WHITE PAPER

Characterization of Respirable Output from the Vyntus™ APS dosimeter used with the Cirrus2 nebulizer

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Introduction

With the introduction of the new Cirrus™2 nebulizer, the Vyntus™ APS system was characterized to assess the respirable output of this configuration. This white paper summarizes the methods and results, providing health care professionals with practical data to support consistent bronchial challenge testing (BCT) in daily practice.

Consistent and well-controlled aerosol delivery is important for BCT. Various aerosol delivery systems are available, including jet nebulizers, breath-actuated nebulizers, and dosimeter-based devices. The Vyntus™ APS is a dosimeter device, delivering short, precisely timed aerosol actuations (0.2–1.0 seconds) during inhalation, ensuring consistent dosing for each breath. Whenever components of a dosimeter system are updated, their performance should be re-evaluated to maintain consistent delivered doses and reproducible BCT results over time.[1,2]

The 2017 ERS/ATS technical standards for methacholine challenge testing[1] recommend that devices intended for BCT be characterized to confirm respirable output. This includes measuring inhaled mass (IM) via filter-based aerosol collection and determining the respirable fraction (RF; aerosol droplets ≤ 5 µm) under simulated breathing conditions.[1,2] For a dosimeter such as the Vyntus™ APS, characterization is performed using actuation times of 0.2–1.0 seconds, reflecting typical clinical practice.[1] The product of IM and RF defines the respirable output, a key parameter for calculating delivered doses and setting up challenge protocols.

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Methods characterization Vyntus™ APS with Cirrus2 nebulizer

A series of tests was conducted to evaluate the respirable output in mg/min of the newly introduced Cirrus™2 nebulizer when paired with the Vyntus™ APS dosimeter. The procedures below describe the system setup and how IM and RF were determined.

Vyntus™ APS system setup

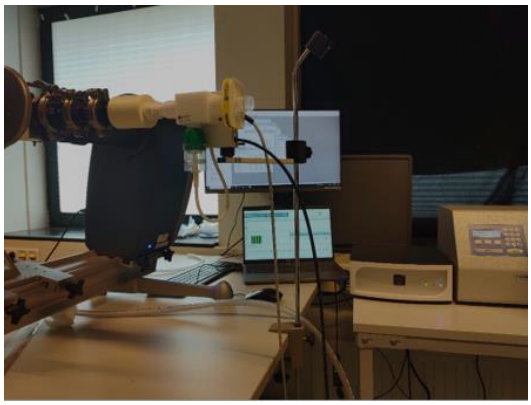
One Vyntus™ APS system was used for testing, including the APS Connection Block for Cirrus™2 (V-707506, Jaeger Medical GmbH) and the APS Tube (V-892080, single-use, Jaeger Medical GmbH), see

Figure 1. Five Cirrus™2 nebulizers (V-8922609, single-use, Intersurgical® GmbH, Germany) from three production lots were tested, each paired with its own dedicated APS Intersurgical® filter (V-892060, single-use, Intersurgical® GmbH, Germany). These pairings were maintained throughout all tests. Prior to testing, all five nebulizer/filter sets underwent a compressed air check, all checks were within the limit range of 0.09–0.170 L/s. Testing was conducted using SentrySuite™ software version 3.30.

Figure 1. *Vyntus™ APS sustem set up*

Test procedure Inhaled Mass

All five nebulizer/filter sets were evaluated under controlled measurement conditions (see ***Figure 2***). Each nebulizer was filled with 3 mL of 0.0625% albuterol hemisulfate solution containing 0.5% fluorescein, allowing measurement via



ultraviolet–visible (UV-VIS) spectroscopy. Aerosol output was collected on inhalation filters (V-892020, AirLife™, single-use, Vyaire Medical, USA) at the patient outlet, with a breathing simulator (BRS 1100,

Copley Scientific, UK) connected to reproduce a 1:1 inhalation-to-exhalation ratio, tidal volume 750 mL, and 15 breaths per minute. The Vyntus™ APS was tested at three actuation durations (0.2, 0.4, 1.0 seconds) with 30, 15, and 10 actuations per setting, respectively. Each nebulizer was tested five times per setting, yielding 75 IM measurements in total.
Inhaled mass (µg/sec) was determined by UV–VIS spectroscopy. Inhaled volume (µL/sec) was calculated by dividing recovered dose by total nebulization time, then converted to IM (mg/min) using the formulation density (1.0001 mg/µL) and converting seconds to minutes.

Figure 2. *System setup for IM testing*

Test procedure Respirable fraction

RF was measured using the same nebulizer/filter sets and breathing simulator settings (see ***Figure 3***). Each nebulizer was filled with 3 mL of 0.0625% albuterol hemisulfate solution (without fluorescein). Aerosol particle size

distribution was determined by laser diffraction (Malvern Spraytec) to calculate the RF. The same actuation durations (0.2, 0.4, 1.0 seconds) and actuation counts (30, 15, 10) were applied, with five tests per nebulizer per setting, resulting in 75 RF measurements.

Figure 3. *System setup for RF testing*

Results Characterization Cirrus™2 nebulizer when used with Vyntus™ APS Dosimeter

Results for both IM and RF are summarized in ***Table 4***. For each actuation time (0.2, 0.4, and 1.0 seconds), the table presents mean values and the corresponding coefficient of variation (CoV in %) across all five nebulizers. It also shows the derived respirable output (mg/min), calculated as the product of inhaled mass and respirable fraction for each actuation time.

	Actuation time		
	0.2 sec	0.4 sec	1.0 sec
Inhaled mass in mg/min (CoV)	**243** (9.7)	**262** (10.4)	**275** (8.5)
Respirable fraction in % (CoV)	**74** (4.1)	**75** (5.1)	**80** (4.0)
Respirable output in mg/min (CoV)	**180** (10.5)	**197** (11.6)	**220** (9.4)

Table 4. *Results IM, IF and Respirable Output*

The overall mean respirable output across the three actuation times was approximately 200 mg/min. Considering the inherent variability of BCT testing, this rounded value was selected as a representative estimate for respirable output and can be applied to actuation times between 0.2 and 1.0 seconds.

Conclusion

Characterization of the Vyntus™ APS Dosimeter with the new Cirrus™2 nebulizer confirmed that it delivers consistent aerosol performance under controlled conditions. Both IM and RF showed stable results across actuation times of 0.2, 0.4, and 1.0 seconds, resulting in a mean respirable output of approximately 200 mg/min. This value provides a practical basis for developing standardized BCT protocols, allowing the delivered dose to be accurately calculated at each step. Considering the inherent variability in BCT testing[1,3,4] the rounded mean of 200 mg/min can be applied across the full actuation time range of 0.2–1.0 seconds, ensuring consistent dose delivery. These reference data support clinical users in confidently applying the device with nebulizers for methacholine challenge testing, in line with current ERS/ATS 2017 recommendations.[1]

References

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