Original Article* / *Çalışma - Araştırma

The effect of topical mometasone furoate nasal spray on carriage of *Staphylococcus aureus*

Staphylococcus aureus taşıyıcılığı üzerinde topical mometazon furoat burun spreyinin etkisi

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Objectives: This study aims to examine the effect of topical mometasone furoate nasal spray on nasal *Staphylococcus aureus (S. aureus)* colonization in the treatment of allergic rhinitis.

Patients and Methods: Between January 2012 and February 2013, 53 patients having perennial allergic rhinitis symptoms (37 females, 16 males) and 53 healthy controls (36 females, 17 males) were included in the study. Nasal cultures were obtained and evaluated before and after the treatment in allergic rhinitis patients who were admitted to the ear, nose and throat (ENT) outpatient clinic and receiving a mometasone furoate nasal spray treatment (200 mcg/day) once a day for one-month. In healthy controls, nasal cultures were obtained and evaluated once.

Results: In allergic rhinitis patients, five cultures were positive for *S. aureus* before the treatment while the number of cultures positive for *S. aureus* was six after the treatment. There was no significant difference in the pre-treatment and post-treatment *S. aureus* colonization between the patient group and controls (p>0.05).

Conclusion: Mometasone furoate nasal spray used in the treatment of allergic rhinitis appears to be ineffective for nasal *S. aureus* colonization.

Key Words: Allergic rhinitis; colonization; mometasone furoate; nasal spray; Staphylococcus aureus.

Amaç: Bu çalışmada alerjik rinit tedavisinde *Staphylococcus aureus (S. aureus)* kolonizasyonu üzerinde topical mometazon furoat burun spreyinin etkisi araştırıldı.

Hastalar ve Yöntemler: Ocak 2012 - Şubat 2013 tarihleri arasında uzun yıllardır alerjik rinit semptomları olan 53 hasta (37 kadın, 16 erkek) ve 53 sağlıklı kontrol (36 kadın, 17 erkek) çalışmaya alındı. Kulak Burun Boğaz polikliniğine başvuran alerjik rinit hastalarından burun kültürleri alındı ve tedaviden önce ve bir ay boyunca günde bir kez mometazon furoat burun spreyi ile tedaviden sonra değerlendirildi. Sağlıklı kontrollerde burun kültürleri yalnızca bir kez alındı ve değerlendirildi.

Bulgular: Alerjik rinit hastalarında tedaviden önce beş kültür *S. aureus* pozitif iken, tedaviden sonra altı kültür *S. aureus* pozitifti. Tedavi öncesi ve sonrası *S. aureus* kolonizasyonu açısından hasta grubu ve kontroller arasında anlamlı bir fark yoktu (p>0.05).

Sonuç: Alerjik rinit tedavisinde kullanılan mometazon furoat burun spreyinin burun *S. aureus* kolonizasyonu açısından etkisiz olduğu görülmektedir.

Anahtar Sözcükler: Alerjik rinit; kolonizasyon; mometazon furoat; burun spreyi; *Staphylococcus aureus*.

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Allergic rhinitis is an inflammation of the nasal mucosa. It causes symptoms such as sneezing attacks, itchy eyes, nose and palate, rhinorrhea and nasal congestion. It can be accompanied by postnasal drip, coughing, restlessness and fatigue.[1]

In the treatment of allergic rhinitis, the primary concern should be to identify responsible allergens and to employ methods to avoid these if it is possible.[2]

In cases where measures to avoid allergens do not lead to a sufficient improvement, topical nasal corticosteroid or anti-histamine treatment is the most effective treatment approach.[3]

Clinical effects of the topical steroids commonly used to control inflammation in rhinitis and sinusitis can be related to prevention of the accumulation of inflammatory cells in the airway, selective suppression of local cytokine production, inhibition of mediator release and structural repair of the nasal mucosa.[4]

Although nasal colonization is the major risk factor in *Staphylococcus aureus (S. aureus)* infections, factors predisposing to nasal carriage of *S. aureus* are not fully known. *Staphylococcus aureus* plays an important role both in community acquired and hospital acquired infections. While skin infections are the most frequently encountered *S. aureus* infections, *S. aureus* plays a role in various other infections such as respiratory system infections, endocarditis and osteomyelitis. Carriage of *S. aureus* is an important public health issue as it creates a potential for infection and may lead to an epidemic. Antibiotic resistance evolving rapidly over a short time scale causes important problems in its treatment.[5,6]

In humans, the causative agents Staphylococci are colonizers of the skin and mucosal surfaces. These agents are part of the normal flora in the anterior nasal mucosa, nasopharynx, perineal region and the skin. Studies have shown that the anterior nares are the most common site of colonization. Three types of *S. aureus* carriage can be seen-- 10-35% of healthy individual are persistent carriers and always carry one strain of *S. aureus*, another 20-75% are intermittent carriers, while the ratio of non-carriers is 5-50%. In persistent carriers, bacteria load is more and thus the risk of developing infection is higher. The ratio of persistent carriers is higher in children when compared to the adults and most people become intermittent carriers at the age of 10-20 years.[7]

In some patient subgroups, carriage status is significantly increased. These subgroups include patients having insulin-dependent diabetes mellitus, hemodialysis or peritoneal dialysis, those receiving intravenous drugs, those having *S. aureus* skin infections, liver failure and human immunodeficiency virus (HIV) infections. There are other factors affecting nasal carriage. These factors include lipoteichoic acid on the cell wall and some surface proteins, increased adherence to nasal epithelium during viral infections, some human leukocyte antigen (HLA) types (such as DR3), age, ethnicity, genetic structure, immunologic status, hormonal status in women and hospitalization.

Nasal carriage of *S. aureus* is a rather complicated issue where many variables remain unsolved. However, nasal carriers of *S. aureus* have been shown to be more open to infections caused by this bacteria.[5] Staphylococci are colonized in the nose by using materials such as fibrinogen, fibronectin and thrombocytes as a receptor. It has been shown that aspirin may decrease receptor material release by impairing arachidonic acid metabolism and thus decrease nasal carriage of *S. aureus*.[8]

Steroids have been shown to affect both cyclooxygenase and the lipoxygenase pathways. Thus, it is possible for steroids to affect nasal carriage of *S. aureus* by affecting many nasal factors in the nose through cyclooxygenase.

In studying the effect of a very short-term steroid release, our hypothesis was that steroids would affect carriage of *S. aureus* by affecting the amount of some molecules (fibrinogen, fibrinogen binding protein, fibronectin) through cyclooxygenase rather than through their effects on local immunity. For this reason, our aim was to examine the effect of mometasone furoate, which is a topical nasal steroid used in the treatment of allergic rhinitis patients, on nasal *S. aureus* colonization and to compare the results to those obtained in controls.

PATIENTS AND METHODS

The study group was composed of those applying to Elazığ Training and Research Hospital Ear Nose and Throat Polyclinic with allergic rhinitis

symptoms between January 2012-February 2013. Fifty-three patients (37 females, 16 males; mean age 27.3±14.8 years; range 8 to 66 years) having perennial allergic rhinitis symptoms supported by physical examination findings and having high specific immunoglobulin (Ig) E levels and 53 healthy controls (36 females, 17 males; mean age 28.9±11.6; range 12 to 58 years) were included in the study. Verbal and written informed consents were obtained from all the patients. Those receiving antihistaminic, antibiotic, topical or oral steroids four weeks before the study, smokers and those consuming alcohol, those having nasal polyps or immune disorders were excluded from the study.

All the patients were administered mometasone furoate nasal spray (200 mcg/day) once a day for a one-month term. Nasal cultures were obtained and evaluated before and after the treatment in allergic rhinitis patients. In healthy controls, nasal cultures were obtained and evaluated once.

Culture samples were taken from the anterior third of the nares. Samples were placed into Stuart's transport medium and kept at 4 °C until plating on to mannitol-salt medium [Chapman Medium, BioMérieux (BIM:EN Paris), Marcy I'Etoile, (Bio Merieux SA, France)]. All mannitol-positive colonies were subcultured onto 5% blood agar and *S. aureus* isolated were defined as catalase-producing gram-positive cocci that were positive for tube coagulase and confirmed by a rapid *S. aureus* latex agglutination test [Staphaurex Plus® (Murex Diagnostics Ltd., Kent, England). BioMérieux (BIM:EN Paris), Marcy I'Etoile, (Bio Merieux SA, France)]. Cases having more than three *S. aureus* colonies were regarded as carriers.[9]

Statistical analysis

SPSS statistical software version 15.0 for windows (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. Significance of post-treatment *S. aureus* carriage when compared to the pre-treatment one was studied using nonparametric Mc Nemar test. Chi-square test was used to compare healthy controls and pre-treatment allergic rhinitis groups, *S. aureus* carriage, gender and age. P<0.05 was regarded as statistically significant.

RESULTS

Between allergic rhinitis patients and healthy controls, there was no statistically significant difference in terms of average age (p=0.547) and gender (p=0.834).

In allergic rhinitis patients, five cultures obtained before the treatment were positive for *S. aureus* (Table 1). The number of cultures positive for *S. aureus* was six after the treatment. In the control group, six cultures were positive for *S. aureus*. In allergic rhinitis patients, pre-treatment *S. aureus* colonization showed no difference when compared to the controls (p=0.750). There was no difference when the post-treatment nasal *S. aureus* colonization was compared to the pre-treatment colonization in allergic rhinitis group (p=1.000).

DISCUSSION

Nasal carriage of *S. aureus* is a major risk factor for developing either community-acquired or hospital-acquired staphylococcal infections. The origin of methicillin-resistant *Staphylococcus aureus* (MRSA), which has become endemic for many hospitals, is usually the colonized or infected patients or the health employees.[10]

Table 1. Ratio of *Staphylococcus aureus* in the control group and allergic rhinitis patients before the treatment and after intranasal mometasone furaote treatment

	Preoperative treatment			Postoperative treatment			Control group			
	n	%	Mean±SD	n	%	*p*	n	%	Mean±SD	*p*
Gender										
Female	37	69.8					36	67.9		>0.05
Male	16	30.2					17	31.1		
Average age			27.34±14.801						28.91±11.595	>0.05
Staphylococcus aureus (+)	5	9.43		6	11.32	>0.05	6	11.32		>0.05

SD: Standard deviation.

In a study, Von Eiff et al.[11] found that the nasal colonizing strains and subsequently developing bacteremia had the same genotype in more than 80% of the cases.

Prevalence of nasal carriage of *S. aureus* differs among the populations studied. In normal controls or healthy volunteers, the rate of nasal carriage of *S. aureus* was found as 18.4% by Baykam et al.[10] In 500 adults and children applying to Dokuz Eylül University, Erdenizmenli et al.[12] found that 9.4% had nasal *S. aureus* colonization without methicillin-resistant strains. The low colonization rate of *S. aureus* was linked to risk factors being not significant enough and having patients representing the medium to high socio-economical class. In the same study, nasal carriage ratio of *S. aureus* was found to be statistically significantly higher when compared to the adults.[12] In our study, *S. aureus* carriage ratio (11.32%) was similar to the ratios obtained in other studies. Based on the results we obtained, we found that mometasone furoate, which is an intranasal topical steroid used in the treatment of allergic rhinitis patients, did not affect *S. aureus* nasal colonization. It has been thought that *S. aureus* has an important role in the pathogenesis of atopic dermatitis observed in atopic patients. It may affect onset of the disease and/or attacks.[13]

The exact role of *S. aureus* carriage and infections is not fully known in bronchial asthma that occurs mostly in atopic people. Some studies have reported that the frequency of oropharyngeal colonization differs in asthma patients when compared to healthy controls. Sachs et al.[14] found that the frequency of *S. aureus* colonization was less in asthmatic cases when compared to controls. Vázquez et al.[15] found that *S. aureus* colonization did not differ between asthmatic cases and healthy controls. In a study conducted in the USA on 10,477 people, people younger than 65 years of age, men, persons with less education, and persons with asthma had higher rates of nasal *S. aureus* colonization.[16] Soysal et al.[17] studied *S. aureus* colonization in axillary and perineal regions in 1,000 children aged between 0 to 16 years and found that the ratio of allergic rhinitis was higher in *S. aureus* carriers when compared to non-colonized children. They reported that there was no difference between carriers and non-colonized children in terms of asthma and atopic dermatitis.

In a study conducted on patients with asthma, oral inhaled budesonide did not affect nasal and oropharyngeal *S. aureus* colonization.[18]

In terms of nasal *S. aureus* colonization in allergic rhinitis patients, we found no difference when the nasal *S. aureus* colonization observed after topical mometasone furoate treatment was compared to the pre-treatment colonization. Similarly, in terms of *S. aureus* colonization, there was no difference between allergic rhinitis patients and controls.

Nasal carriage of *S. aureus* has been a known issue in the epidemiology of staphylococcal infections. The ratio of nasal carriage of *S. aureus* has been reported to be between 10-30% in the normal population. It has been reported that nasal carriage is especially higher in patients having chronic dermatitis, allergic rhinitis, other chronic lesions and hemodialysis when compared to the normal population.[18]

In a study, Kluytmans et al.[5] found that nasal carriage of *S. aureus* was higher in hemodialysis patients (30.1-84.4%), patients having insulin-dependent diabetes (24.1-76.4%), patients having HIV infection (26.9-54.7%), those having *S. aureus* skin infection (42-100%) and intravenous drug addicts (33.8-61.4%) when compared to the controls.

However, despite all the known facts, many factors affecting nasal colonization of *S. aureus* have not yet been clearly established. Nasal carriage of *S. aureus* can be important in a specific population having an underlying lung problem such as patients with asthma. Under normal conditions, due to defective cellular immunity, increased colonization can be expected in those using steroids. Despite all these expectations, in our study, we could not establish an increased nasal colonization of *S. aureus* in those using steroids. This could be because of two reasons. Firstly, local and topical use of steroids may not be affecting the nasal defense mechanism. Secondly, nasal carriage of *S. aureus* is directly related with the density of some materials in the anterior nares such as fibronectin and fibrinogen. These materials play a key role in adhesion of *S. aureus* to the nasal skin. Steroids could be affecting the frequency of carriage of *S. aureus*

negatively by blocking the release of fibronectin from fibroblasts.[18,19]

Conclusion

In conclusion, we established in the present study that mometasone furoate nasal spray used in the treatment of allergic rhinitis patients did not affect nasal *S. aureus* colonization.

Declaration of conflicting interests

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