

Comparison of once daily fluticasone propionate aqueous nasal spray with once daily budesonide reservoir powder device in patients with perennial rhinitis

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Summary

Background Previous studies comparing the corticosteroids fluticasone propionate (FP) and budesonide (BUD) in both perennial and seasonal rhinitis have shown no consistent difference between treatments. However, the therapeutic outcomes may have been influenced by study design.

Objective To compare the effect of FP aqueous nasal spray (ANS; 200 µg/day) with BUD reservoir powder device (RPD; 200 µg/day) on rhinitis symptoms, productivity loss and device preference in patients with perennial rhinitis.

Methods After a 2-week run-in period, 440 patients were randomized to receive either FPANS, BUD RPD or matched placebo (ANS or RPD) for 8 weeks, followed by an open-label 4-week follow-up treatment with FPANS. Patients completed diary card visual analogue scores for nasal symptoms, and questionnaires on satisfaction with the treatment and preferred choice of device.

Results During weeks 1–4, the visual analogue total nasal symptom scores (VATNS) in the FPANS group were significantly lower than scores in the BUD RPD group (mean difference = −17.8; 95% CI = −34.4, −1.3; $P = 0.036$). FPANS also significantly reduced the VATNS compared with the ANS placebo at all time-points assessed ($P \leq 0.005$). BUD RPD did not significantly differ from the RPD placebo at weeks 5–8 ($P = 0.167$), or the ANS placebo at any time-point ($P \leq 0.151$). Over the 8-week treatment period FPANS was significantly more effective than BUD RPD at reducing sneezing (mean difference = −4.4; 95% CI = −8.6, −0.3; $P = 0.036$) and nasal itching (mean difference = −5.3; 95% CI = −9.9, −0.8; $P = 0.022$), and was significantly superior to the ANS placebo for all symptoms assessed at weeks 1–4 and 1–8 ($P < 0.016$). At the same time-points BUD RPD was no better at alleviating nasal itching than the RPD placebo ($P \leq 0.306$), and compared with the ANS placebo, significantly reduced only one symptom; nasal blockage ($P \leq 0.016$). After 8 weeks of treatment, patients preferred the ANS device to the RPD ($P < 0.001$), and at 12 weeks a significantly greater number of patients were satisfied with FPANS treatment compared with BUD RPD ($P = 0.0019$) or the respective placebos ($P = 0.0001$).

Conclusion FPANS and BUD RPD are effective therapies with a good safety profile for the treatment of perennial rhinitis but, in this direct placebo-controlled comparison, FPANS was more efficacious than BUD RPD, and the patients preferred the ANS device to the RPD.

Keywords: fluticasone propionate, budesonide, perennial rhinitis, aqueous nasal spray, device preference, patient satisfaction

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Introduction

Intranasal corticosteroids are important therapies in the management of seasonal and perennial rhinitis. The corticosteroid fluticasone propionate (FP) was developed to optimize anti-inflammatory activity, whilst minimizing any systemic activity. The nasal spray formulation of FP is an aqueous suspension that has limited absorption across the nasal mucosa, due to a slow dissolution rate and mucociliary clearance, resulting in most of the dose being swallowed. These factors, combined with the rapid first pass metabolism of the swallowed portion of the drug [1], and negligible oral bioavailability [2], means that the systemic exposure to FP aqueous nasal spray (ANS) is very low. The absolute bioavailability of FPANS has previously been calculated as only 0.51% [3], which has important implications for reducing the incidence of systemic adverse events and improving tolerability.

FPANS has proved to be an effective and safe agent for the treatment of rhinitis in both adults and children [4–11]. Two studies comparing FP and the corticosteroid budesonide (BUD) in perennial [12] and seasonal [13] rhinitis have shown no difference between treatments. However, the therapeutic outcomes in those two studies may have been influenced by study design. In the study in perennial rhinitis only 98 patients were enrolled, and the study lacked statistical power as well as an appropriate placebo control for FP [12]; this may have biased the results in favour of BUD TurbuhalerTM. The larger two-centre study of seasonal rhinitis compared aqueous suspensions of FP with BUD, both administered as nasal sprays, but in this instance there was no direct dose equivalence, and the study was also not double-blind with respect to FP [13].

The present study was a large multicentre trial, which included both adolescents and adults with perennial rhinitis, the aim of which was to compare the efficacy of microgram-equivalent doses (200 µg/day) of FPANS and BUD reservoir powder device (BUD RPD, TurbuhalerTM), using appropriate placebos to match both active agents. The study was designed specifically to compare not only treatment outcome relative to the effects observed with the respective placebos, but also the patient preference for, and satisfaction with, these two agents under identical and unbiased conditions.

Material and methods

Patients

Four hundred and ninety adult and adolescent patients with perennial rhinitis were recruited into the study. Patients were eligible for inclusion in the study if they were male or female aged 12–60 years, with a history of moderate

to severe perennial rhinitis for at least the previous 2 years. On at least 4 of the last 7 days of the run-in period, patients must have had two or more symptoms of perennial rhinitis (nasal blockage and rhinorrhoea, sneezing, nasal itching or postnasal drip) of at least moderate severity. A patient was excluded from the study if they: had received systemic corticosteroids within the previous month; were receiving inhaled corticosteroids at a dose of > 1000 µg/day of beclomethasone dipropionate or the equivalent; had an infection of the paranasal sinuses or upper or lower respiratory tract; or had nasal bleeding or obstructing nasal polyps.

Study design

The study was a multicentre, double-blind, double-dummy, parallel-group design. The study was conducted in 19 centres in six countries (Austria, Finland, Indonesia, New Zealand, Taiwan and The Netherlands). Prior to starting the study, approval was obtained from each local ethics committee, and written informed consent was obtained from each patient. The study was conducted according to Good Clinical Practice guidelines, in accordance with the latest version of the Declaration of Helsinki (1996).

The study consisted of a 2-week run in phase, in which all patients received placebo intranasal RPD. The patients who were eligible to enter the study were randomized to one of four treatment groups: (i) FPANS 200 µg/day; (ii) placebo for ANS once daily; (iii) BUD RPD 200 µg/day; and (iv) placebo for RPD once daily. The treatment period was 8 weeks followed by an open-label 4-week follow-up period, during which patients who completed treatment or dropped out because of lack of efficacy received open-label treatment with FPANS. The patients attended clinic at the start of the run-in period (visit 1), at the start of the treatment period (visit 2), after 2 weeks (visit 3), 4 weeks (visit 4), 8 weeks (visit 5) and at the end of the 4-week follow-up period (visit 6). The patients who did not satisfy the inclusion criteria at visit 2 entered a second run-in period. In this case the second run-in period and the second visit 2 (visit 2A) was used in the analysis.

During the first visit, the patients' demographic information, medical history and history of allergy were recorded, and a general physical examination was performed. Patients' rhinitis symptoms and a nasal assessment were also performed. A nasal assessment and an oropharyngeal examination were undertaken at each subsequent visit, and the patients' rhinitis symptoms recorded as at visit 1.

Patients were issued with a diary card at each visit, up to and including visit 5, and asked to return it completed by the next visit. Medication was issued at

each visit, and patients were asked to return the medication at the next visit.

Measures of efficacy

The primary efficacy parameter was the patients' mean visual analogue total nasal symptom score (VATNS) over treatment weeks 1–4 and 5–8. The daily VATNS was obtained from the diary cards. An overall daily score ranged from 0 (absent) to 100 (constant) for each symptom. The patients' mean VATNS were recorded each day for sneezing, runny nose (rhinorrhoea), nasal itching and nasal blockage. The daily total nasal symptom score was the sum of these four scores (range 0–400). The patients' mean VATNS was the mean of the daily total. If any of the symptom scores were missing on any day, the total available scores were adjusted to give an overall total out of 400 to account for this. Incomplete VATNS were adjusted by dividing by $n \times 100$ and multiplying by 400 (where n is the number of symptoms for which a score was recorded). The patients' mean VATNS over treatment weeks 1–8 and during the 4-week follow-up were calculated as above. The influence of treatment on attendance at work or school was recorded daily in the diary over weeks 1–8 and during the follow-up period.

Measures of device preference, patient satisfaction and adverse events

The patients' device preferences were recorded at visit 5 (8 weeks) and visit 6 (12 weeks), and satisfaction with the treatment, and whether or not the patients would use the medication again, were recorded at visits 2, 5 and 6. The incidence of adverse events and changes in concomitant medication were recorded at all visits.

Statistical analysis

The safety population consisted of all patients randomized to receive treatment irrespective of whether they actually took treatment, and the intent-to-treat population included all patients who received at least one dose of study medication. Randomized patients were only excluded if no medication was taken. All statistical analyses were done using SAS[®] Version 6.12, and no adjustment was made to P -values for multiple comparisons. A relationship was statistically significant if the P -value was < 0.05 . The baseline measurements from the diary card data were taken from the second week of the 2-week run-in period, and baseline measurements for the visit data were taken from visit 2.

Mean VATNS were assessed using analysis of covariance (ANCOVA) over treatment weeks 1–4 and 5–8 adjusting for centre, age (age groups: up to 19 years, 20–39 years, and 40 years and above), sex and patients' mean baseline VATNS. The total combined scores over the same time periods for each of the treatment groups with their respective baseline scores were compared using the Wilcoxon rank-sum statistic. The same analysis methods were used for the patients' mean VATNS over treatment weeks 1–8 and the percentage of missed school or work days during weeks 1–4, 5–8 and 1–8. Patient satisfaction was analysed using the Wilcoxon rank sum test and device preference at visits 5 and 6 was analysed using McNemar's test.

Results

Of the 490 patients entering the run-in phase of the study, 50 were not randomized to treatment and excluded from the study. The remaining 440 patients were randomized to one

Table 1 Patient demographic details

	Aqueous nasal spray		Reservoir powder device	
	Fluticasone propionate	Placebo	Budesonide	Placebo
<i>n</i>	110	108	115	107
Males (<i>n</i> , %)	46 (42%)	45 (42%)	46 (40%)	44 (41%)
Age (years, mean $\pm$ SD)	28.1 $\pm$ 11.2	28.7 $\pm$ 10.3	28.9 $\pm$ 9.9	31.5 $\pm$ 11.4
Ethnic origin (<i>n</i> , %)				
Caucasian	44 (40%)	44 (41%)	49 (43%)	43 (40%)
Asian	59 (54%)	60 (56%)	62 (54%)	59 (55%)
Oriental	3 (3%)	3 (3%)	4 (3%)	4 (4%)
Height (cm, mean $\pm$ SD)	163.7 $\pm$ 10.0	164.0 $\pm$ 15.8	164.6 $\pm$ 9.8	164.6 $\pm$ 10.3
Weight (kg, mean $\pm$ SD)	57.7 $\pm$ 14.4	62.3 $\pm$ 17.3	60.8 $\pm$ 14.1	61.0 $\pm$ 12.5

SD = standard deviation.

Table 2 Primary reasons for withdrawal from the study

	Number of patients (%) Aqueous nasal spray		Reservoir powder device	
	Fluticasone propionate	Placebo	Budesonide	Placebo
Total patients	110	108	115	107
Patients withdrawn during or after treatment	10 (9%)	7 (6%)	14 (12%)	6 (6%)
Reasons for withdrawal				
Lack of efficacy	1 (< 1%)	0	2 (2%)	0
Adverse event	2 (2%)	0	4 (3%)	0
Failed to return	4 (4%)	4 (4%)	4 (3%)	4 (4%)
Other	3 (3%)	3 (3%)	4 (3%)	2 (2%)

of the four treatment groups as follows: 110 to FPANS, 108 to placebo ANS, 115 to BUD RPD and 107 to placebo RPD.

Patient population

The demographic data for the 440 patients randomized into the four treatment groups are shown in Table 1. The groups were well matched in terms of age, sex, ethnic origin, height and weight. Over 70% of patients in each group had a history of allergy to house mite, and 58–65% to house dust. The next most frequently implicated allergens were cats (30–41%) and dairy products (17–25%). Respiratory

and ear, nose and throat conditions were the most prevalent underlying medical conditions at screening, being present in 7–13% and 9–12% of patients, respectively. The continued use of any concomitant medications after randomization was low (10% or less), and was principally β -agonists (salbutamol, salmeterol, terbutaline) or corticosteroids (beclomethasone dipropionate, BUD).

In total 37 patients (8.4%) withdrew from the study, 10 (9%) from the FPANS group, 14 (12%) from the BUD RPD group, seven (6%) from the ANS placebo group and six (6%) from the RPD placebo group. Reasons for withdrawal from the study were similarly distributed between treatment groups (Table 2).

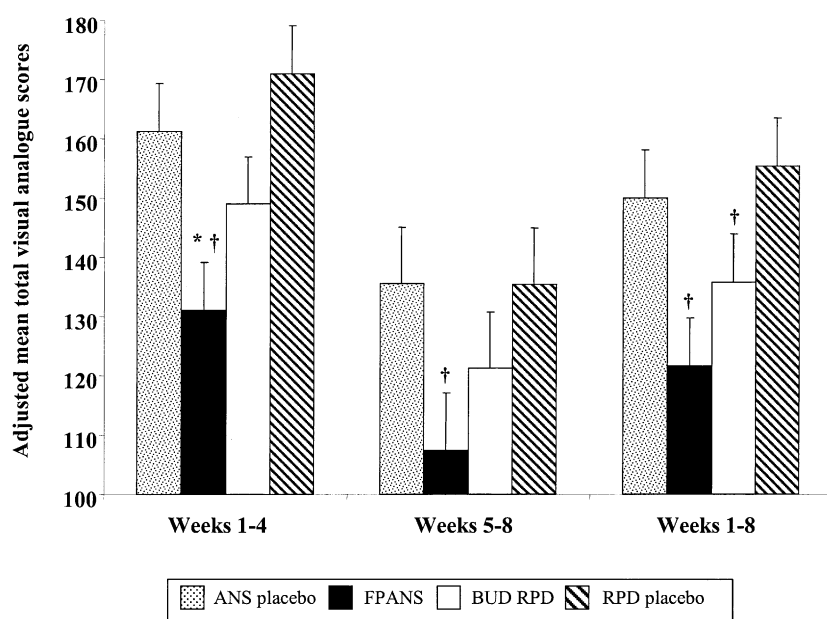


Fig. 1. Comparison of the total nasal symptom scores at weeks 1–4, 5–8 and 1–8 in patients with perennial rhinitis treated with fluticasone propionate aqueous nasal spray (FPANS; 200 μ g/day; n = 110), budesonide reservoir powder device (BUD RPD; 200 μ g/day; n = 115), placebo aqueous nasal spray (ANS placebo; n = 108) or placebo reservoir powder device (RPD placebo; n = 107). * P = 0.036 vs. BUD RPD; † P < 0.03 vs. respective placebos.

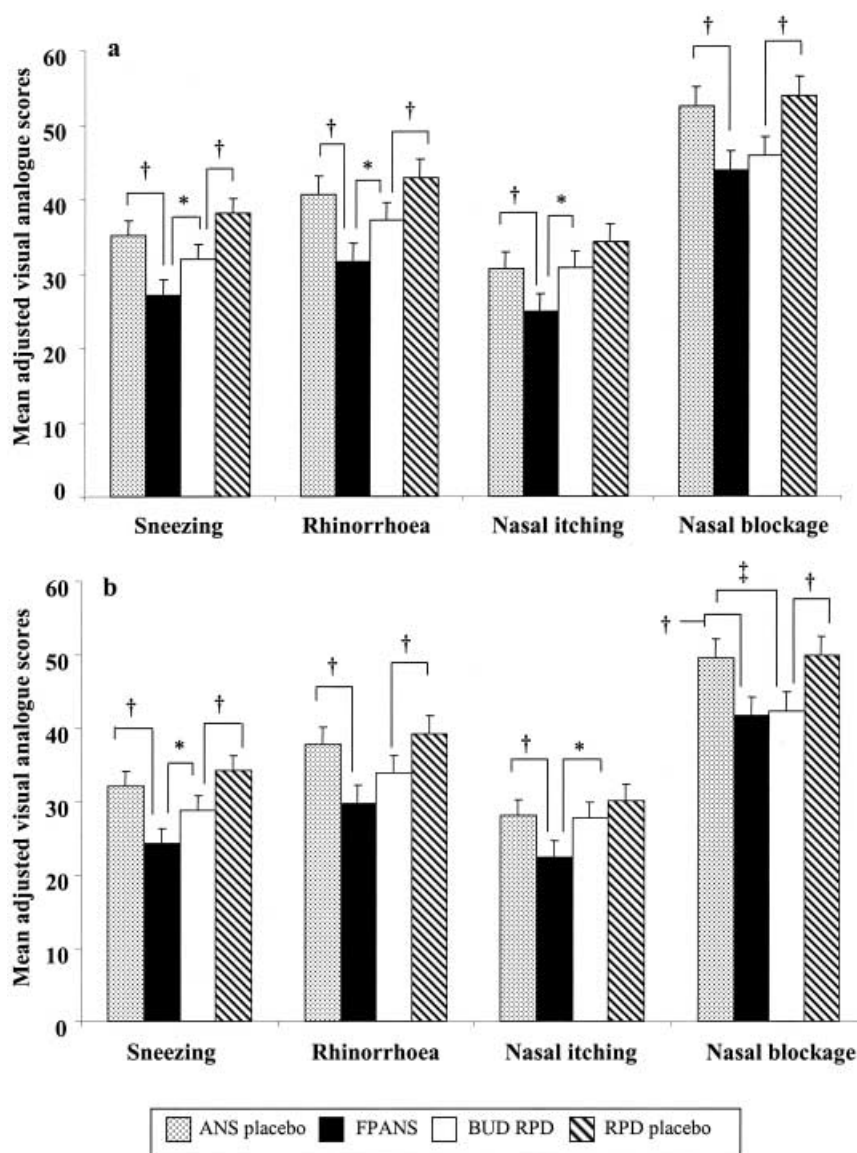


Fig. 2. Comparison of the individual nasal symptom scores at (a) weeks 1–4 and (b) weeks 1–8 in patients with perennial rhinitis treated with fluticasone propionate aqueous nasal spray (FPANS; 200 µg/day; $n = 110$), budesonide reservoir powder device (BUD RPD; 200 µg/day; $n = 115$), placebo aqueous nasal spray (ANS placebo; $n = 108$) or placebo reservoir powder device (RPD placebo; $n = 107$). * $P < 0.04$ vs. BUD RPD; † $P < 0.04$ vs. respective placebos; ‡ $P < 0.01$ vs. ANS placebo.

Efficacy

The mean VATNS at weeks 1–4, 5–8 and 1–8 are shown in Fig. 1, and the mean adjusted VATNS for sneezing, rhinorrhoea, nasal itching and nasal blockage during weeks 1–4 and 1–8 are shown in Fig. 2(a, b). During the first 4 weeks of treatment, FPANS significantly reduced the VATNS compared with BUD RPD (mean difference = -7.8 ; 95% CI = $-34.4, -1.3$; $P = 0.036$). FPANS also significantly reduced the VATNS compared with the ANS placebo during weeks 1–4 (mean difference = -30.1 ; 95% CI = $-46.8, -13.5$; $P \leq 0.001$), weeks 5–8 (mean difference = -28.0 ; 95% CI = $-47.3, -8.6$; $P = 0.005$) and weeks 1–8 (mean difference = -28.3 ; 95%

CI = $-44.9, -11.8$; $P = 0.001$). In contrast, BUD RPD did not significantly differ from the RPD placebo at weeks 5–8 ($P = 0.167$), or the ANS placebo at any time point ($P \leq 0.151$).

In terms of the individual symptoms, FPANS was significantly more effective than BUD RPD at reducing sneezing (mean difference = -4.4 ; 95% CI = $-8.6, -0.3$; $P = 0.036$) and nasal itching (mean difference = -5.3 , 95% CI = $-9.9, -0.8$; $P = 0.022$) throughout the 8 weeks of treatment, and also significantly more effective at alleviating sneezing, rhinorrhoea and nasal itching during the first 4 weeks ($P \leq 0.034$). The reduction in symptom scores for nasal blockage was similar in the FPANS and BUD RPD groups during weeks 1–8. FPANS

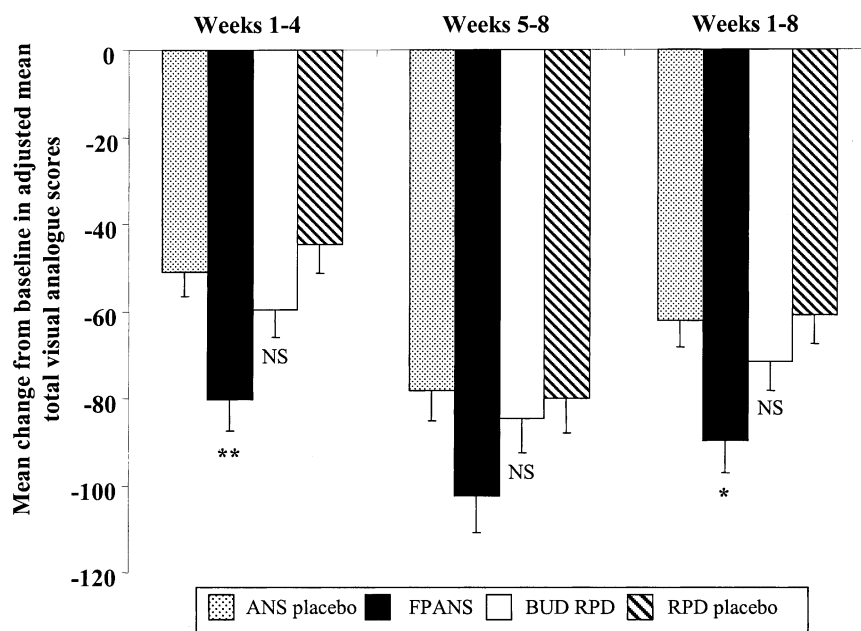


Fig. 3. Change from baseline of total nasal symptom scores at weeks 1–4, 5–8 and 1–8 in patients with perennial rhinitis treated with fluticasone propionate aqueous nasal spray (FPANS; 200 µg/day; $n = 110$), budesonide reservoir powder device (BUD RPD; 200 µg/day; $n = 115$), placebo aqueous nasal spray (ANS placebo; $n = 108$) or placebo reservoir powder device (RPD placebo; $n = 107$). * $P = 0.018$ vs. ANS placebo; ** $P = 0.005$ vs. ANS placebo; NS = non-significant.

significantly reduced the individual symptom scores for all symptoms assessed compared with the ANS placebo at weeks 1–4 and 1–8 ($P \leq 0.016$). At the same time-points, BUD RPD did not significantly differ from the RPD placebo in reducing nasal itching ($P \leq 0.306$), and compared with the ANS placebo, the only symptom which BUD RPD significantly reduced was nasal blockage ($P \leq 0.016$).

As expected, the changes from baseline in total combined scores were smaller for the placebo groups than for the treatment groups throughout (Fig. 3). The changes in the FPANS group were significantly greater than in the ANS placebo group during weeks 1–4 ($P = 0.005$) and weeks 1–8 ($P = 0.018$). In contrast, at weeks 1–4 and 1–8, the changes from baseline for the BUD RPD group compared with either the RPD or ANS placebo groups were not significant ($P \leq 0.218$ and $P \leq 0.333$, respectively).

Differences between the two treatments were apparent in the number of days lost from school or work because of symptoms of perennial rhinitis, but did not reach significance. Although the number of work days lost due to rhinitis was low, there were approximately half as many days lost during the treatment period due to rhinitis symptoms in the patients receiving FPANS (76 days, or 1% of all treatment days) compared with BUD RPD (158 days, or 3% of all treatment days). Patients in the ANS and RPD placebo groups lost 2% and 4% of school/work days, respectively, due to rhinitis symptoms during the 8-week treatment period.

Device preference and medication satisfaction

At the end of 12 weeks, all patients had had some experience with both the ANS and RPD delivery systems. At the end of the 8-week double-blind period, significantly more patients preferred the ANS system ($n = 163$, 41%) compared with the RPD system ($n = 84$, 21%) ($P < 0.001$) (visit 5) (Fig. 4). After the 4-week follow-up period (visit 6), the proportion of patients expressing a preference for the ANS rose to 68% ($n = 268$) compared with 25% ($n = 98$) for the RPD ($P < 0.001$) (Fig. 4).

At the end of the 8-week treatment period, the satisfaction with the treatments received was not significantly different between FPANS and BUD RPD at the end of the 8-week treatment period ($P = 0.727$). However, at the end of the 4-week open-label FPANS treatment (visit 6), the patients who had previously received BUD RPD or placebo RPD were significantly more satisfied with the subsequent FPANS treatment (BUD RPD, $P = 0.0019$; placebo RPD $P = 0.0001$). In addition, patients who had received the ANS placebo were significantly more satisfied with the FPANS treatment ($P = 0.0001$).

Adverse events

Of the 440 patients randomized to treatment, 145 (33%) experienced an adverse event: FPANS $n = 37$ (34%), ANS placebo $n = 35$ (32%), BUD RPD $n = 43$ (37%), RPD placebo $n = 30$ (28%). Forty-six patients experienced a treatment-related adverse event: 14 (13%) in the FPANS group, eight (7%) in the ANS placebo group, 17 (15%) in the BUD RPD group and seven (7%) in the RPD placebo

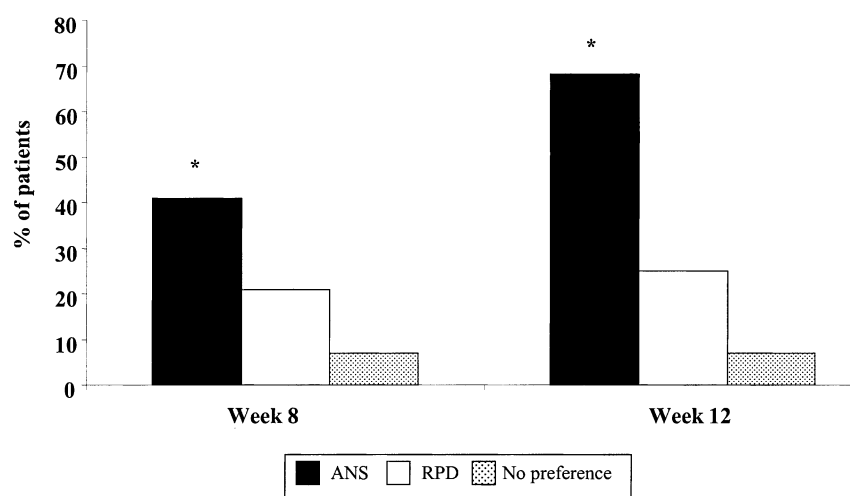


Fig. 4. Patient preference for the aqueous nasal spray (ANS) device or reservoir powder device (RPD) at 8 and 12 weeks. * $P < 0.001$ vs. RPD.

group. The adverse events were primarily associated with the ear, nose and throat: 12 patients (11%) in the FPANS group, six patients (6%) in the ANS placebo group, 14 patients (12%) in the BUD RPD group and four patients (4%) in the placebo RPD group. Two patients were withdrawn from the FPANS group due to adverse events (gastric ulcer and events related to the ear, nose and throat, and skin), and four were withdrawn from the BUD RPD group (ankle injury, convulsions and nausea, Dengue haemorrhagic fever and influenza).

No serious adverse events were experienced in the FPANS group, whereas three (3%) were reported in the BUD RPD group (typhoid fever and intestinal TB infection, chronic tonsillitis, and Dengue haemorrhagic fever) and one (< 1%) in each of the placebo groups (anaphylactic reaction, fibrous adenoma mammae). None of these events were judged to be related to treatment. With the exception of the patient with Dengue haemorrhagic fever, which developed after 14 days of treatment, none of the patients were withdrawn due to a serious adverse event.

Discussion

In this large double-blind, double-dummy, comparator study, FPANS was significantly more effective than BUD RPD at reducing the majority of individual symptom scores and the combined nasal symptom score at weeks 1–4. Over the whole treatment period FPANS was significantly superior to BUD RPD at reducing sneezing and nasal itching. The two active treatments had a similar effect in reducing nasal blockage. FPANS was also significantly more effective than its own placebo at improving the VATNS score and the individual symptom scores at all time-points assessed. By contrast BUD RPD was no more effective than placebo RPD at reducing nasal itching at weeks 1–4 or 1–8, and showed no advantage over placebo

RPD in terms of changes from baseline in overall total nasal symptom score in these patients with perennial rhinitis.

This study was adequately controlled and powered, in contrast to previous studies that compared FPANS and BUD RPD in patients with allergic rhinitis [12,13]. An important aspect of the present study was its double-dummy nature, providing the correct controls for both active agents. During the run-in period, all patients received placebo via RPD which was intended to familiarize patients with the device, which was either unavailable or relatively new in some of the centres participating in this multinational study. Although FPANS was significantly more effective than BUD RPD at reducing the symptoms of rhinitis, these 2 weeks of familiarization with the RPD may have biased the results in favour of BUD RPD in the following 8 weeks of treatment. Conversely, the use of open-label FPANS during weeks 9–12 may have biased treatment satisfaction and device preference results in favour of FPANS, although before this period of open-label treatment, a significant proportion of patients had already expressed a preference in favour of the ANS device.

The present study used the currently recommended clinical doses of FPANS and BUD RPD and, by using the same dose for both agents in a correctly powered study, the distinct therapeutic advantages for FPANS over BUD RPD in the reduction of rhinitic symptoms were apparent. In addition, FPANS had a faster onset of action than BUD RPD in the nose, reflecting its more potent topical anti-inflammatory activity [14,15]. The superior efficacy of FPANS compared with BUD RPD in perennial rhinitis shown in this study, supports the findings of a recent meta-analysis of studies in which inhaled FP was compared with BUD RPD in asthmatic patients [16]. In that meta-analysis, inhaled FP at half the dose (or less) was found to be more effective than BUD RPD for asthma treatment, as indicated

by improvements in peak expiratory flow rates, irrespective of delivery system. In rhinitis patients, studies have also shown that there is no significant difference between the powder, aerosol or aqueous forms of beclomethasone dipropionate [17] or BUD [18–20].

The efficacy of BUD as an aerosol in the treatment of perennial rhinitis has been widely reported, but the effectiveness of the RPD is known to be dependent upon prior use of a decongestant because correct activation of the device requires a peak nasal inspiratory flow of at least 20 L/min [19]. This may explain why there was no difference in efficacy between BUD RPD and its own placebo in patients with perennial rhinitis in the present study. The drug depositions achieved by a powder inhaler and an aqueous nasal spray have not been directly compared, but several studies have shown a similar deposition pattern in the nasal cavity from nasal sprays and pressurized aerosols [21,22], and from multidose powder inhalers and pressurized aerosols [23]. Therefore, in the present study, it seems likely that there was no difference in the deposition pattern of BUD RPD or FPANS, and that the movement of cilia in the nasal passages redistributed both drugs evenly throughout the nose.

In the present study, FPANS was effective when administered at 200 µg once daily, confirming the findings of an earlier study in perennial rhinitis, which showed that FPANS given once-daily at 200 µg was as effective as twice-daily administration of the same dose, or a twice-daily regimen of beclomethasone dipropionate ANS [24]. Scadding and colleagues (1995) showed that in patients with perennial rhinitis once-daily FPANS at 200 µg was effective in the majority of patients, the remainder with more severe symptoms responding to a twice-daily dosage schedule [25,26,27].

Similar observations have been reported in seasonal allergic rhinitis, in which symptoms of the majority of patients were controlled by FPANS at 200 µg once daily, and 200 µg twice daily provided additional relief in those patients not controlled by a once-daily regimen. The efficacy of the once-daily dosage regimen of FPANS was considered to have potential advantages in terms of patient acceptance, compliance and ease of administration in seasonal rhinitis [6], and the present study indicates that it could offer similar benefits in patients with perennial rhinitis. A recent study in hayfever has also shown that once-daily FPANS 200 µg is significantly superior to mometasone furoate in reducing total nasal symptoms ($P = 0.03$) (FDA website: <http://www.fda.gov/cder/foi/nda/index97.htm>).

The good safety profile of FPANS reported previously was confirmed in this study. Adverse events were mainly related to the ear, nose and throat. The minimal systemic

bioavailability of FP from the ANS may have advantages for patients also taking inhaled steroids for asthma, particularly in patients who require long-term use [8]. In the present study, approximately 10% of the patients had an underlying respiratory condition and 2–6% also took inhaled corticosteroids besides their study drug. In the present study, the possible systemic effects of FPANS or BUD RPD were not assessed. Previous studies have shown that clinically recommended doses of FP or BUD (200 µg/day) have no effect on hypothalamic pituitary adrenal function [27–28].

Patients preferred the ANS device to the RPD for administering medication. The ANS has a washing effect and therefore its use is more likely to clear nasal blockage and provide more immediate relief than the RPD, a factor that may have contributed to the patients' choice of device. When FP and BUD were both administered by ANS in a comparative study in seasonal allergic rhinitis patients [13], both agents were reported to produce substantial or total control of rhinitis symptoms, although there was no formal dose-equivalence or assessment of patient preference. In the present study, however, patients reported that they were significantly more satisfied with overall treatment with FPANS than with BUD RPD or with the respective placebos. The therapeutic advantage of FPANS was further reflected in the fewer number of workdays that were lost.

Overall, FPANS and BUD RPD were effective and safe treatments for perennial rhinitis. However, in this direct comparison, FPANS was more effective than BUD RPD in reducing sneezing and itching, rhinorrhoea and overall nasal symptom scores. Moreover, the nasal spray device used to deliver FP was preferred by patients to the RPD used to dispense BUD.

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