Validation of the Red Maple Trials Allergen Challenge Theatre™
For Ragweed Pollen Challenge

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Background: Spatial and temporal variability in seasonal pollen concentrations can confound the results of field studies for new allergy medications. Allergen exposure facilities such as the Red Maple Trials Allergen Challenge Theatre™ (ACT) provide stable, controlled pollen concentrations year round and offer an alternative to field studies. A full scale validation of the ACT for ragweed (Ambrosia artemisiifolia) pollen challenge was performed.

Methods: The ACT is a 4-zone facility holding up to 100 seats in a series of elevated rows. Pollen was injected into the air supply and blown into the facility through ducts located across the top of the front wall. Pollen concentrations in the ACT were measured using laser particle counters (LPC) and impact samplers (IS). For the technical validation, LPC were used to assess the long-term stability of pollen levels; IS were used to determine pollen uniformity at 15 locations in the room. For the clinical validation, 30 ragweed allergic subjects were exposed to ragweed for 4 hours on two separate days to assess the reproducibility of rhinitis symptoms. Pollen was monitored at 30 min intervals by 15 located in the patient seating area. Results: Three-hour stability results were comparable for LPC (5107 ± 244 g/m³) and IS (4838 ± 414 g/m³). Uniformity testing gave an average ragweed concentration of 4,622 g/m³, with a front-to-back SD of ± 544 g/m³ and a side-to-side SD of ± 333 g/m³.

For the subject challenges, the mean 4-hour pollen concentration was 3,929 g/m³ for Day 1 and 4,099 g/m³ for Day 2. Plateau (2-4 hour) nasal symptom scores were 6.18 ± 1.49 and 6.19 ± 2.14, p=0.74, respectively. Ocular symptom scores were 2.82 ± 1.4 and 2.93 ± 1.82, p=0.59, respectively.

Conclusion: The validation studies showed that ragweed pollen levels in the ACT could be maintained stable over long periods. Subjects responded to the allergen challenge with reproducible rhinitis symptoms on different days. Facilities such as the ACT can provide a suitable means to test new allergy medications.

Introduction

Allergen challenge chambers expose allergen-sensitive subjects to a predetermined concentration of allergen in a closed, controlled environment and provide a mechanism to induce clinical symptoms and measure the effect of medication.

The purpose of this study was to validate the Red Maple Trials ACT [Allergen Challenge Theatre] for controlled ragweed pollen inhalation studies in ragweed-allergic subjects. This was done by first ensuring consistent and stable ragweed concentrations in the ACT. Then, ragweed allergic subjects were exposed to a constant pollen concentration and symptoms measured.

Methods

Ragweed pollen was aerosolized in the ACT and pollen concentrations were measured using an array of impact samplers and a laser particle counter which controlled the dispersion of the pollen. The relationship between laser particle counter and impact sampler readings was evaluated over a range of ragweed concentrations. The stability of ragweed concentration was evaluated over a 3-hour period at a constant pollen output.

The study population consisted of healthy male and female adults, 18 to 65 years of age, with a clinical diagnosis of seasonal allergic rhinitis, positive skin prick tests to ragweed pollen and nasal symptoms during the ragweed pollen season in the previous 2 years. Each subject gave written informed consent before any study evaluations were performed. Thirty-three subjects who reported a peak TNSS ≥5 in a priming exposure were selected for two subsequent 4-hour challenges with ragweed pollen (Ambrosia artemisiifolia) in the ACT.

Three subjects with protracted rhinitis symptoms were not included in the second challenge leaving an evaluable population of 30 subjects. Total nasal (TNSS), ocular (TOSS) and respiratory symptom scores (TRSS) were recorded at baseline and every 30 minutes during each challenge.

Pollen concentrations were shown to be readily adjustable between 5000 and 10000 pμg/m³, through a series of real-time tests. As depicted in Figure 1 a high correlation was seen between measured pollen concentrations obtained from manual impact samplers and continuous readings provided by laser particle counters located at the same position.

Pollen concentrations measured by LPC and the Impact Samplers (IS) were stable and comparable over the 3 hour stability testing period (Table 1). Ragweed levels were stable over three hours (Table 1) whether measured by IS or LPC.

During the subject testing period, the mean pollen concentration was 3359 grains/m³ for challenge 1 and 3468 grains/m³ for challenge 2. The mean ragweed concentration was 3929 grains/m³ for Challenge 1 and 4099 grains/m³ for Challenge 2.

Results

TNSS (Figure 2) and TOSS (Figure 3) scores were comparable on the two challenge days, reaching a plateau at about 120 minutes. The mean primary challenge values for the 30 subjects were also included in the graphs, for comparison.

The mean symptom scores for the plateau (120 to 240 minutes) were calculated for each subject. The group means are shown in Table 2. There was not statistically significant differences for either TNSS or TOSS.

The study demonstrates that the Red Maple Trials ACT can generate consistent ragweed pollen concentration over long periods of time sufficient to perform challenges in allergic patients. Symptomatic responses to ragweed were consistent over several exposures on different days indicating that this chamber can be confidently used for the evaluation of treatments for allergic rhinitis.

References