REVIEW ARTICLE

Drug Safety 2007; 30 (4): 317-326
0114-5916/07/0004-0317/$44.95/0

Mometasone Furoate Nasal Spray
A Review of Safety and Systemic Effects

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Abstract

The development of corticosteroids that are delivered directly to the nasal mucosa has alleviated much of the concern about the systemic adverse effects associated with oral corticosteroid therapy. However, given the high potency of these drugs and their widespread use in the treatment of allergic rhinitis, it is important to ensure that intranasal corticosteroids have a favourable benefit-risk ratio. One agent that typifies the systemic safety found in the majority of intranasal corticosteroids is mometasone furoate nasal spray, a potent and effective treatment for seasonal and perennial allergic rhinitis and nasal polyposis. Mometasone furoate does not reach high systemic concentrations or cause clinically significant adverse effects. Results from pharmacokinetic studies in adults and children suggest that systemic exposure to mometasone furoate after intranasal administration is negligible. This is probably because of the inherently low aqueous solubility of mometasone furoate, which allows only a small fraction of the drug to cross the nasal mucosa and enter the bloodstream, and because a large amount of the administered drug is swallowed and undergoes extensive first-pass metabolism. There is no clinical evidence that mometasone furoate nasal spray suppresses the function of the hypothalamus-pituitary-adrenal axis when the drug is administered at clinically relevant doses (100–200 μg/day); consequently, mometasone furoate nasal spray has not been associated with growth inhibition in children. The safety and tolerability of mometasone furoate nasal spray have been rigorously assessed in clinical trials involving approximately 4500 patients, with

epistaxis, headache and pharyngitis being the most common adverse effects associated with treatment in adolescents and adults.

The clinical effectiveness of mometasone furoate nasal spray, coupled with its agreeable safety and tolerability profile, confirms its favourable benefit-risk ratio.

1. Intranasal Corticosteroids

Corticosteroids are the most potent medications available for the prevention and treatment of allergic rhinitis. Intranasal corticosteroids are recommended as first-line daily therapy for allergic rhinitis in individuals with persistent disease, especially those in whom congestion as a predominant symptom,[1] or in individuals who have continuing symptoms despite treatment with histamine H_1 receptor antagonists.[2] Although the specific mechanisms by which corticosteroids relieve the symptoms of allergic rhinitis are yet to be completely elucidated, it is thought that binding of the exogenous corticosteroid to an intracellular glucocorticoid receptor induces a conformational change in the glucocorticoid receptor that allows it to enter the nucleus.[2] The glucocorticoid receptor then binds to the glucocorticoid-response element on specific response genes, altering transcription and a number of aspects of the inflammatory process.[2] The downstream effects of this alteration include a reduction in the local production of proinflammatory cytokines, inhibition of inflammation in the nasal epithelium and submucosa (including a decrease in eosinophils, basophils and mast cells) and reduction in mucus secretion from submucosal gland cells (succinctly reviewed by Bousquet et al.[2]). Unlike oral corticosteroids, which affect only the late-phase allergic reaction, persistent use of topical corticosteroids mitigates both the early- and late-phase allergic responses.[3]

The objective of this article is to review the systemic bioavailability and systemic adverse effects associated with intranasal corticosteroids when used in the treatment of allergic rhinitis, with a focus on one of the most recently approved intranasal corticosteroids, mometasone furoate nasal spray. Several searches of the PubMed database for the period covering January 1995–December 2005 were conducted to identify clinical studies and review articles about the treatment of allergic rhinitis and the safety, tolerability and adverse events of the six intranasal corticosteroids (beclometasone dipropionate, budesonide, flunisolide, fluticasone, mometasone furoate and triamcinolone acetonide) currently marketed in the US. Search keywords included the brand and generic names of each intranasal corticosteroid and the terms 'intranasal corticosteroids' and 'intranasal steroids' coupled with the keywords 'tolerability', 'safety', 'adverse events', 'side effects', 'bioavailability' and 'systemic bioavailability'. Papers on preclinical and clinical studies and review papers about the pharmacokinetics and pharmacodynamics of intranasal corticosteroids were also consulted. Additional searches were conducted for specific adverse events and systemic effects related to adverse events with the keywords 'hypothalamic-pituitary-adrenal axis suppression', 'HPA axis suppression', 'growth inhibition', 'bone mineral density loss', 'osteoporosis', 'myopathy', 'cataracts', 'glaucoma' and 'skin defects, thinning, (and) bruising'. References about mometasone furoate and other intranasal corticosteroids were selected if they discussed clinical data on systemic safety and adverse events. Review articles about the class of drugs were chosen as references if they provided an overview of the safety of drugs used in the treatment of allergic rhinitis.

1.1 Safety

Despite the effectiveness of corticosteroid therapy in preventing and treating the nasal symptoms of allergic rhinitis, physicians are often reluctant to prescribe long-term courses of these medications, particularly to children. This reluctance is mainly due to the adverse systemic effects reported with oral and some high-dose topical corticosteroids, including hypothalamus-pituitary-adrenal (HPA) axis

suppression-induced growth inhibition, decreased bone mineral density, myopathy, cataracts, glaucoma and thin or easily bruised skin. [4,5] Newer topical corticosteroid formulations, which ensure the presence of a high concentration of the drug at its site of action and low systemic bioavailability, considerably minimise the risk of systemic adverse effects.[6] The ideal intranasal corticosteroid has high potency and high affinity at local glucocorticoid receptors, and low systemic toxicity at therapeutic doses, leading to a favourable benefit-risk ratio.[6]

The systemic bioavailability and toxicity of a drug are significantly dependent on the extent to which the drug undergoes first-pass hepatic metabolism. The intranasal corticosteroids that are currently in use generally have favourable first-pass metabolism associated with low systemic bioavailability compared with oral agents. However, substantial differences among the intranasal corticosteroids exist.[7] For example, Allen,[7] when writing from an endocrinologist's perspective about the systemic effects of intranasal corticosteroids, estimated that the bioavailabilities of fluticasone propionate and mometasone furoate following intranasal administration are both <1% and that the bioavailabilities for flunisolide, beclometasone dipropionate and budesonide were 49%, 44% and 34%, respectively. The bioavailability of intranasal corticosteroids also depends on their degree of absorption across, rather than into, the nasal mucosa, which in turn depends on their water solubility and lipophilicity. Intranasal agents with lower systemic bioavailability (e.g. fluticasone propionate and mometasone furoate) are highly lipophilic, while those with higher bioavailability (e.g. flunisolide, beclometasone dipropionate, budesonide) are less lipophilic.[7] However, the active metabolite of beclometasone dipropionate, beclometasone-17-monopropionate, is considered highly lipophilic, and an *in vitro* study showed that beclometasone-17-monopropionate was more lipophilic than flunisolide and budesonide but less lipophilic than fluticasone propionate.[8]

Increased lipophilicity correlates with greater deposition of a corticosteroid in the targeted respiratory tract tissue, prolonged occupation of the corticosteroid receptor, greater binding affinity for the corticosteroid receptor, slower release from the respiratory tissue and, consequently, a smaller amount of unbound drug.[9] The unbound drug is the only portion capable of interacting with glucocorticoid receptors and, therefore, potentially resulting in adverse events. An assessment of the percentages of plasma concentrations of inhaled corticosteroids that were unbound concluded that 10% of fluticasone propionate, 12% of budesonide, 13% of beclomethasone dipropionate (no data were available for beclomethasone-17-monopropionate) and 20% of flunisolide were not bound to proteins, such as albumin, in the systemic circulation; binding to protein minimises their bioactivity.[6,10] Given that mometasone furoate nasal spray has a bioavailability of <1% and a relatively higher binding affinity for the glucocorticoid receptor than the other intranasal corticosteroids, the amount of unbound mometasone furoate nasal spray in plasma is virtually undetectable.[11,12]

An additional factor that may affect the relationship between the favourable and adverse systemic effects of intranasal corticosteroids is the frequency of administration.[7] For example, in children administered budesonide 200μg twice daily via intranasal spray, a reduction in lower leg growth from a pretreatment rate of 0.59 mm/week to 0.05 mm/week during treatment was noted. A subsequent study in which children received once-daily intranasal budesonide 200 or 400 μg/day via a dry powder inhaler showed no effect on lower leg growth.[7] These effects could be due to the extent of bioavailability associated with either the different drug formulations or the effect of once- versus twice-daily administration. In a 12-month, double-blind, placebo-controlled study in prepubescent children with allergic rhinitis, beclomethasone 168μg given twice daily caused a small but statistically significant reduction in annual height gain. These data led, in part, to the implementation of a class label that recommends close monitoring of the effect on growth of all inhaled corticosteroids. However, data from most clinical studies suggest that, when given at therapeutic doses, once-daily intranasal cortico-

steroids do not have an adverse long-term effect on growth because of efficient first-pass hepatic metabolism.[7]

2. Mometasone Furoate Nasal Spray

Mometasone furoate is a potent 17-heterocyclic corticosteroid formulated in an aqueous suspension for intranasal use with a metered-dose, manual pump nasal spray. Mometasone furoate nasal spray has been proven effective for the prophylaxis and treatment of seasonal allergic rhinitis,[13-17] the treatment of perennial allergic rhinitis[18-20] and nasal polyposis[21,22] and as an adjunct to antibacterials for the treatment of acute rhinosinusitis.[23,24] *In vitro* comparisons with other topical corticosteroid formulations have shown mometasone furoate to have a high binding affinity for the glucocorticoid receptor and to be a potent stimulator of glucocorticoid receptor-mediated gene expression.[12] Given the high potency of mometasone furoate, it is important that the drug has only negligible systemic concentrations at recommended doses and, therefore, does not cause clinically significant adverse effects.

2.1 Systemic Bioavailability

Studies have indicated that mometasone furoate is minimally absorbed into the systemic circulation following intranasal administration. At therapeutic doses (100–200 μg/day), the plasma concentrations of mometasone furoate nasal spray were generally undetectable (using an assay with a lower limit of quantification [LLOQ] of 50 pg/mL) in adults[6] and children.[25] Such results were further illustrated in a randomised, single-blind, crossover study in which healthy volunteers were randomly assigned to receive mometasone furoate nasal spray 800μg every 8 hours for 4 days, fluticasone propionate aqueous nasal spray 800μg every 8 hours for 4 days, or placebo.[26] For both drugs, the dosages administered were 12 times that recommended for the prevention or treatment of allergic rhinitis. After 4 days, the estimated mean absolute bioavailabilities of fluticasone proprionate aqueous nasal spray and mometasone furoate nasal spray were 0.42% and 0.46%, respectively, relative to intravenous infusions (using an assay with an LLOQ of 20 pg/mL).

The low systemic bioavailability of mometasone furoate nasal spray may be explained by its rapid hepatic metabolism and inherently low aqueous solubility (≈0.1 μg/mL), which, as shown in the comparative study with fluticasone proprionate aqueous nasal spray, results in a negligible amount of the drug crossing the nasal mucosa and entering the bloodstream.[26] The remaining drug is cleared from the nose by the mucocilia and swallowed.[6] Any drug absorbed through the intestine undergoes extensive first-pass metabolism, resulting in little systemic absorption.[6] After hepatic biotransformation, mometasone furoate metabolites are excreted primarily through the bile into the faeces and, to a limited extent, into the urine.[27,28]

2.1.1 Systemic Bioactivity at Therapeutic Doses

While systemic bioavailability gives important information about the amount of drug that reaches the systemic circulation, the question that follows is whether systemic exposure leads to clinical adverse effects.[5] One potential adverse effect of systemic exposure to intranasal corticosteroids is interference with normal HPA-axis function, potentially leading to a decreased ability of the adrenal glands to produce cortisol and consequently impairing the patient's normal response to stress. A possible effect of systemic bioactivity on HPA-axis function was seen in a comparative study with fluticasone propionate aqueous nasal spray and triamcinolone acetonide in children (n = 59; mean age: 7.2 years) who received treatment for 4 weeks with each of triamcinolone acetonide (110 and 220 μg/day), fluticasone propionate aqueous nasal spray (200 μg/day) and placebo.[29] Treatment with triamcinolone acetonide and fluticasone propionate aqueous nasal spray did not have a clinically significant effect on growth velocity in the lower leg. However, the change in the mean urine cortisol/creatinine ratio was significantly less with fluticasone propionate aqueous nasal spray treatment than with triamcinolone acetonide or placebo. The bioactivity of fluticasone propionate aqueous nasal spray – specifically, its high potency and extended receptor binding – is thought to be a

possible explanation for the increased incidence of effects on the HPA axis with fluticasone propionate aqueous nasal spray. However, the authors said the clinical importance of this result was uncertain.[29]

Other potential long-term effects of increased systemic exposure to corticosteroids include growth inhibition, decreased bone mineral density, myopathy, cataracts, glaucoma and thin or easily bruised skin.[4] Measuring plasma or urinary cortisol levels is considered to be a reliable reflection of HPA axis function and of the systemic bioactivity of an exogenous corticosteroid.[30] A review of the literature concluded that intranasal corticosteroids do not suppress HPA axis function to a clinically relevant extent in most patients.[6] However, measuring plasma or urinary cortisol excretion levels at the beginning of treatment and again during treatment may be a prudent means of detecting the potential for systemic adverse effects.[6]

2.1.2 Hypothalamus-Pituitary-Adrenal (HPA) Axis Function in Adults

A number of studies have been conducted to assess the impact of mometasone furoate nasal spray on HPA axis function in adults. In one study, 64 patients with allergic rhinitis received mometasone furoate nasal spray 200 or 400 μg/day, oral prednisone 10 mg/day or placebo for 36 days.[31] HPA axis suppression was evaluated by monitoring the response to tetracosactide (cosyntropin), a synthetic analog of corticotrophin that stimulates cortisol release by the adrenal cortex. A 6-hour tetracosactide stimulation test revealed no significant differences in mean plasma cortisol levels between patients who received mometasone furoate nasal spray and those who received placebo. However, oral prednisone treatment was associated with significant ($p < 0.01$) reductions in cortisol levels compared with placebo. In other studies in adults with allergic rhinitis, a single dose of mometasone furoate nasal spray 400μg[32] showed no effect on HPA axis function as assessed with the tetrasactide stimulation test, and 200 μg/day dosages of each of mometasone furoate nasal spray and intranasal budesonide and triamcinolone acetonide 220 μg/day did not produce significant suppression of 24-hour urinary plasma cortisol levels, the cortisol/creatinine ratio, osteocalcin levels or the blood eosinophil count.[33]

Additional evidence that mometasone furoate nasal spray has no clinically significant impact on HPA axis function was shown in patients with perennial allergic rhinitis (n = 27).[34] Administration of mometasone furoate nasal spray 200 μg/day and triamcinolone acetonide 220 μg/day for 3 weeks did not produce any notable changes in overnight 10-hour urinary free cortisol excretion corrected for creatinine excretion (to account for different urine volume collections) as well as in 8:00am plasma cortisol and serum osteocalcin levels.

2.1.3 HPA Axis Function in Children

The importance of evaluating the potential effect of mometasone furoate nasal spray on the HPA axis is particularly pertinent in children, given the association of some drugs with HPA axis suppression-induced growth inhibition. The effects of intranasal corticosteroids on HPA-axis function in children have been evaluated in a number of short-term (2–4 weeks) and a few long-term (≥6 weeks) studies.[25,29,31-36]

No effects of mometasone furoate nasal spray on growth velocity or the function of the HPA axis were observed in children treated with mometasone furoate nasal spray at therapeutic doses in both a short-term (up to 2 weeks) and a long-term (1 year) study.[25,37] For example, in one study children aged 3–12 years were administered mometasone furoate nasal spray 50, 100 or 200 μg/day or placebo for 7 days (children aged 6–12 years) or 14 days (children aged 3–5 years).[25] The function of the HPA axis was assessed using morning plasma cortisol levels and 24-hour urinary free cortisol levels in the older children and by response to the 30-minute tetrasactide test in the younger children. A standard intramuscular injection of 0.25mg of tetrasactide dissolved in 1mL of sodium chloride was administered to evaluate the children's response to tetrasactide stimulation. No statistically significant changes in any measures of HPA axis activity were observed following administration of mometasone furoate nasal spray in either age group.

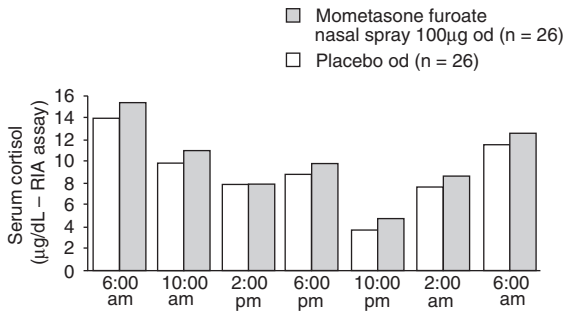

Fig. 1. Mean serum cortisol concentration-time profile on day 42 in children aged ≥2 to <6 years with allergic rhinitis receiving mometasone furoate nasal spray 100μg od or placebo.[36] **od** = once daily; **RIA** = radioimmunoassay.

A 6-week, placebo-controlled study in children (n = 55) aged 2 and 3 years did also not find any indication that treatment with fluticasone propionate aqueous nasal spray was correlated with effects on the HPA axis, as measured by 12-hour creatinine-corrected urinary-free cortisol levels.[35] Fluticasone propionate was administered at a dose of 200μg once daily, the highest recommended dose in children.

Similar findings were reported in a 42-day study in children (n = 56) aged ≥2 to <6 years with allergic rhinitis who were randomly assigned to treatment with mometasone furoate nasal spray 100μg once daily or placebo.[36] No statistically significant between-group differences in creatinine-corrected urinary free cortisol levels on day 42 or at the end of treatment (four patients discontinued treatment at day 31; the reason for discontinuation was not specified) were noted. Similarly, no apparent between-group differences in mean serum cortisol level-time profiles (figure 1) or area under the concentration-time curve for cortisol concentration were observed following 42 days of treatment.

Taken together, these data demonstrate that mometasone furoate nasal spray has no notable effect on the function of the HPA axis.

2.2 Safety and Tolerability

The safety and tolerability of mometasone furoate nasal spray have been assessed in a comprehensive clinical trial programme involving approximately 4500 patients, with the incidence of adverse events being generally similar in patients receiving mometasone furoate nasal spray and those receiving vehicle.[13-20,27,38-41] All published information relates to the use of a phenylethyl-containing vehicle and formulation of mometasone furoate nasal spray. While the formulation of mometasone furoate nasal spray that is currently marketed in all regions outside of the US contains phenylethyl, the formulation marketed in the US does not and is scent and alcohol free. This latter formulation may possibly cause less intranasal irritation and therefore be preferred by patients, although studies supporting this assumption have not yet been reported.

2.2.1 Local Adverse Effects

Local adverse effects commonly associated with intranasal corticosteroid therapy include irritation of the nose and throat, crusting, transient dryness and epistaxis.[42] Local adverse effects such as epistaxis (defined in studies of a mometasone furoate nasal spray formulation containing phenylethyl as an event ranging in severity from blood-tinged mucus to frank bleeding) occurred more frequently in adults and adolescents receiving mometasone furoate nasal spray than in those using vehicle.[27,38,41] The incidence of epistaxis in clinical studies with mometasone furoate nasal spray has ranged from <2% to 19% in adults and from <2% to 12% in children and adolescents, with the incidence in the majority of studies ranging between 6% and 9% (table I).[13-20,27,38-41] In patients from all age

Table I. Percentages of patients experiencing the most common adverse events associated with mometasone furoate 200 μg/day, as reported in placebo-controlled studies

Adverse event	Adverse event rate with mometasone furoate nasal spray 200 μg/day vs placebo (% patients)
Headache	5.8 vs 5,[13] 35 vs 38,[14] 36 vs 23,[15] 10 vs 7,[16] 7 vs 6,[17] 10 vs 7,[18] 6 vs 9,[19] 9 vs 8,[20] 13 vs 13,[25] 7 vs 11,[36]a 4.9 vs 4.9,[39] 27.2 vs 27.2[40]
Epistaxis	6 vs 1,[14] 6 vs 3,[16] 2 vs 7,[17] 19 vs 11,[18] 17 vs 11,[19] 6 vs 2,[20] 1.6 vs 2.5,[39] 12.4 vs 5.6[40]
Pharyngitis	1.7,[13]b 6 vs 7,[14] 6 vs 5,[15] 2 vs 4,[16] 2 vs 2,[17] 4 vs 4,[18] 6 vs 5,[19] 3 vs 4[20]
Sore throat	11.2 vs 8[40]
Upper respiratory tract infection	6 vs <1,[15] 7 vs 0,[36]a 27.2 vs 30.2[40]
Viral infection	0 vs 4,[18] 3 vs 3,[19] 3 vs 4[20]

a Mometasone furoate nasal spray administered 100 μg/day in children aged ≥2 to <6 years.

b Adverse event rate not provided for placebo.

groups, the majority of local adverse effects were mild in intensity, self-limiting and resolved without discontinuation of therapy. The occurrence of septal perforation with intranasal corticosteroids is rare, even after prolonged use.[2] Most cases of septal perforation have occurred in young women, patients with a history of nasal surgery and patients who point a corticosteroid applicator toward the septum.[42] Manufacturers of intranasal corticosteroids and one study group have recommended pointing the applicator away from the septum, toward the side of the nose.[42,43]

There has been concern about the impact of the long-term use of intranasal corticosteroids on nasal histopathological changes, including atrophy of the nasal mucosa. Results from *in vitro* studies have suggested that benzalkonium chloride, which is present in many intranasal corticosteroid formulations, has a detrimental effect on mucosal tissue.[44] However, *in vivo* studies support the mucosal safety of these agents.[44] Topical corticosteroids, particularly those that are fluorinated, can cause skin atrophy regardless of the presence or absence of benzalkonium chloride. In a study of clinical use of mometasone furoate nasal spray, which contains benzalkonium chloride and is chlorinated rather than fluorinated,[45] no signs of nasal mucosal atrophy were observed. In a 12-month study in patients with perennial allergic rhinitis who received mometasone furoate nasal spray 200 μg/day, a marked reduction in intraepithelial eosinophilia and mast-cell infiltration was seen.[46] The percentage of patients with a complete absence of inflammatory cells increased from 9.8% at baseline to 35.3% after 1 year of mometasone furoate nasal spray treatment.[46]

2.2.2 Systemic Adverse Effects

Intranasal corticosteroids are generally well tolerated, with, for example, the most common adverse effects reported with mometasone furoate nasal spray in clinical trials being headache, viral infection and pharyngitis.[13-20,27,38-41] Concerns have been expressed about systemic adverse effects related to corticosteroid therapy, such as increases in intraocular pressure, reductions in bone mineral density that are associated with osteoporosis and thinning of the skin; however, these effects have usually been shown to not be associated with the use of intranasal corticosteroids.[42]

Treatment with intranasal corticosteroids does not lead to either the elevation of intraocular pressure to clinically relevant levels or the formation of cataracts in most people.[47,48] A study in adults[47] (n = 360; aged 18–60 years) with seasonal allergic rhinitis who were divided equally into four groups receiving mometasone furoate nasal spray, fluticasone propionate aqueous nasal spray, beclomethasone dipropionate or placebo for 1 year found non-significant variations in intraocular pressure in the treatment groups. No significant differences in intraocular pressure were observed among the treatment groups or between the treatment groups and the placebo group. In addition, no evidence of cataracts or glaucoma was observed in adults (n = 81; aged 18–40 years) who received fluticasone propionate aqueous nasal spray for 1 year.[49] The long-term use of mometasone furoate nasal spray in 166 paediatric patients was not associated with significant changes in intraocular pressure.[38] Elevated intraocular pressure was seen in a case study of three patients aged ≥60 years who

were treated with intranasal or inhaled beclometasone dipropionate. Intraocular pressure returned to pre-treatment levels in two patients upon discontinuation of beclometasone dipropionate; the third patient continued treatment and was given medication to reduce intraocular pressure.[50] A study of a patient cohort (n = 101 805) in a Canadian insurance database of people aged ≥65 years compared the risk for cataracts in individuals receiving treatment with inhaled or intranasal corticosteroids (beclometasone dipropionate, budesonide, flunisolide, fluticasone propionate aqueous nasal spray and triamcinolone acetonide) with that in a control group over a 4-year period.[51] The study concluded that inhaled corticosteroids have a small but significant excess risk for cataracts, including cataracts requiring surgical extraction. The risk for cataracts with intranasal corticosteroids was less apparent, and the intranasal agents were not associated with an increased risk for cataracts requiring extraction.[9]

The use of intranasal corticosteroids does not appear to be associated with a reduction in bone mineral density or osteoporosis. Treatment with mometasone furoate nasal spray for 3 weeks in patients with perennial allergic rhinitis and with fluticasone propionate aqueous nasal spray for 1 year in patients with seasonal allergic rhinitis was not found to be associated with an increase in levels of serum markers of decreased bone mineral density.[34,49] A review of the database (containing >1 million patient records) of the Committee on Safety of Medicines and Medicines Control Agency in the UK concluded that the evidence is insufficient to establish a causal relationship between the use of intranasal corticosteroids and osteoporosis.[9]

3. Conclusion

Extensive clinical use of the intranasal corticosteroids beclomethasone dipropionate, budesonide, fluticasone propionate aqueous nasal spray, mometasone furoate nasal spray and triamcinolone acetonide over several decades has established their clinical tolerability. Although some concerns have persisted about the systemic adverse effects of these agents, very little clinical evidence suggested that they are connected with growth suppression in children or inhibition of HPA-axis function in adults and children despite differences in lipophilicity and bioavailability among these agents. In one of the few studies in which an intranasal corticosteroid (budesonide) was associated with growth suppression, the agent was administered twice daily instead of the recommended once-daily dosage. Similarly, studies with intranasal corticosteroids have concluded that their use is not related to histopathological nasal changes during long-term use, elevations of intraocular pressure to clinically relevant levels, a reduction in bone mineral density or the onset of osteoporosis. The incidence of septal perforation with intranasal corticosteroids is rare and often related to the incorrect use of the applicator.

Mometasone furoate nasal spray has a high binding affinity for the glucocorticoid receptor and, consequently, is a potent intranasal corticosteroid that is effective for the treatment of seasonal and perennial allergic rhinitis, nasal polyposis and acute rhinosinusitis. The low systemic bioavailability and bioactivity and low rates of occurrence of adverse effects associated with mometasone furoate nasal spray have been adequately demonstrated in studies in both adults and children.

Acknowledgements

Funding for the preparation of this manuscript was provided by Schering-Plough. Dr Zitt reports being a consultant for Schering-Plough, Alcon, Sanofi Aventis, Greer Laboratories, Verus Pharmaceuticals, Aerocrine and Altana, and having received honoraria from Sanofi Aventis, Altana, Schering-Plough, Aerocrine, Verus Pharmaceuticals, Merck, Genentech and Novartis.

Drs Kosoglou and Hubbell are employees of Schering-Plough.

The authors wish to thank Andrew Gannon, medical writer, and Jayne Harrison, editor, of Gardiner-Caldwell London and Judy Andraski and Matthew Cahill, editors, of Adelphi Inc. for assistance in the writing and editing of this manuscript.

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