Xylitol nasal irrigation in the treatment of chronic rhinosinusitis

Authors Lin Lin, Xinyue Tang, Jinjin Wei, Fei Dai, Guangbin Sun

Abstract

Objective

To evaluate the efficacy of xylitol nasal irrigation (XNI) treatment on chronic rhinosinusitis (CRS) and to investigate the effect of XNI on nasal nitric oxide (NO) and inducible nitric oxide synthase (iNOS) mRNA in maxillary sinus.

Materials and methods

Patients with CRS were enrolled and symptoms were assessed by Visual Analog Scale (VAS) and Sino-Nasal Outcome Test 22 (SNOT-22). Nasal NO and iNOS mRNA in the right maxillary sinus were also examined. Then, they were treated with XNI (XNI group) or saline nasal irrigation (SNI, SNI group) for 30 days, after which their symptoms were reassessed using VAS and SNOT-22, and nasal NO and iNOS mRNA in the right maxillary sinus were also reexamined.

Results

Twenty-five out of 30 patients completed this study. The scores of VAS and SNOT-22 were all reduced significantly after XNI treatment, but not after SNI. The concentrations of nasal NO and iNOS mRNA in the right maxillary sinus were increased significantly in XNI group. However, significant changes were not found after SNI treatment. Furthermore, there were statistical differences in the assessments of VAS and SNOT-22 and the contents of nasal NO and iNOS mRNA in the right maxillary sinus between two groups.

Conclusions

XNI results in greater improvement of symptoms of CRS and greater enhancement of nasal NO and iNOS mRNA in maxillary sinus as compared to SNI.

Introduction

Chronic rhinosinusitis (CRS) is an inflammatory disease involving the nasal and paranasal sinus mucosa. It is defined as chronic inflammation when it lasts longer than 3 months without complete symptom resolution. CRS is a common health problem which significantly affects quality of life. The disease has been estimated to affect 12.5% to 15.5% of the total population in the United States and 10.9% in Europe [1], [2]. Saline irrigation has been shown to be beneficial for patients with CRS [3].

Xylitol is a five-carbon sugar alcohol that has gained extensive attentions in the past decades as a natural antibacterial agent. It decreases the salt concentration of human airway surface liquid that contains many antimicrobial substances, which can contribute to the improvement of the innate immune system, and thereby prevent airway infections [4], [5]. In addition, this agent can exert antibacterial actions through disrupting glucose cell-wall transport and intracellular glycolysis, thus inhibiting bacterial growth [6]. An elegant study reported that xylitol nasal irrigation (XNI) could improve symptoms of CRS clinically [7]. However, the study did not evaluate the inflammatory conditions of the paranasal sinuses of those patients.

It is well known that nitric oxide (NO) provide a first-line defense via its antiviral and antibacterial action and via its upregulation of ciliary motility [8]. High concentrations of NO are found in normal paranasal sinuses, and the lack of NO may lead to the pathogenesis of sinus inflammation [9]. The epithelial cells in the paranasal sinuses were identified as the major source of NO in some studies, and inducible nitric oxide synthase (iNOS) would account for most of this NO production [10], [11]. Measurement of nasal NO may be a useful tool in the diagnosis, management and assessment of patients with CRS [12].

A previous study demonstrated that xylitol at 5% stimulated NO production from macrophage, which inhibited macrophage infection by Leishmania amazonensis [13]. Macrophage is involved in chronic inflammation of paranasal sinuses though generating NO and cytokines [14], [15]. Therefore, it is reasonable to hypothesize that xylitol treatment may control the development of CRS through regulating the NO concentration produced by macrophage or other cells located in sinus mucosa. Based on the above findings, we sought to explore the therapeutic potential of XNI in treating CRS and the influence of XNI on the inflammatory conditions of paranasal sinuses.

Study design

This study was designed as a prospective, randomized, double-blinded, controlled pilot study. Recruitment was done in the department of Otorhinolaryngology-Head and Neck Surgery, Huashan Hospital of Fudan University, with all patients enrolled between April and July 2016.

Study population

Thirty patients with CRS, aged between 35 and 67 years, had undergone bilateral functional endoscopic sinus surgery including at least maxillary antrostomy and anterior ethmoidectomy. Maxillary and ethmoid sinus patency was

Patient clinical characteristics and demographics

Of thirty patients, only twenty-five finished the study. Four subjects were excluded for poor adherence to treatment, and one did not complete the study for other reasons (Fig. 2). Demographic and clinical characteristics were similar between the

two groups at baseline (Table 1), and there were no statistical differences in gender and age between them (Fig. 3A and B).

Comparisons of XNI and SNI group before treatments

The scores of VAS (Fig. 3C) and SNOT-22 (Fig. 3D), and the concentrations of nasal NO (Fig. 3E) and iNOS mRNA in the right

Discussion

This study was designed as a randomized blinded controlled trial, furthermore, there were no statistical differences in gender, age, the scores of VAS and SNOT-22 and the concentrations of nasal NO and iNOS mRNA in the right maxillary sinus before treatments between XNI and SNI group. All of the above reduced potential bias.

On the basis of research on the airway surface liquid located on the surface of upper and lower airway epithelium which can inhibit microbial infection dependent on innate

Conclusion

In conclusion, this study indicates that XNI improves the scores of VAS and SNOT-22, and also increases the contents of nasal NO and iNOS mRNA in maxillary sinus. However, there are no statistical differences in the above assessments after SNI treatment. XNI results in greater improvement of symptoms of CRS and greater enhancement of nasal NO and iNOS mRNA in maxillary sinus as compared to SNI.

Funding sources

This work was supported by the National Natural Science Foundation of China (grant no. 81371076), and the Shanghai Suburb Tertiary Hospital Clinical Capacity Building Project (grant no. SHDC12015905).

Disclosures

The authors have no financial conflicts of interest.

References (27)

- M.J. Goldman *et al.*
  Human beta-defensin-1 is a salt-sensitive antibiotic in lung that is inactivated in cystic fibrosis
  Cell
  (1997)
- P.G. Djupesland *et al.*
  Nitric oxide in the nasal airway: a new dimension in otorhinolaryngology
  Am J Otolaryngol

(2001)
- A.S. Ferreira *et al.*
  Leishmania amazonensis: xylitol as inhibitor of macrophage infection and stimulator of macrophage nitric oxide production
  Exp Parasitol
  (2008)
- G. Hauptman *et al.*
  The effect of saline solutions on nasal patency and mucociliary clearance in rhinosinusitis patients
  J Otol HNS
  (2007)
- B. Jain *et al.*
  Modulation of airway epithelial cell ciliary beat frequency by nitric oxide
  Biochem Biophys Res Commun
  (1993)
- R.G. Shashy *et al.*
  Prevalence of the chronic sinusitis diagnosis in Olmsted County, Minnesota
  Arch Otolaryngol Head Neck Surg
  (2004)
- D. Hastan *et al.*
  Chronic rhinosinusitis in Europe – an underestimated disease. A GA(2)LEN study
  Allergy
  (2011)
- M.A. Pynnonen *et al.*
  Nasal saline for chronic sinonasal symptoms: a randomized controlled trial
  Arch Otolaryngol Head Neck Surg
  (2007)
- L. Durairaj *et al.*
  Safety assessment of inhaled xylitol in mice and healthy volunteers
  Respir Res
  (2004)
- H. Miyasawa-Hori *et al.*
  Difference in the xylitol sensitivity of acid production among *Streptococcus mutans* strains and the biochemical mechanism
  Oral Microbiol Immunol
  (2006)