Unlike the EPO maneuver, the measurement of auto-PEEP by the Pawo method is dynamic in nature. Regional airway time constant inequalities (pendelluft) would cause earlier flow into the areas with lowest airway resistance or highest compliance, or both, thus underestimating auto-PEEP when compared to the EPO method. On the basis of this effect, it is generally accepted that the EPO method reflects the actual amount of auto-PEEP more reliably.²,³,¹¹ In the absence of lung time constant inequalities, there would only be a minute discrepancy between EPO and Pawo methods, attributable to stress relaxation of the respiratory system.¹² This discrepancy would be expected to be greatest in patients with obstructive airways disease (OAD) where time constant inequalities are maximum.⁶,¹³,¹⁴ The differences are relatively small in the patients with OAD, when they were on controlled mode ventilation. In such patients, this discrepancy is accentuated during spontaneous breathing, as shown by Petrof et al.,¹¹ they found auto-PEEP by the Pawo method was, on the average, 58 percent of the value obtained by the EPO method in four spontaneously breathing patients with OAD.

Conceivably, the discrepancy between the Pawo- and EPO-derived amount of auto-PEEP in this study could result from regional lung time constant inequalities or stress relaxation. In our population, however, the discrepancy is much higher than previously reported, even in settings where it would be expected to be maximum (ie, spontaneously breathing patients with OAD).¹¹ For example, it was as high as 19.2 cm H₂O in case 4; the amount of auto-PEEP measured by the Pawo, on average, was 13 percent (range, 1.5 to 25 percent) of the amount measured by the EPO method.

The clustering of these cases during the study period led us to question the reliability of our methods and the integrity of our system. We tested our approach in a single-compartment lung simulator (Medishield, England), while the adapter-incorporating pneumotachograph was located at the Y-junction. Different levels of auto-PEEP were created by the changes on the ventilator (Siemens 900C) settings, while the compliance and the resistance were kept constant on the lung simulator (compliance = 20 ml/cm H₂O; resistance = 20 and 50 cm H₂O/L/s). The amount of auto-PEEP was measured by the Pawo and EPO methods. Two techniques for the EPO were used: the expiratory occlusion button of the Siemens Servo 900C ventilator (readings were taken from the printout of a strip recorder), and the inflatable occlusive balloon of the respiratory mechanics module. The values were obtained by read out of the respiratory mechanics module; the results, shown in Figure 4, demonstrate an excellent relationship between the two methods for measuring auto-PEEP with either the Siemens Servo 900C and recorder or the respiratory mechanics module.

The patients in our study had no clinical evidence of active OAD. In fact, two of the six patients had no detectable pathologic findings of the lung, and the other four had ARDS. Despite this, small amounts of end-expiratory flow persisted in nine of ten studies showing a small amount of auto-PEEP by the Pawo method. Although we cannot completely dismiss the possibility of pendelluft within the lungs, we suggest that retrograde flow across a pleural mediastinal air leak is a more likely explanation.

The prolonged rise to plateau during the EPO maneuver noted in our patients (up to 4.6 s) is atypical. Generally, the EPO reaches a plateau almost instantly. This observation is not inconsistent with collateral flow from extrapulmonary compartments. Another unusual feature, noted in some of these patients, was the observation that changing the timing of the EPO maneuver did not alter the plateau pressure. In determining auto-PEEP by the EPO method, accurate timing is imperative.² If, however, the plateau pressure reached reflects the equilibration of a pulmonary and extrapulmonary compartment, such as mediastinum or subcutaneous tissue, the time dependents may not be as critical.

Presumably, the presence and degree of retrograde flow into the airway will depend on the pressure gradient between the airways and the extrapulmonary compartment, the size of the air collection, and the size and location of the airway defect. It is interesting to note that two patients with subcutaneous emphysema were screened and had no evidence of auto-

![Diagram](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21671/) Figure 4. The EPO and Pawo methods for determining auto-PEEP are compared on a lung simulator. The squares and solid line represent the digital readout values from the respiratory mechanics module, while the asterisks and broken line reflect measurements made using the end-expiratory occlusion button (EEOB) of the ventilator.
PEEP by the EPO method.

The fifth and sixth cases are perplexing; no evidence of barotrauma, OAD, bronchoconstriction, or atelectasis could be found to explain the discrepancy between the methods. Closer inspection of the strip recordings revealed that after the exponential decrease in expiratory flow, there was near-zero expiratory plateau flow which never returns to zero. A problem in the measurement system (ie, a drift in the zero flow baseline) was entertained; however, in both cases end-expiratory occlusion revealed return of the expiratory flow plateau to the zero baseline. This ruled out the possibility of baseline drift; thus, given their similarities to the other four cases with subcutaneous and mediastinal emphysema, clinically occult barotrauma may explain the observations in these two cases.

Our data suggest that pseudo-auto-PEEP is not a rare event; it accounted for 6 of 16 of the patients with auto-PEEP by the EPO method in a 57-patient study population. Further, the possibility of pseudo-auto-PEEP should be considered in patients with subcutaneous or mediastinal emphysema, or both. These observations raise the issue of what methods used for determining auto-PEEP are actually measuring. If pseudo-auto-PEEP is present in a patient, then simply relying on the EPO method could lead to problems. For example, using the EPO-derived auto-PEEP to calculate the corrected C_{ST,RS} would result in an overestimation of C_{ST,RS} (range, 15 to 65 percent in this study).

Though the evidence presented in this report is circumstantial, we believe the constellation of findings unusual enough to warrant further investigations. In the meantime, it would seem prudent to interpret the results of auto-PEEP determined by the EPO method with some degree of caution—especially in the presence of subcutaneous or mediastinal emphysema, or both.

REFERENCES
1 Marini JJ. Should PEEP be used in airflow obstruction? Am Rev Respir Dis 1989; 140:1-3
2 Pepe PE, Marini JJ. Occult positive end-expiratory pressure in mechanically ventilated patients with airflow obstruction. Am Rev Respir Dis 1982; 126:166-70
9 Duncan SR. Inverse-ratio ventilation: PEEP in disguise? Chest 1987; 92:300-02