ORIGINAL ARTICLE

Efficiency of hypertonic and isotonic seawater solutions in chronic rhinosinusitis

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ABSTRACT

Aim To compare the efficiency of isotonic and hypertonic seawater solutions used for nasal lavage and quality of life of the patients with chronic rhinosinusitis.

Methods A random and controlled clinical study was performed. The study included 60 patients with history of chronic rhinosinusitis. At the beginning of the study, each subject was given a Patient Logbook, which needed to be filled out daily during the 15-day study period. There were three visits per each patient during the study.

Results Patient Logbook notes showed significant statistical differences in all symptoms in the group of patients using hypertonic seawater solution. However, while the notes showed significant statistical differences in congestion and rhinorrhea, in the group of patients using isotonic seawater solution, other symptoms showed no major changes during the study period.

Conclusion Hypertonic seawater solution has been proven to be better than isotonic seawater solution in eliminating the symptoms of nasal congestion, rhinorrhea, cough, headache and waking up during the night.

Key words: seawater solution, chronic rhinosinusitis, hypertonic, isotonic, QoL

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INTRODUCTION

Some discrepancies among definitions of chronic rhinosinusitis occur mainly because of the usage of different criteria, such as symptom type, duration, intensity, as well as the need for other exploration methods, such as radiologic imaging or bacterial culture test. In the definition proposed by the International Conference on Sinus Disease, the criteria for chronic rhinosinusitis in adults are symptoms and signs persisting for eight weeks, or four episodes of recurrent acute rhinosinusitis per year, each lasting for at least 10 days, in association with persistent changes on computerized tomography scans, at four weeks of medical treatment, without intervening acute infection (1). The new and more specific Task Force definition is as follows: "Chronic rhinosinusitis is a group of multifactorial diseases characterized by inflammation of the mucosa of the nose and paranasal sinuses, with a history of at least 12 weeks of persistent symptoms and signs, despite maximum medical therapy" (2). Chronic rhinosinusitis has been reported to affect a varying percentage of the population. According to the National Health Interview Survey in the United States, the rate of chronic rhinosinusitis ranges from 14% to 16%. However, current prevalence may often be exaggerated (3).

The clinical picture of chronic rhinosinusitis is predominated by nasal obstruction and increased nasal discharge. Irrespective of the etiology of chronic inflammation, topical therapy by lavage and administration of vasoconstrictive agents is the main mode of treatment aimed at the restitution of the nasal physiologic functions (4). Stimulators of alpha-adrenergic receptors are most frequently used for nasal decongestion (2). The decongestion of nasal mucosa is crucial in the management of nasal obstruction of any etiology. When sympathomimetics are used, the possible undesired effects should be taken in consideration. Therefore, the use sympathomimetics should be limited to a few days only (5). Discontinuation of prolonged sympathomimetic therapy may also result in side effects characterized by vasodilation, congestion and rhinorrhea. These events are attributed to the so-called rebound phenomenon (5).

The nasal mucosa lavage with isotonic saline is definitely useful. Nasal mucosa produces about half a liter of mucus per 24 hours, which contains 2% mucin and 1%-2% salt, pH 6.5-7.2 (4). The use of hypertonic solution may reduce the need of nasal decongestives, thus avoiding the risk of side effects due to the overstimulation of adrenergic receptors in the nasal mucosa (6).

Patients with rhinosinusitis experience symptoms of nasal disease, along with associated symptoms, such as headaches (7). Each of the symptoms may influence the individual's physical, occupational or social functioning to a certain extent (7). The great impact of these diseases on the quality of life (QoL) may occasionally be inadequately recognized by the patient's environment (7).

In rhinosinusitis patients, the aim of treatment is to alleviate the disease signs and symptoms. Therefore, this clinical study also included an assessment of the impact that health conditions have on the QoL as the primary disease outcome. QoL assessment frequently implies different terms for different people, thus making its definition more difficult (7). The QoL is influenced by health, material conditions and the general state of mind of each individual (7). The health-dependent QoL is part of the overall QoL that is primarily determined by the overall state of health, and it can be influenced by clinical intervention (7). It should be assessed as a functional impact of the disease. The patient is preoccupied by discomforts associated with the disease. It is especially emphasized in clinical conditions, where the primary therapeutic goal is the patient's wellbeing, and the majority of patients suffering from rhinosinusitis expect some improvement as the ultimate result (8).

In chronic rhinosinusitis, clinicians evaluate the clinical status of the nasal region on the basis of nasal symptoms, objective examination, rhinomanometry, and radiologic examination. These usual parameters of nasal mucosa inflammation indicate the condition of the nose itself, but do not refer to the issue of the reduced QoL in patients with rhinosinusitis (8). Rhinosinusitis can cause sleep disorders and consequently chronic fatigue (9). Patients suffer from frequent headaches, which, in some cases, may lead to transient inability to work. In addition, patients encounter various other problems of varying intensity, depending on their ability to cope with the problems (9).

The primary aim of the study was to compare the efficiency of isotonic and hypertonic seawater solutions used for nasal lavage and maintaining patency in chronic rhinosinusitis. The secondary aim was to evaluate the improvement in the QoL of patients suffering from chronic rhinosinusitis with the use of seawater solutions.

MATERIALS AND METHODS

Data were collected at ENT Outpatient Clinic, University Hospital in Osijek and ENT Outpatient Clinic, Josip Benčević General Hospital in Slavonski Brod, Croatia. The treatment lasted for two weeks. The study started on November 15, 2008, with the anticipated inclusion period of three months, i.e. till February 14, 2009, and was completed on February 28, 2009.

Subjects

The study included 60 patients with the history of chronic rhinosinusitis who wanted to participate in the study were required to sign an informed consent form. Patients needed to be at least 18 years of age, of whichever sex, and needed to have clinically established signs of the disease. These signs were determined by a physical examination and included nasal discharge, nasal obstruction, headaches, pain in the facial region, and high body temperature. Sinus endoscopy or x-ray finding was not necessary for including criteria; they were already performed and recorded in patient's file (5). If all of these criteria were met, patients were thoroughly informed on the aims, preparations and methodology which were to be used in the study, after which they were administered the informed consent form to sign.

Exclusion criteria were the subject's decision not to take part in the study, his/her physician's request, intolerance to seawater solution, and any circumstance incompatible with the study protocol. Excluded patients could have been replaced unless the inclusion period had not yet expired.

The study included 60 patients with chronic rhinosinusitis, 30 per study location, who met the inclusion criteria and signed the informed consent form. Along with therapy prescribed by their physicians, study patients applied either nasal spray at least three times daily or six times if necessary, keeping notes on the exact daily dose in the Patient Logbook.

Study preparations

The efficiency of the two seawater solutions: isotonic solution (Sterimar) and hypertonic solution (Sterimar Hypertonic) was investigated. Sterimar is an isotonic seawater solution available in the form of a microspray with an anatomic applicator. The active substance is natural seawater, mean salinity 2.80%-2.85%. The solution contains 31.82 mL of seawater in 100 mL solution, with physiologic NaCl concentration of 0.9%. Apart from NaCl, the solution contains natural minerals and oligoelements in traces, i.e. in lower than physiologic concentrations. The solution is intended for daily nose hygiene and nasal mucosa lavage in infants, children and adults. The solution is applied 3-6 times daily by pressing the applicator for at least 3 seconds, spraying the solution into both nares.

Sterimar Hypertonic is a solution in a microspray with anatomic applicator. The active substance is natural seawater, mean salinity 2.80%-2.85%. The preparation contains 75.00 mL seawater in 100 mL solution, with NaCl concentration of 2.12%. Besides NaCl, the solution contains natural minerals and oligoelements in traces, i.e. in lower concentrations than physiologic ones. The solution is additionally enriched with monohydrated manganese (Mn) salts and pentahydrated copper (Cu) salts to the concentrations identical to those found in body cells. The preparation is intended for nasal lavage and maintaining nasal mucosa patency, which is achieved by osmotic effect induced by the higher solution NaCl concentration and natural decongestive action. The use is identical to that described for isotonic solution.

The study was designed as an open and random controlled trial. Study subjects continued taking their previous medication (e.g., antibiotics, steroids, vasoconstrictors, etc.), as advised by the physician, which was recorded in the Test List. The use of vasoconstrictive drops (each administration) was additionally noted in the Logbook.

Randomization

Randomization was performed using a table of random numbers for cohorts of 30 subjects each. Group 1 included numbers 1 to 30, and group 2 included numbers 31 to 60. Each group had randomly distributed 15 even numbers and 15 odd

numbers. Study subjects were allocated numbers according to randomization, whereby those allocated even numbers received the isotonic solution, and those allocated odd numbers received the hypertonic solution. For example, group 1-30 included the number sequence 12, 15, 22, 11, 28, 10, 13, 9, etc., and the respective subjects were administered study solutions as follows: 12 Sterimar, 15 Sterimar Hypertonic, 22 Sterimar, 11 Sterimar Hypertonic, 28 Sterimar, 10 Sterimar, etc. (source: Random Sequence Generator, Sequence 1 and 2).

Test List

History data and data obtained by clinical physical examination were entered into the Test List. The history included demographic data (age and sex), socioeconomic status (employed, unemployed or retired), educational level (elementary school, high school or university), current disease (onset and frequency) and other diseases, medication used and side effects (if present). On physical examination, the presence of rhinorrhea, congestion, cough, headache and sinus region sensitivity on palpation were assessed in grades 0 (symptom-free) to 3 (severe); breath sounds were assessed by auscultation. Current medication was recorded in the Test List.

Patient Logbook

At study entry, each subject was administered a Patient Logbook to be filled out daily during the 15-day study period; day 0 in the Logbook corresponded to the day of the first follow up visit noted in the Test List. Study subjects entered data on total dosage, i.e. number of Sterimar applications, and on total doses of other drugs taken along with Sterimar, e.g., nasal decongestives, antihistamines, corticosteroid drops and possibly other topical therapies. In addition, data on particular symptoms such as nasal obstruction, rhinorrhea, cough, headache, and related waking episodes were entered in grades ranging from symptom-free condition to fully pronounced symptoms. Accordingly, the patient followed up nearly the same symptoms as the physician, with the exception of facial sensitivity on palpation evaluated by the physician after physical examination, whereas the patient recorded possible episodes of symptom-induced waking during the night. The physician assessed the symptoms during the follow up examination, whereas patients did it by self-assessment.

QoL questionnaire

Study subjects filled out the QoL questionnaire (self-assessment) on day 0, at the first follow up visit and at the end of the study, i.e. at the end of week 2. They entered data on the following six groups of symptoms: nasal disease symptoms, other symptoms, sleep, activities, daily problems, and emotions, grading them on the visual analog scale 0-10, marking the grade corresponding best to the difficulties caused by rhinosinusitis and experienced during the study period.

Statistical analysis

Apart from the descriptive analysis of the data collected, statistical significance of between-group differences was determined. Student's t-test, Whitney Rank Sum test and Chi-square test with a significance level of $p<0.05$ were used when appropriate for the evaluation of the results. The analysis had enough statistical power to detect the significant difference that would have been evident if the statistical power had been greater. Odds ratios were calculated by cross-tabulation with a 95% confidence interval. All analyses were performed with SigmaStat 3.0 for Windows (SPSS Science software products, Chicago, IL, US).

Follow up of adverse events

The randomized controlled clinical study protocol included the recording of any possible untoward event (e.g., side effect, associated disease, etc.) in the Test List. According to the protocol, data on the type, date, duration, therapy and outcome of the adverse event were recorded. Any serious adverse event should have been readily reported to the Agency for Drugs and Medicinal Products of the Republic of Croatia, while the investigator was obliged to fill out the severe adverse event reporting form.

RESULTS

The study included more female than male subjects (n=47; 78.3% *vs*. n=13; 21.7%), therefore women predominated in the use of both study preparations (Table 1).

According to age, the 20-29 age group prevailed (n=14; 23.3%). Generally, two thirds of the study subjects (n=37; 61.7%) were aged 20-49. The hypertonic solution was mostly administered in the 20-29 age group (n=11; 36.7%) and isotonic solution in the 30-39 and 40-49 age groups (n=7; 23.3%).

In the majority of study patients, the disease duration was 7 or more years, or 85 or more months (n=26; 43.3%).

The mean number of daily doses declined in both patients taking hypertonic solution and those using isotonic solution, i.e. from 4.17 to 3.40 (18.5%) and from 3.60 to 2.97 (17.5%), respectively.

From previous therapy for chronic rhinosinusitis, most patients were taking medications in the following order: antibiotics (n=43/60; 71.7%), nasal decongestives (40; 66.7%), intranasal corticosteroids (27; 45.0) and antihistamines (23; 38.3%). There were no significant statistical differences between the two study groups. During 2nd visit the number of patients who were still taking other medications beside the saline solutions were significantly reduced. Antibiotics were prescribed to three patients in hypertonic solution group and one in isotonic solution group. Corticosteroids were used by five patients in hypertonic group and four in isotonic group, but nasal decongestants were taken only by two patients in isotonic group. There was no statistical significant difference between the two patient groups, but there was a significant difference between the number of prescribed medications before the beginning of the study and 2nd and 3rd visit during the trial with everyday administration of saline solutions ($p<0,05$).

During the two-week study period, five symptoms closely associated with chronic rhinosinusitis, i.e. rhinorrhea, congestion, cough, headache and facial sensitivity on palpation, were followed up and recorded in the Test List. On the initial examination (1st follow up visit), there was no difference in the symptoms between the subjects using hypertonic solution and those using isotonic solution. At the 2nd follow up visit, a statistically significant between-group difference was found for congestion, and on the 3rd follow up visit, at two weeks of seawater solution application, such a difference was recorded for congestion and cough (Table 2).

On day 0 in the Logbook notes, there was no difference in the symptoms between the groups of subjects using hypertonic and isotonic seawater solutions. The earliest statistically significant difference was recorded for congestion (day 4), followed by waking (day 6, just for a while, then

Table 1. Demographic and clinical characteristics of study sample and patients

	n (% on total)	Hypertonic n (%)	Isotonic n (%)
No. of patients	**60 (100.0)**	**30 (50.0)**	**30 (50.0)**
Age groups			
10-19	5 (8.3)	3 (10.0)	2 (6.7)
20-29	14 (23.3)	11 (36.7)	3 (10.0)
30-39	11 (18.3)	4 (13.3)	7 (23.3)
40-49	12 (20.0)	5 (16.7)	7 (23.3)
50-59	9 (15.0)	5 (16.7)	4 (13.3)
60-69	8 (13.3)	2 (6.7)	6 (20.0)
70-79	1 (1.7)	0 (0.0)	1 (3.3)
= >80	0 (0.0)	0 (0.0)	0 (0.0)
Gender			
Males	13 (21.7)	5 (16.7)	8 (26.7)
Females	47 (78.3)	25 (83.3)	22 (73.3)
Duration of illness (months)			
≤12	6 (10.0)	2 (6.7)	4 (13.3)
13-24	4 (6.7)	3 (10.0)	1 (3.3)
25-36	7 (11.7)	6 (20.0)	1 (3.3)
37-48	6 (10.0)	4 (13.3)	2 (6.7)
49-60	5 (8.3)	4 (13.3)	1 (3.3)
61-72	4 (6.7)	3 (10.0)	1 (3.3)
73-84	1 (1.7)	1 (3.3)	0 (0.0)
85+	26 (43.3)	7 (23.3)	19 (63.3)
Missing	1 (6.7)	0 (0.0)	1 (3.3)

Table 2. Symptom variations between hypertonic and isotonic solution groups at 1st, 2nd and 3rd follow up visit

Symptom	Follow up visit	P value*	Statistical significance of difference
Rhinorrhea	1st visit	0.295	No
	2nd visit	0.711	No
	3rd visit	0.145	No
Congestion	1st visit	0.994	No
	2nd visit	0.038	Yes
	3rd visit	0.009	Yes
Cough	1st visit	0.728	No
	2nd visit	0.318	No
	3rd visit	0.040	Yes
Headache	1st visit	0.506	No
	2nd visit	0.549	No
	3rd visit	0.300	No
Facial sensitivity on palpation	1st visit	0.061	No
	2nd visit	0.813	No
	3rd visit	0.652	No

Source: Test List; *Mann-Whitney Rank Sum Test

again on day 9), headache (day 11), cough (day 14), and no such difference for rhinorrhea (Table 3).

Testing for significance of difference in particular symptoms between day 0 and day 15 of the Patient Logbook notes yielded statistically significant differences in all symptoms in the group of patients using hypertonic seawater solution. Testing for significance of difference in particular symptoms between day 0 and day 15 of the Patient Logbook notes yielded statistically significant differences in congestion and rhinorrhea, whereas other symptoms showed no major changes during the study period in the group of patients using isotonic seawater solution.

A comparison was made between the symptoms recorded by the physician on the 1st, 2nd and 3rd physical examination (taken at 7-day intervals and noted in the Test List) and the same symptoms recorded by the study patients in the Logbook on day 1, day 8 and day 15, separately for the groups of patients receiving isotonic and hypertonic seawater solutions.

Symptom patterns in patient groups administered hypertonic and isotonic seawater solutions as recorded in the QoL questionnaire filled in by study patients at study entry, then at week 1 and week 2, are shown below. Mean values were presented; patients graded their symptoms on a 0-10 scale, where 10 indicated severe and very frequent symptoms, and 0 indicated a symptom-free condition.

Table 3. Symptom differences between subjects using hypertonic and isotonic seawater solution

Day	Rhinorrhea	Congestion	Cough	Headache	Waking
1	0.684	0.106	0.169	0.367	0.965
2	0.363	0.141	0.231	0.420	0.290
3	0.344	0.056	0.332	0.610	0.085
4	0.965	0.027*	0.237	0.918	0.063
5	0.862	0.030*	0.180	0.762	0.183
6	0.574	0.027*	0.251	0.424	0.034*
7	0.679	0.014*	0.631	0.277	0.158
8	0.476	0.017*	0.665	0.143	0.082
9	0.848	0.019*	0.807	0.157	0.030*
10	0.178	0.027*	0.524	0.110	0.034*
11	0.099	0.070*	0.303	0.006*	0.001*
12	0.252	0.018*	0.141	0.025*	0.011*
13	0.147	0.005*	0.102	0.023*	0.031*
14	0.112	0.013*	0.028*	0.007*	0.022*
15	0.154	0.001*	0.023*	0.001*	0.015*

Source: Patient Logbook

The severity of almost all of the symptoms present in the patient group using Hypertonic seawater solution, as evaluated at three time points (initial, at week 1 and week 2), was reduced by over 50%. The greatest reduction was recorded in the following symptoms: morning weariness and sleep deprivation (75.6%), anxiety (70.8%), unease for nasal disease symptoms (70.4%), sleeping difficulties (68.8%), headaches (67.9%), frustration (67.5%).

The grade of reduction in the symptom patterns in the patient group using isotonic seawater solution, evaluated at three time points (initial, at week 1 and week 2), greatly varied. The greatest reduction was recorded in the following symptoms: sleeping difficulties (46.4%), waking during the night (38.7%), cough (38.1%).

No side effects were recorded during the clinical trial period (15 days).

DISCUSSION

The role of mucus in the inflammatory process has been widely discussed. Some studies demonstrated the potential disease association with mucociliary functional changes, with special reference to the role of mucus within the nasal cavity (10). The mucus transport ratio decreases significantly in patients with chronic rhinosinusitis, as compared with healthy subjects, and modified mucus properties rather than ciliary abnormalities are considered to underlie pathologic changes (11). In another study, seawater solution applied in the form of spray considerably improved the rate of nasal mucociliary clearance in cystic fibrosis patients, free from sinus disease symptoms (11). A study in healthy subjects free from nasal or sinus disease symptoms revealed that the clearance rate only improves upon lavage with a hypertonic saline, but not with a physiological (isotonic) saline (8).

The destruction of the ciliary epithelium, due to long-lasting nasal mucosa colonization with pathogenic microorganisms, is another cause of reduced nasal mucociliary clearance in chronic rhinosinusitis patients (12). It is manifested as a decreased frequency of ciliary movements, which increases with long-term antibiotic therapy (13).

A continuous reduction of disease symptoms is one of the indicators of the seawater solution efficiency recorded in the present study, 18,5%

and 17,5% with hypertonic and isotonic seawater solution, respectively. Results of this clinical trial showed that the use of seawater solution is beneficial in patients with chronic rhinosinusitis. In addition, hypertonic seawater solution proved to be better than isotonic seawater solution in removing the symptoms of nasal congestion, rhinorrhea, cough, headache and waking due to discomforts caused by the disease.

The evaluation of the effectiveness and safety of topical saline in the management of chronic rhinosinusitis were done by searching the Cochrane Central Register of Controlled Trials (4). There is evidence that saline is beneficial in the treatment of the symptoms of chronic rhinosinusitis when used as the sole therapy. Two studies compared different hypertonic solutions against isotonic saline. Some evidence suggests that hypertonic solutions improve objective measures but the impact on symptoms is less clear. In our study hypertonic solution showed superiority on the symptoms of congestion (2^{nd} visit , p= 0,038 ; 3^{rd} visit .p= 0,009) and cough (3^{rd} visit, p=0,04).

The size of the study sample was based on the prevalence of chronic rhinosinusitis in Croatia of 1.5‰ according to the health statistics data, or 1.5 *per* 1000 inhabitants older than 18. As Osijek has 88767 citizens older than 18, the calculated prevalence is 133, and for Slavonski Brod with 47613 citizens older than 18 it is 71, or 204 in total. According to the total sample size (N=204), the study sample should have consisted of 134 patients. However, the present study included 60 patients. This sample size was considered adequate because of the low phenomenon variability (strictly defined symptoms of chronic rhinosinusitis) and for financial restrictions (1,10).

A number of randomized controlled trials have tested nasal and antral irrigation with isotonic or hypertonic saline in the treatment of acute/intermittent and chronic/persistent rhinosinusitis (4). Although saline is considered a control treatment itself, patients in these randomized trials were assigned different modalities of saline application, hypertonic saline, or hypertonic compared to isotonic saline. Group results were compared. Most of them offer evidence that nasal washouts, or irrigations with isotonic or hypertonic saline, are beneficial in terms of symptom alleviation, endoscopic findings and Health-Related QoL improvement in patients with chronic persistent rhinosinusitis (14). Hypertonic saline is preferred to isotonic treatment for rhinosinusitis by some authors in the USA, mostly based on a paper indicating it significantly improves nasal mucociliary clearance, measured by saccharine test, in healthy volunteers (5, 6).

The present study showed that the QoL in patients with chronic rhinosinusitis improves sooner with the use of hypertonic seawater solution. During the two-week study period, a follow up of the five symptoms closely associated with chronic rhinosinusitis yielded a statistically significant difference in improvement of the symptoms of nasal congestion and cough. Apart from these medical findings, study patients made notes on favorable changes themselves, with the earliest statistically significant difference recorded for nasal congestion (day 4), waking up for a while (day 6, then again on day 9), headache (day 11) and cough (day 14), but not for rhinorrhea. The spray was well tolerated and was not associated with any significant adverse event. The superiority of hypertonic seawater solution was manifested by the statistically significant reduction in all of the symptoms observed, unlike with the isotonic seawater solution, where some symptom reduction was only recorded in nasal congestion and rhinorrhea.

Most questionnaires concentrate on the duration of the symptoms and not on the severity of the symptoms. A QoL questionnaire, developed by Damm et al, includes the severity of the symptom scale (15). The domains in the questionnaire are the overall QoL, nasal breathing obstruction, post-nasal drip or discharge, dry mucosa, smell, headache and asthmatic complaints.

In a generic SF-36 survey, the scores of chronic rhinosinusitis patients were compared to those of a healthy population. The results showed statistically significant differences in seven of eight domains (7). Gliklich and Metson (9) have reported that patients with chronic rhinosinusitis have more bodily pain and worse social functioning than for example, patients with chronic obstructive pulmonary disease, congestive heart failure, or back pain.

The questionnaire used in the present study was validated in the previous research (16).

It has a similar structure to the one used in the study with allergic rhinitis patients. The day to day analysis showed the high sensitivity, noticing even short, intermittent changes, which is characteristic of chronic diseases.

The results of this clinical trial have shown that the use of seawater solution is beneficial to patients with chronic rhinosinusitis. Hypertonic seawater solution has been found to be better than isotonic seawater solution in eliminating the symptoms of nasal congestion, rhinorrhea, cough, headache and waking up during the night. The study demonstrated that the QoL in patients with chronic rhinosinusitis improves sooner with the use of hypertonic seawater solution. Additional topical therapy with nasal decongestants was required in only four study patients (two in the group receiving hypertonic and isotonic seawater solution each, during the study period only in the patients using isotonic solutions), which was statistically non-significant.

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REFERENCES

1. Van Cauwenberge P, Watelet JB. Epidemiology of chronic rhinosinusitis. Thorax 2000; 55 (Suppl 2): 20-1;doi:10.1136/thorax.55.suppl_2.20.
2. Eloy P, Watelet JB, Rombaux P, Dale J, Bertrand B. Management of chronic rhinosinusitis without polyps in adults. B-ENT 2005; 1(Suppl): 65-74; quiz 75-6.
3. Ron G, Shashy MD, Eric J, Moore MD, Amy Weaver MS. Prevalence of the chronic sinusitis diagnosis in Olmsted County, Minnesota. Arch Otolaryngol Head Neck Surg 2004; 130: 320-3.
4. Harvey R, Hannan SA, Badia L, Scadding G. Nasal saline irrigations for the symptoms of chronic rhinosinusitis. Cochrane Database Syst Rev 2007; 18: CD006394.
5. Fokkens WJ, Lund VJ, Mullol J; European Position Paper on Rhinosinusitis and Nasal Polyps group. European position paper on rhinosinusitis and nasal polyps 2007. Rhinology 2007; 45(Suppl 20): 1-139.
6. Talbot AR, Herr TM, Parsons DS. Mucociliary clearance and buffered hypertonic saline solution. Laryngoscope 1997; 107: 500-3.
7. Durr DG, Desrosiers MY, Dassa C. Quality of life in patients with rhinosinusitis. J Otolaryngol 1999; 28: 108-11.
8. Lund VJ, Kennedy DW. Quantification for staging sinusitis. The staging and therapy group. Ann Otol Rhinol Laryngol 1995; 167 (Suppl): 17-21.
9. Gliklich RE, Metson R. The health impact of chronic sinusitis in patients seeking otolaryngologic care. Otolaryngol Head Neck Surg 1995; 113: 104-9.
10. Croatian Health Service Yearbook 2007. Zagreb: Croatian National Institute of Public Health, 2008.
11. Majima Y, Sakakura Y, Matsubara T, Murai S, Miyoshi Y. Mucociliary clearence in chronic sinusitis: related human nasal clearence and in vitro bullfrog clearence. Biorheology 1983; 20: 251-62.
12. Middleton PG, Geddes DM, Alton EW. Effect of amiloride and saline on nasal mucociliary clearance and potential difference in cystic fibrosis and normal subjects. Thorax 1993; 48: 812-6.
13. Wilson R, Cole PJ. The effect of bacterial products on ciliary function. Am Rev Respir Dis 1988; 138: 49-53.
14. Scadding GK, Lund VJ, Darby YC. The effect of long-term antibiotic therapy upon ciliary beat frequency in chronic rhinosinusitis. J Laryngol Otol 1995; 109: 24-6.
15. Damm M, Quante G, Jungehuelsing M, Stennert E. Impact of functional endoscopic sinus surgery on symptoms and quality of life in chronic rhinosinusitis. Laryngoscope 2002; 112: 310-5.
16. Včeva A, Djanić D, Kotromanović Z, Pajić-Penavić I. Comparison of isotonic and hypertonic seawater solution in the treatment of chronic rhinosinusitis. In: Abstract of the 6th Congress of Croatian Society for Otorhynolaryngology and Head and Neck Surgery with International Participation, Dubrovnik, Croatia, 2009. Abstract 104, str. 119. Croatian Society for Otorhynolaryngology and Head and Neck Surgery, Zagreb, Croatia.