Introduction
Proportional assist ventilation (PAV+) is a partial ventilatory support mode delivering airway pressure (Paw) in proportion to patient effort, enhancing patient-ventilator interactions. The ventilator estimates muscular pressure by using the respiratory system equation of motion with the instantaneous volume (V) and flow (V′) and the automatically calculated compliance and resistance. The mode gains in popularity but the accuracy of the delivered Paw by PAV+ is unknown.

Objectives
To assess the accuracy of PAV+ by comparing the delivered Paw by the ventilator (Paw_meas) to the theoretical Paw as defined by the equation of motion (Paw_Th) and to examine the factors influencing this accuracy.

Methods
An active servo lung (ASL5000) was programmed to resemble 4 respiratory mechanics: normal (Compliance (C) = 60mL/cmH2O, Resistance (R) = 10cmH2O/L/sec), obstructive (C = 60, R = 20), restrictive (C = 30, R = 10), and mixed (C = 30, R = 20). A Puritan-Bennett 840 ventilator with PAV+ was used. PAV+ was tested varying gain (30 and 60%), inspiratory trigger (IT) (0.8, 5 and 15 L/min), muscular pressure (Pmus) (10 and 15 cmH2O), positive end-expiratory pressure (PEEP) (0 and 5 cmH2O), and respiratory rate (RR) (10 to 30/min) to simulate intrinsic PEEP (PEEPi). PEEPi was measured using the Pmus curve. Paw_Th was calculated as follows: Paw_Th = [(V/C)+(R×V′)] × Gain + total PEEP.

Results
Irrespective of respiratory mechanics and gain, mean Paw_meas was lower than mean Paw_Th. This underassistance by the ventilator was greatest at the beginning (25%) of the cycle and decreased later (75%) in inspiration. These findings were replicated under different IT, Pmus or PEEP settings. A high IT led to greater underassistance at the end of inspiration versus a low IT. A high Pmus was associated with a greater underassistance during the entire inspiration versus a low Pmus. A decrease in PEEP was associated with a major underassistance at the start of the inspiration. A higher RR resulted in a higher %Δ, showing that PEEPi increases total trigger delay and affects PAV+ accuracy. Combining the data from all conditions, PEEPi was correlated with the mean %Δ (R² = 0.61, p < 0.001).

Conclusions
PAV+ assistance is globally accurate compared to Paw_Th even if underassistance is often observed, especially at the start of inspiration. PEEPi leading to increased trigger delay is a major factor contributing to PAV+ inaccuracy. Clinical recommendations should include using a high trigger sensitivity and a careful PEEP titration when PEEPi is suspected.
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Table 1

| Gain (%) | Mechanics | Mean Pawmeas (cm H2O) | Mean PawTh (cm H2O) | Difference mean Pawmeas - mean PawTh (cm H2O) | mean Δ% (%) |
|----------|-----------|------------------------|---------------------|---------------------------------------------|-------------|
| 30       | Normal    | 6.6                    | 9.4                 | -2.8                                        | -29.8       |
|          | Obstructive| 8.4                    | 10.8                | -2.4                                        | -22.2       |
|          | Restrictive| 7.0                    | 8.5                 | -1.5                                        | -17.6       |
|          | Mixed     | 6.7                    | 8.8                 | -2.1                                        | -23.9       |
| 60       | Normal    | 9.6                    | 13.7                | -4.2                                        | -29.9       |
|          | Obstructive| 9.5                    | 13.6                | -4.1                                        | -30.1       |
|          | Restrictive| 10.2                   | 13.0                | -2.8                                        | -21.5       |
|          | Mixed     | 10.3                   | 13.5                | -3.2                                        | -23.7       |
| All conditions | 8.5 | 11.4 | -2.9 | -25.4 |