

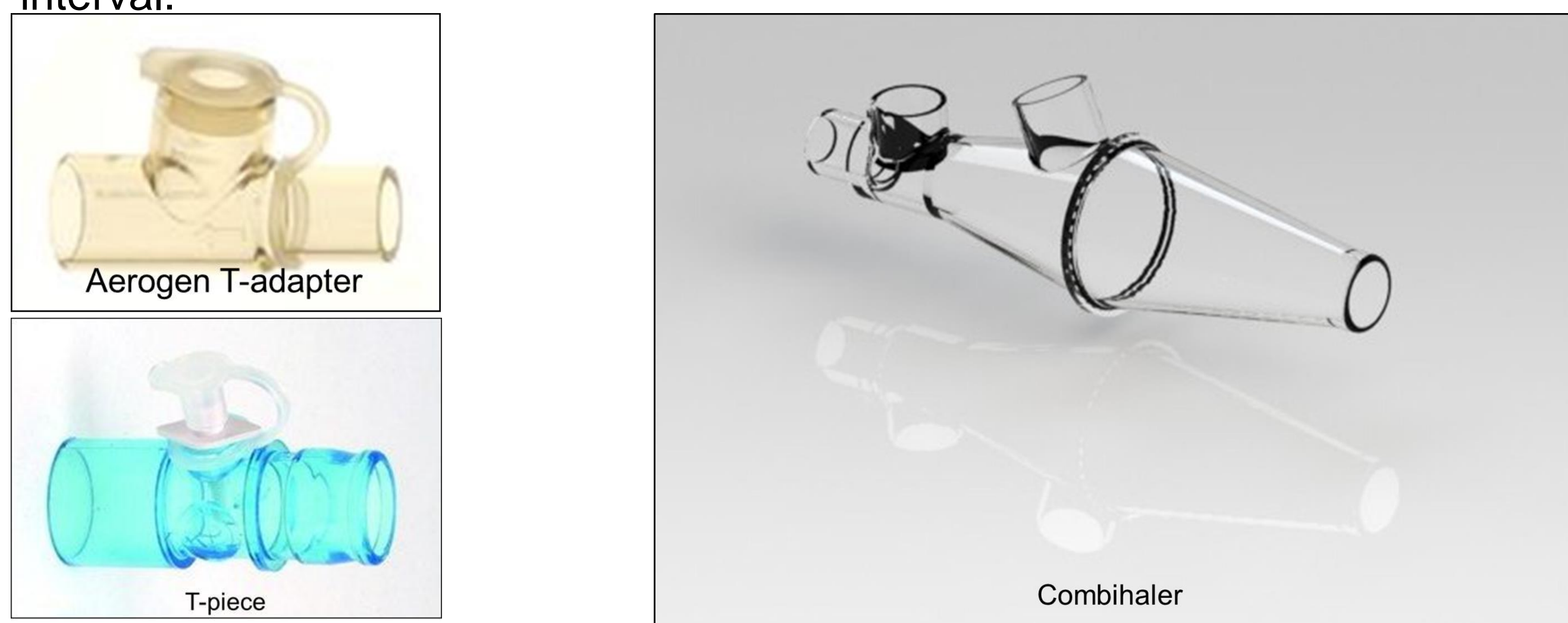
Introduction

The factors influencing aerosol delivery in mechanical conditions relate to the ventilator, the ventilation circuit and the device used to administer inhaled medication. Use of a spacer would appear therefore as a way to optimize aerosol delivery in mechanical ventilations, both with MDIs and mesh nebulizers. A new spacer suitable for either a pMDI or a mesh nebulizer has been specifically designed for circuits of invasive mechanical ventilation.

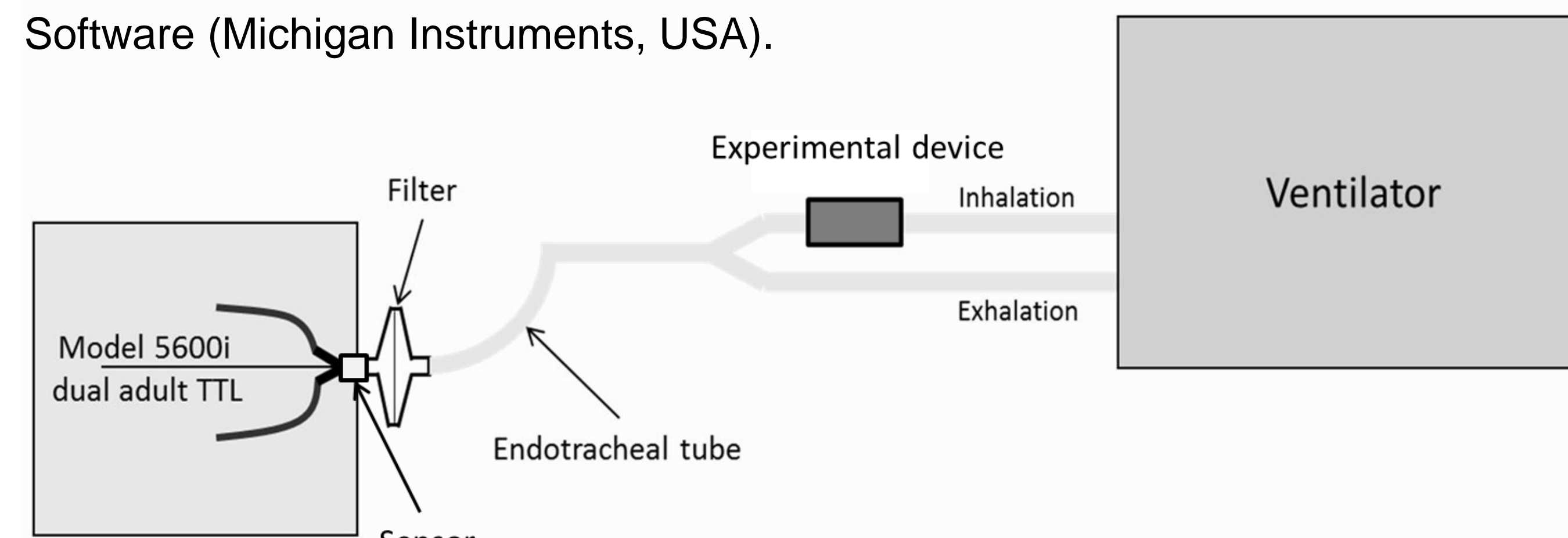
The objective of this study was to evaluate the performances of a new spacer called Combihaler (Protec'som, France) to improve drugs delivery either from nebulizer or pMDI.

Materials and methods

- In this study, two devices were compared for nebulization:
 - Aerogen T-adapter (Aerogen, Ireland) + Aeroneb Solo.
 - Inhalation chamber prototype called Combihaler + Aeroneb Solo.
- 1g of amikacin/8ml was loaded into the Aeroneb Solo (Aerogen, Ireland) nebulizer reservoir.
- In addition, two devices were compared for use with a pMDI :
 - T-piece (Allegiance Healthcare Corporation, USA).
 - Inhalation chamber prototype called Combihaler.
- Ventoline 100 µg/dose (GlaxoSmithKline, France) was used. A total of 10 actuations were made at the beginning of the inspiratory phase and during 10 respiratory cycles of interval.



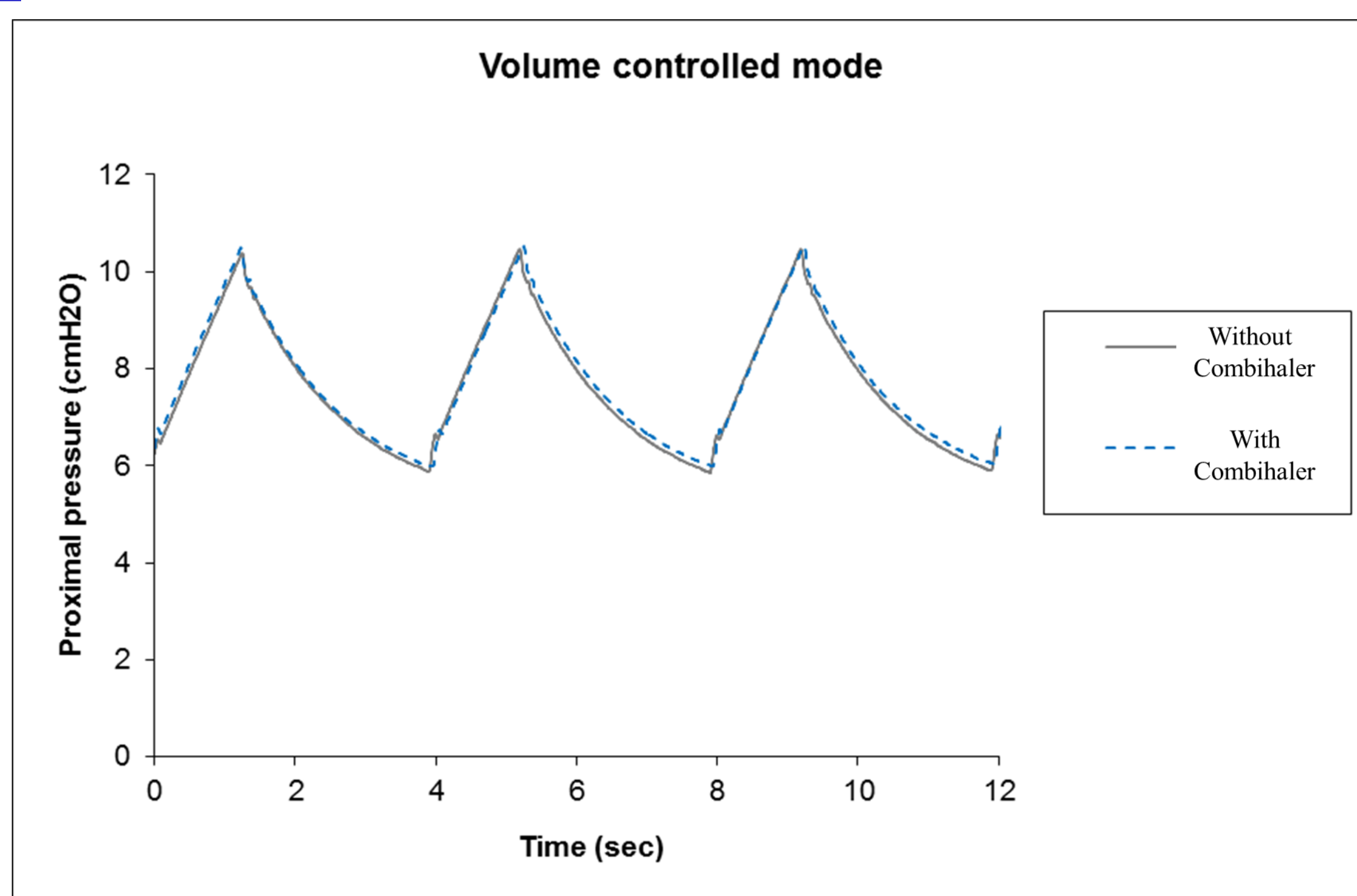
- To assess the Combihaler chamber in clinical conditions, assembly below including a Servo ventilator 300 (Siemens, France) (Volume controlled, Vc = 450mL, f = 15/min, PEEP = 6, P max = 12; Pressure controlled, f = 15/min, PEEP = 6, P max = 11) and a model of adult lung Dual TTL model 5600i (Michigan Instruments) was used. The pressure was measured using a pressure sensor (Michigan Instruments, USA) connected to a laptop using the PneuView® Software (Michigan Instruments, USA).



- A filter was placed after the endotracheal tube to measure the delivered aerosol.
- Values, expressed as mean +/- SEM, were compared using one-way ANOVA.

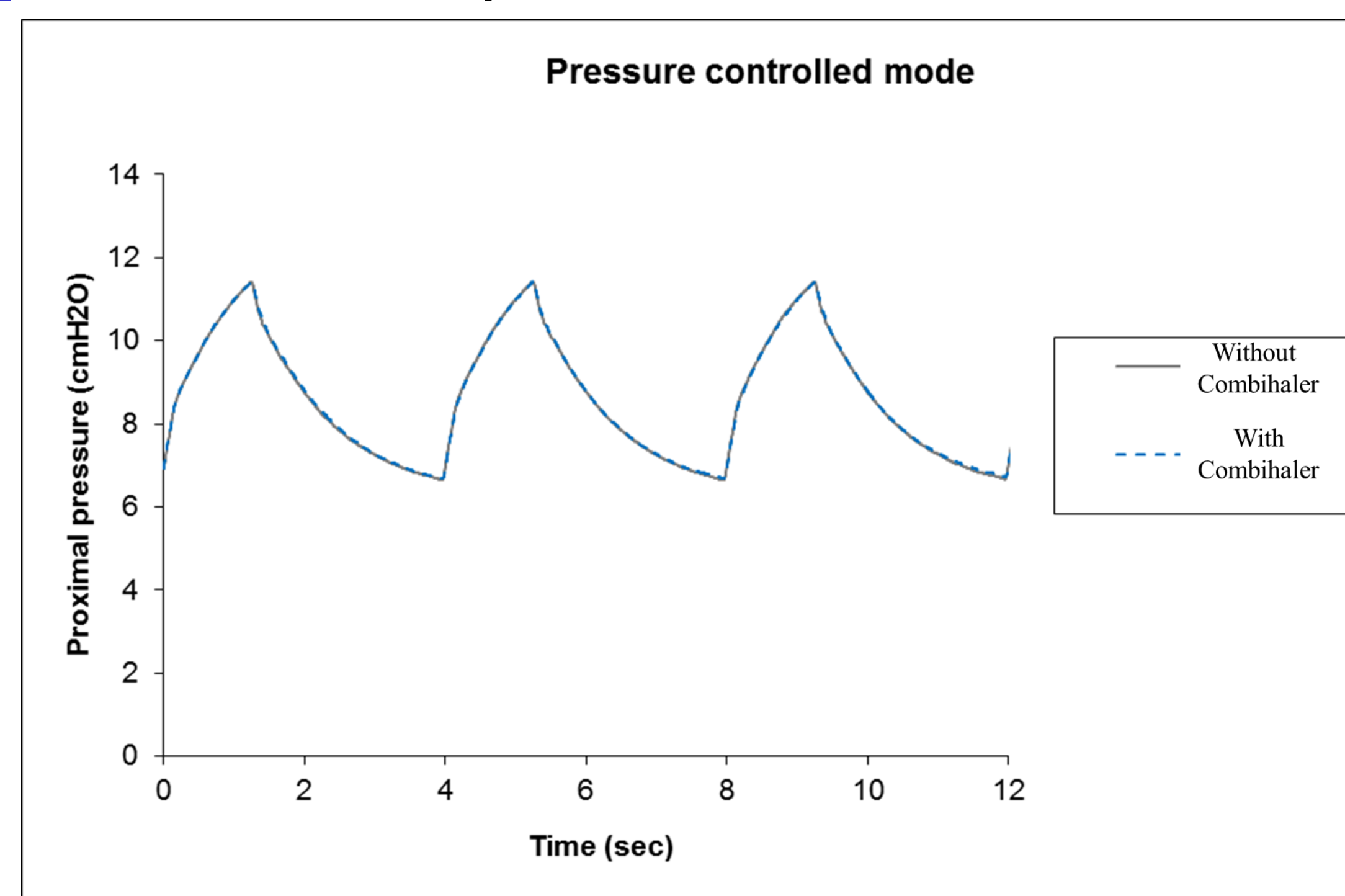
Results

Figure 1: Pressure variation in volume controlled mode



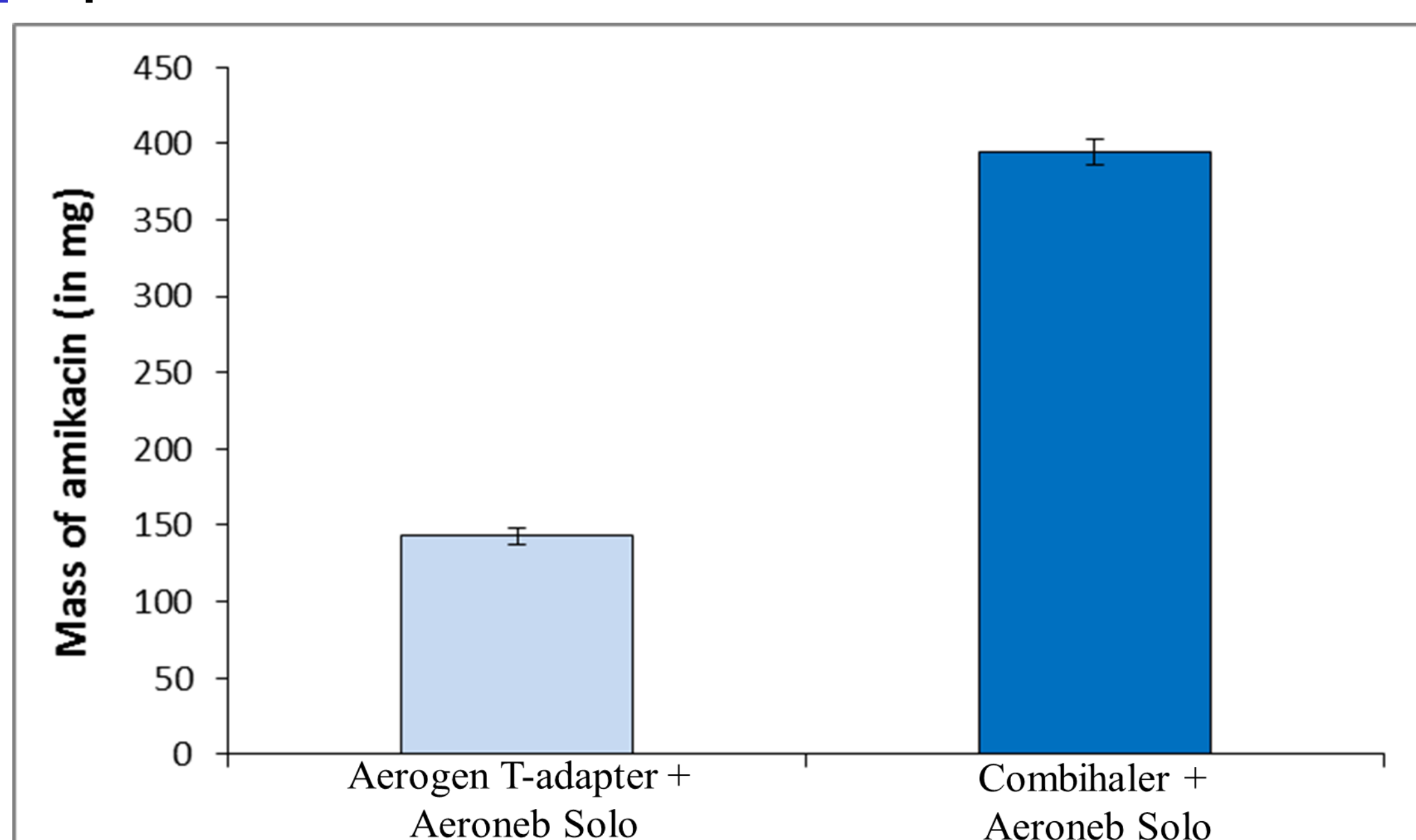
◆ The maximal pressure was similar without or with Combihaler (10.5±0.04 vs 10.6±0.03 cm H₂O).

Figure 2: Pressure variation in pressure controlled mode



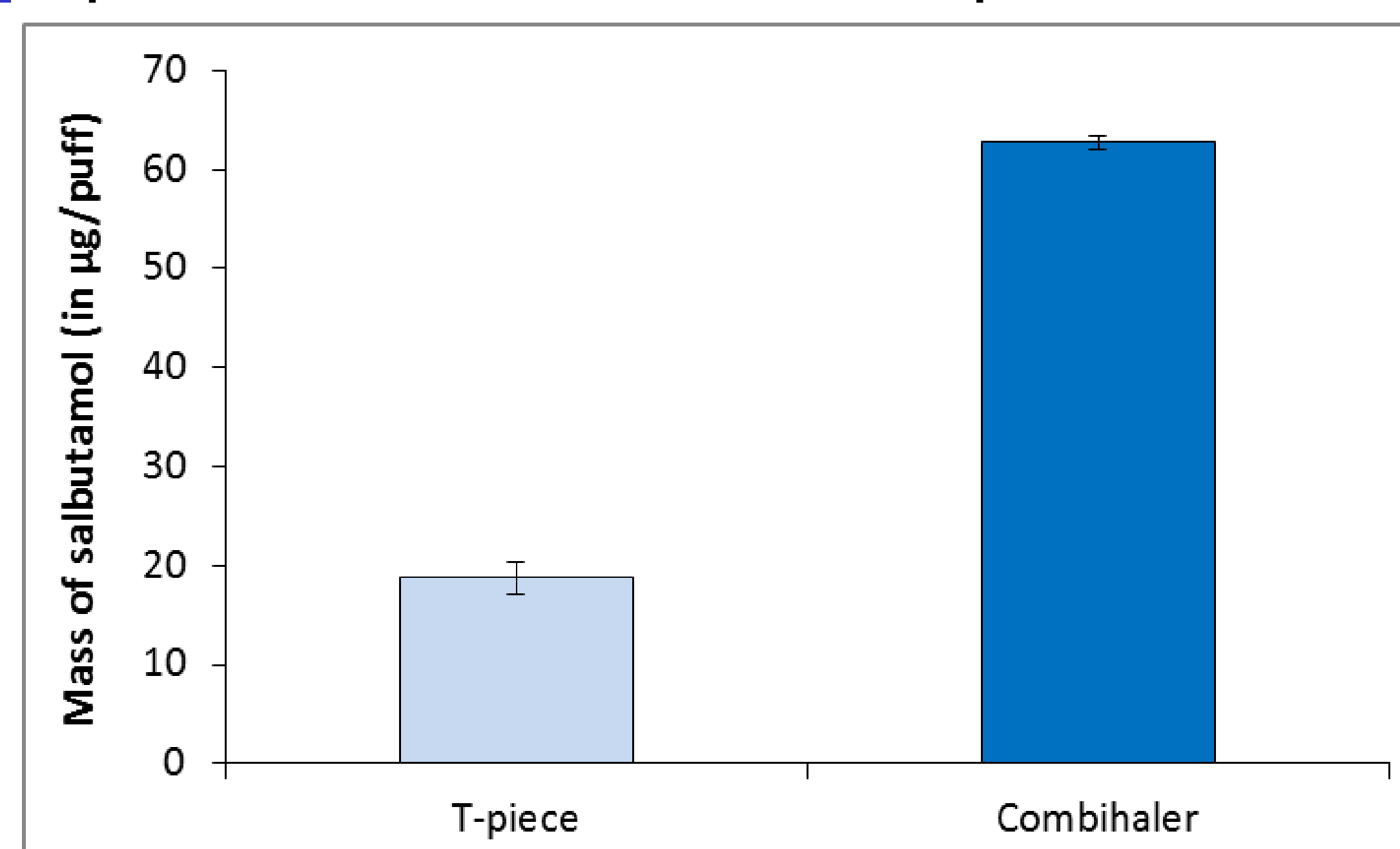
◆ The maximal pressure was identical without or with Combihaler (11.4±0.01 vs 11.4±0.02 cm H₂O).

Figure 3: Deposition of amikacin after nebulization



◆ After nebulization, the mass of amikacin deposited on the filter was higher with the Combihaler chamber compared with the Aerogen T-adapter (394.4±8.9 mg vs 142.4±4.9 mg, p < 0,05).

Figure 4: Deposition of salbutamol after the use of pMDI



◆ After the use of pMDI, the mass of salbutamol deposited on the filter was higher with Combihaler chamber in comparison with T-piece (62.7±0.7 µg vs 18.8±1.9 µg, p < 0,05).

Conclusion

In conclusion, the combihaler spacer allows the efficiency of aerosol delivery through both pMDI and nebulizer, in conditions of invasive mechanical ventilation. The use of this new prototype of inhalation chamber increases the aerosol delivery by mesh nebulizer and by pMDI in comparison with the use of a T-piece.