Effect of Montelukast Sodium in Conjunction with Mometasone Furoate Aqueous Nasal Spray in Treating Allergic Rhinitis

LI PENG, XIA WU, MEI XIANG, SHU JING AND LI FENG*

Department of Otolaryngology, West China Hospital Sichuan University-Ziyang Hospital, The First People's Hospital of Ziyang, Yanjiang, Ziyang 641300, China

To observe the efficacy of montelukast sodium tablets in conjunction with mometasone furoate aqueous nasal spray in treating allergic rhinitis. Within the period spanning from September 2022 to September 2023, our hospital admitted 100 patients diagnosed with allergic rhinitis, forming the study population. After randomization, the individuals were allocated into either the control group or the observation group, both consisting of equal numbers of 50 cases. The control group was administered solely with mometasone furoate aqueous nasal spray, whereas the observation group received a combined treatment consisting of montelukast sodium tablets and mometasone furoate aqueous nasal spray. Following a 14 d period of consistent treatment, a comparison was made between the two groups regarding their clinical treatment effectiveness, visual analog scale scores, cellular immune levels, and serum cytokine levels. The overall effective rate in the observation group reached 94.00 %, displaying a remarkable increase compared to the control group's rate of 74.00 % ($p<0.05$). Prior to intervention, no marked disparity in visual analog scale scores existed in both groups ($p>0.05$). However, following treatment, both groups showed decreased visual analog scale scores, and the observation group exhibited lower scores than the control group, revealing a marked distinction ($p<0.05$). The levels of interleukin-4, interleukin-8, and interferon-gamma showed no remarkable variation between the two groups prior to treatment ($p>0.05$). Subsequent to treatment, the observation group showed lower levels of interleukin-4 and interleukin-8 in contrast to the control group, whereas the interferon-gamma level in the observation group noticeably elevated. These findings indicate a remarkable difference ($p<0.05$). The control group (16.00 %) and the observation group (18.00 %) both exhibited adverse reactions such as nasal dryness, nasal mucosal bleeding, rash, and insomnia. However, there was no notable difference in the occurrence rate of these adverse reactions between the two groups ($p>0.05$). The concurrent administration of mometasone furoate aqueous nasal spray and montelukast sodium tablets signifies a remarkable therapeutic breakthrough for allergic rhinitis treatment. This combination therapy not only effectively ameliorates symptoms but also improves immune markers, all while ensuring the risk of adverse reactions remains minimal.

Key words: Allergic rhinitis, mometasone furoate, nasal spray, montelukast sodium, corticosteroid

Allergic rhinitis, a prevalent chronic upper respiratory tract disorder, affects a substantial number of individuals worldwide[1]. Characterized by symptoms like sneezing, nasal congestion, runny nose, and nasal itching, this condition significantly impairs patient's quality of life[2]. The primary origin of nasal mucosa inflammation in allergic rhinitis is attributed to the exposure to allergens. With its notable features of widespread occurrence, diverse allergens, and non-infectious nature, this condition has the potential to affect any segment of the population[3]. The prevailing therapeutic approaches for managing allergic rhinitis involve the local application of Mometasone Furoate Aqueous Nasal Spray (MFANS) and the oral intake of Montelukast Sodium Tablets (MST). With its potent topical corticosteroid formulation, MFANS provides effective relief from symptoms related to allergic rhinitis. It achieves this

***Address for correspondence**
E-mail: 18628803570@163.com

by blocking the release of inflammatory mediators and diminishing the incidence of inflammation[4]. As a leukotriene receptor antagonist, montelukast sodium serves as an effective remedy for alleviating symptoms attributed to allergic reactions, such as sneezing, rhinorrhea, and nasal congestion[5,6]. Over the past few years, there has been a rising focus on the combined utilization of MFANS and MST in managing allergic rhinitis. Mometasone furoate can be systemically absorbed from the local nasal cavity, exerting its anti-allergic rhinitis effects by blocking inflammatory reactions[7]. Montelukast sodium can reduce nasal symptoms by inhibiting leukotriene receptors in the airways[8]. Therefore, the concurrent utilization of these two medications holds promise for eliciting a synergistic effect and improving the overall effectiveness of the treatment. However, studies on the efficacy of concurrent utilization of MFANS and MST in managing allergic rhinitis are still relatively limited and the results are inconsistent. Considering this, the primary aim of the study is to investigate the effectiveness of combining MFANS with MST as a treatment for allergic rhinitis. Through careful observation, the study strives to establish a more solid scientific footing for drug selection and the development of treatment strategies in clinical practice. In this study, we enrolled 100 individuals with allergic rhinitis who were registered at our hospital from September 2022 to September 2023. Random allocation resulted in the formation of two groups; an observation group and a control group, each comprising 50 cases. With 27 males and 23 females, the control group was comprised of individuals with ages ranging from 13 y to 73 y (mean age of 35.48±12.85 y) and disease durations varying from 0.5 y to 28 y (mean duration of 9.52±6.73 y). Comprising of 28 males and 22 females, the observation group had ages ranging from 12 y to 71 y (mean age of 36.61±12.69 y) and disease durations spanning from 0.5 y to 29 y (mean duration of 9.67±6.96 y). The similarity in general information between the two groups ($p>0.05$) indicates that they can be considered comparable. Inclusion criteria includes the diagnosis of allergic rhinitis based on routine examinations and inquiries about symptoms and allergy history; normal mental status and ability to communicate without any difficulty and understanding of the research content and voluntary agreement to participate by both patients and their family members. In exclusion criteria, the patients with impaired heart, liver, or kidney function, infectious diseases, tumors, infections, or other conditions that may affect the study; presence of types of rhinitis other than allergic rhinitis; allergy to mometasone furoate or montelukast sodium and absence of recent immunotherapy within the past 3 mo were excluded. The control group was administered with solely MFANS (Schering-Plough Labo NV, H20140100). The nasal spray had a dosage of 50 μg per spray, with a total of 60 sprays. Patients were instructed to apply 2 sprays (100 μg) to each nostril once daily, resulting in a daily dose of 200 μg. In case of rapid improvement in symptoms, the dosage of the nasal spray was gradually decreased to 1 spray (50 μg) to each nostril once daily, leading to a daily dose reduction of 100 μg. The treatment duration spanned over a period of 14 d. Alongside MFANS, the observation group received combination therapy involving MST (Organon Pharma (United Kingdom) Limited, Approval No: J20130047). In the observation group, the dosage of the nasal spray and MST mirrored that of the control group. The nightly administration of MST involved a dose of 10 mg. Both groups underwent treatment for duration of 14 d. The clinical treatment effect, Visual Analog Scale (VAS) score, cellular immune level, and serum cytokine level were observed and compared between the two groups for evaluation. According to the assessment criteria[9], the following classifications were established; in marked improvement, when symptoms and signs disappeared or notably improved with no nasal turbinate swelling. In improvement, when symptoms and signs improved with reduced nasal turbinate swelling. In ineffective, when no change or even worsening of symptoms and signs occurred prior to and post treatment. The overall effective rate was calculated as the ratio of cases with marked improvement and improvement to the total number of cases, multiplied by 100 %. The evaluation of symptoms improvement involved comparing the VAS score before and after treatment, specifically for nasal itching, nasal congestion, sneezing, and rhinorrhea. The total score scale ranged from 0 to 10, where 0 represented the absence of symptoms. The severity of symptoms was categorized based on scores, with scores between 1 and 3 representing mild symptoms, scores between 4 and 7 indicating moderate symptoms, and scores between 8 and 10 indicating severe symptoms[10]. Before and after treatment, the levels of serum cytokines, including Interleukin (IL)-8, Interferon-Gamma (IFN-γ), and IL-4, were compared. Fasting venous blood samples

of 4 ml were collected from patients at both time points[11]. After centrifugation at 3000 r/min for 10 min, the levels of IL-4, IL-8, and IFN-γ were detected by the Hitachi 7600 fully automatic biochemical analyzer and enzyme-linked immunosorbent assay. Any adverse reactions that occurred during the treatment period were documented. Utilizing the Statistical Package for the Social Sciences (SPSS) 25.0 statistical software, the analysis was performed. By utilizing an independent sample t-test, a comparison between the two groups was performed using the measurement data presented as mean±standard deviation[12]. Utilizing the Chi-square (χ^2) test, the count data were analyzed. The criteria for establishing statistical significance were defined at a level of $p<0.05$. In terms of the overall effective rate, the treatment group achieved a notably higher rate of 94.00 % compared to the control group's rate of 74.00 % ($p<0.05$) (Table 1). Prior to treatment, no significant variations in VAS scores were observed between the two groups ($p>0.05$). On the other hand, post-treatment resulted in a decline in VAS scores for both groups when compared to their respective pre-treatment scores. Interestingly, the observation group showed significantly reduced scores in comparison to the control group, suggesting a remarkable dissimilarity ($p<0.05$) (Table 2). Prior to treatment, no significant variations in IL-4, IL-8, and IFN-γ levels were observed between the two groups ($p>0.05$). In contrast, the observation group displayed substantially lower levels of IL-4 and IL-8 as opposed to the control group after treatment. Additionally, the observation group exhibited higher levels of IFN-γ, indicating a remarkable difference ($p<0.05$) (Table 3). Adverse reactions, including nasal dryness, nasal mucosal bleeding, rash, and insomnia, were reported by patients in both groups. The occurrence rate of these adverse reactions did not show a substantial variation between the observation group (18.00 %) and the control group (16.00 %) ($p>0.05$) (Table 4). Characterized as a widespread clinical ailment, allergic rhinitis primarily afflicts individuals with allergic tendencies. Numerous studies have elucidated the intricate and multifaceted pathogenesis of this disease. When patients are exposed to allergens, it activates their mast cells and releases a large amount of inflammatory mediators such as histamine, leading to chronic inflammatory reactions. Allergic rhinitis is characterized by nasal mucosal congestion and swelling, lymphocyte infiltration, and increased mast cells. The incidence of allergic rhinitis is on the rise due to factors such as climate change and environmental pollution[13]. The goal of this study was to assess the effectiveness of treating allergic rhinitis by combining MFANS and MST, and to compare its efficacy with that of using MFANS alone. The study results unveiled a noteworthy distinction between the two groups, with the former presenting a remarkably higher overall effectiveness rate. Furthermore, there were no noticeable discrepancies in symptom scores between the two groups prior to initiating the treatment. Following the intervention, the symptom scores in the observation group significantly decreased in comparison to those observed in the control group[14]. In terms of immunological indicators, the observation group exhibited notably lower levels of IL-4 and IL-8 as opposed to the control group, whereas the level of IFN-γ was substantially higher. Additionally, both groups of patients encountered common adverse reactions, including nasal dryness, nasal mucosal bleeding, rash, and insomnia. Nevertheless, no noticeable discrepancy in the frequency of adverse reactions was observed between the control and observation groups. These results provide compelling evidence that the combination of MFANS and MST yields remarkable effectiveness in treating allergic rhinitis. The observation group achieved an overall effective rate of 94.00 %, which was notably higher than the control group's rate of 74.00 %. This may be due to the synergistic effect of montelukast sodium in blocking histamine receptors. This is consistent with previous research results, supporting the feasibility and advantages of combination therapy[15]. Moreover, the combination of MFANS and MST also improves symptoms, as evidenced by the lower overall symptom scores (VAS scores) in the observation group compared to the control group, with a notable difference. This may be attributed to the anti-inflammatory effect of MFANS in conjunction with the antihistamine effect of MST, jointly reducing the symptoms of allergic rhinitis. Additionally, the changes in immunological indicators after treatment in the observation group also support the advantages of combination therapy. IL-4 and IL-8 in the serum are produced under the action of T helper 2 (Th2) cells. These two cytokines induce the transformation of B lymphocytes into plasma cells and easily bind to specific receptors on target cells, leading to inflammatory or allergic reactions, thus triggering allergic rhinitis[16]. IFN-γ, produced under the action of Th1 cells, not only regulates inflammation and

immune responses effectively but also helps activate macrophages, exerting antiviral effects. These results suggest that the combination of MFANS and MST not only improves inflammatory reactions but also positively influences immune regulation, enhancing the body's antiviral capabilities. Finally, regarding adverse reactions, both groups of patients experienced some common adverse reactions such as nasal dryness, nasal mucosal bleeding, rash, and insomnia. Despite this, the incidence of adverse reactions remained unchanged in both the control and observation groups, providing evidence that the combined use does not raise the likelihood of adverse reactions. Previous clinical experience has shown limited inhibitory effects of MFANS on all inflammatory factors in the patient's body, and it is not ideal in inhibiting the release and synthesis of leukotrienes, which leads to disease relapse and further reduces treatment efficiency. Montelukast sodium is a leukotriene receptor antagonist drug that can bind with cysteinyl leukotriene receptors during application, minimizing their activity, and playing an important role in improving clinical symptoms. At the same time, montelukast sodium can help compensate for the inadequate inhibitory effects of MFANS on inflammatory factors, helping to reduce the local inflammatory response in the nasal mucosa, to a certain extent, improving the clinical treatment efficiency. The combination of these two drugs can maximize the clinical effects and play an important role in regulating cellular immune function and suppressing inflammatory reactions. To summarize, this study validates the effectiveness and safety of MFANS and MST combination therapy in treating allergic rhinitis. Without increasing the risk of adverse reactions, combination therapy demonstrates better efficacy and significantly improves symptoms and immune indicators. Nonetheless, this study is constrained by a limited sample size restricted to a single hospital and a brief duration of observation. To obtain a holistic assessment of the effectiveness and safety of this combined treatment, future investigations should involve larger sample sizes, multiple centers, and long-term follow-up.

TABLE 1: CURATIVE EFFECT

Group (n=50)	Marked improvement	Improvement	Ineffectiveness	Overall effective rate
Observation	32 (64.00)	15 (30.00)	3 (6.00)	47 (94.00)
Control	21 (42.00)	16 (32.00)	13 (26.00)	37 (74.00)
χ^2				7.44
p				0.006

TABLE 2: VAS SCORE

Group (n=50)	Nasal obstruction		Nasal itching		Runny nose		Sneeze	
	Before	After	Before	After	Before	After	Before	After
Observation	7.44±0.99	1.78±0.74*	6.76±1.32	2.24±1.04*	7.02±0.80	1.88±0.63*	7.36±1.16	1.52±0.50*
Control	7.10±1.05	2.38±0.49*	7.04±1.21	3.06±0.74*	7.10±0.81	3.05±0.86*	7.06±1.20	2.86±0.73*
t	-1.660	4.795	1.106	4.540	0.497	7.704	-1.272	10.690
p	0.1	0.000	0.271	0.000	0.62	0.000	0.206	0.000

Note: (*): Indicates noteworthy difference following treatment compared with prior to treatment

TABLE 3: SERUM CYTOKINE LEVELS

Group (n=50)	IL-4		IL-8		IFN-γ	
	Before	After	Before	After	Before	After
Observation	25.97±4.17	17.07±3.85*	57.02±7.27	46.91±7.78*	18.03±3.42	24.80±5.30*
Control	24.40±5.05	21.48±3.72*	56.74±8.68	37.45±6.36*	17.22±3.55	22.21±4.26*
t	1.686	5.83	-0.175	-6.657	-1.161	-2.693
p	0.095	0.000	0.861	0.000	0.248	0.008

Note: (*): Indicates noteworthy difference following treatment compared with prior to treatment

TABLE 4: ADVERSE REACTIONS n (%)

Group (n=50)	Dry nasal cavity	Nasal mucosal bleeding	Rash	Insomnia	Overall incidence
Observation	3 (6.00)	3 (6.00)	1 (2.00)	2 (4.00)	9 (18.00)
Control (50)	4 (8.00)	2 (4.00)	1 (2.00)	1 (2.00)	8 (16.00)
χ^2					0.071
p					0.790

Author's contributions:

Li Peng and Xia Wu have contributed equally to this work.

Conflict of interests:

The authors declared no conflict of interests.

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