REVIEW ARTICLE

THE EFFECTIVENESS OF SALTWATER GARGLING ON THE PREVENTION OF UPPER RESPIRATORY TRACT INFECTIONS

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ABSTRACT:

Upper respiratory tract infections (URI) are prevalent in the United States. URIs can also be debilitating and costly. The most common etiology for an URI is viral, and there are currently no antiviral medications for the common cold. Therefore, cost-effective preventative measures are essential in the prevention of URIs. This literature review intends to compare the few studies evaluating the effectiveness of saltwater gargle for preventing URIs. The goals of this review include commenting on the potential for a saltwater gargle in preventing URIs, shortcomings of the few studies performed and recommendations for further research in evaluating saltwater gargle as an effective prevention method. This review looks explicitly at three studies evaluating the effectiveness of saltwater gargling and the prevention of URIs. Conclusions derived from this review include both physiological and clinical evidence of the potential for saltwater gargling in URI prevention. The first two studies demonstrate patient-derived evidence for saltwater gargling, potentially providing a decreased risk of URI when used preventatively. The third study demonstrates the potential for polymerase chain reaction (PCR) in evaluating the effectiveness of saltwater gargling in reducing the duration of illness. Additionally, in the wake of the COVID-19 pandemic, cost-effective treatment options targeting viral URIs, such as SARS-CoV-2, warrant further evaluation and discussion.

INTRODUCTION

Upper respiratory tract infections (URI) are described as acute inflammation of the upper respiratory tract, usually viral etiology. Symptoms typically include rhinorrhea, cough, sneezing, low-grade fever, malaise, myalgia, headache, nasal congestion and/or sore throat. Generally, URIs are self-limiting but may last for up to 10 days or longer, with a residual cough that can last up to 2–3 weeks.[1]

Prevention of URIs is of utmost importance. URIs have resulted in an estimated increase of 12.5% in inpatient visits per month during cold and flu season.[2] The common cold alone resulted in an estimated $17 billion a year in 1997 related to physician visits, secondary infections and medication costs.[2]

The physiological hypotheses surrounding URI prevention through saltwater gargle echo similar basic physiological principles of a hypertonic solution that pulls water, other debris and potentially viral particles out of cells. In theory, during a viral incubation period, this could potentially wash out the virus from the nasopharynx cells, disrupt the propagation of the virus and potentially prevent URIs from occurring.[3] One study found rinsing with saline promotes human gingival fibroblast migration and better wound healing in vitro.[4] Another study found that the chloride ions provided by a saline rinse could provide immune cells with the proper ammunition to make hypochlorous acid, ultimately aiding in fighting off infection.[5] These studies are not necessarily translatable to clinical data in the prevention of URIs with saltwater gargle but raise the question as to if there is physiologic evidence supporting the need for larger randomized controlled trials involving saltwater gargle and the prevention of URIs.

Many medical institutions recommend saltwater gargle for soothing sore throat pain, but whether this inexpensive and simple concoction can prevent URIs from occurring in the first place remains a question worth asking.[6-8] The Mayo Clinic recommends ¼ to ½ teaspoon of table salt mixed with eight ounces of warm water for sore throat relief.[8] After a literature review, three studies have been noted to be relevant in answering the question of whether a saltwater gargle is beneficial in patients with URIs. This paper intends to describe the findings of these studies, pitfalls of these studies and recommendations for future studies.

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METHODS

Databases searched in this literature review included PubMed®, the Cochrane Library and the Agency for Healthcare Research and Quality (AHRQ). Keywords used included "saltwater gargle," "saltwater gargle prevention," "saltwater gargle and prevention upper respiratory tract infection," "saline gargle prevention upper respiratory tract infection," "common cold prevention and saltwater," "common cold prevention and saline," "prevention of upper respiratory tract infection," "prevention of upper respiratory tract infection by gargling" and "gargling for the common cold." Inclusion criteria included clinical trials, reviews and systematic reviews. Exclusion criteria included case studies, books, documents and patents. Considerations in selecting literature included studies performed on human patients, randomization, sample size and the study's goal to evaluate saltwater gargle on prevention of URI. The number of articles discussed herein is represented by PubMed® results, as Cochrane and AHRQ did not contribute to this search. The number of articles from searching "saltwater gargle" to "saline gargle prevention upper respiratory tract infection" was filtered from 30 to 16, respectively. Searching "saltwater gargle and prevention of upper respiratory tract infection" yielded the result of Study 1. The number of articles from searching "common cold prevention and saltwater" to "common cold prevention and saline" yielded three and seven results, respectively. None of these articles specifically addressed the effects of saltwater gargle on the prevention of URIs. The number of articles from searching "prevention of upper respiratory tract infections," "prevention of upper respiratory tract infection by gargling" and "gargling for the common cold" yielded 14,321 results, 129 results and five results; respectively. Studies 2 and 3 appeared in this last group of searches and were deemed appropriate for the topic of this discussion as to focus solely on saltwater gargling and its effectiveness on the prevention of URIs. It should be noted that Study 3 also includes nasal irrigation along with gargling but was included in this study because of study design and use of gargling.

RESULTS

STUDY 1: Respiratory tract infections and its preventative measures among Hajj pilgrims, 2010: a nested case-control study

In this nested case-control study, researchers evaluated a cohort of 338 Iranian pilgrims to assess preventative measures and their effects on respiratory tract infections other than the common cold. Some of the measures evaluated included influenza vaccination, mask usage, personal prayer carpet and saltwater gargling. The outcomes measured included all respiratory tract infections other than common colds, including tonsillitis, pharyngitis, laryngitis, sinusitis, otitis media, bronchitis, pneumonia and influenza. The subjects infected were clinically diagnosed by a physician and data collection, including asking about the use of saltwater gargle at least once per day, was completed for that individual. At the time of diagnosis of the individual, two pilgrims in the same caravan were randomly selected as a control group not affected by the previously mentioned outcomes. Thirty-two of the 338 pilgrims were affected by respiratory tract infections other than common colds. Using univariable logistic regression analysis, saltwater gargling was essentially effective against preventing respiratory tract infections with an odds ratio of 2.4 (p=0.08). This study claims that if conducted with a larger sample size, it may be concluded that lack of gargling with saltwater increases the risk of respiratory infections by 2.3 times. The study also notes that if rapid test diagnosis were to be used rather than clinical diagnosis alone, the overall accuracy of the study could see an increase.[9]

STUDY 2: Prevention of upper respiratory tract infections by gargling: a randomized trial

Gargling saltwater in Japan is often viewed as a routine hygienic routine capable of preventing URIs, but the clinical trials proving this are lacking. This randomized control trial took 387 healthy volunteers aged 18–65 and randomly assigned participants to the water gargling, povidone-iodine gargling and usual care (control) groups. Both gargling groups were suggested to gargle three times per day and were followed for 60 days. A total of 130 participants contracted URIs during this time. The incidence rate of the first URI was 0.26 episodes/30 person-days among control subjects and decreased to 0.17 episodes/30 person-days in the water gargling group. The povidone-iodine groups saw only a small decrease of 0.24 episodes/30 person-days. The incidence rate ratios against controls were 0.64 (95% confidence interval [CI]=0.41-0.99) and 0.89 (95% CI=0.60-1.33); respectively. The intervention groups were asked to complete a prescribed gargling diary every day. The form included frequency of gargling and hand washing and various URI complaints such as nasal symptoms, pharyngeal symptoms, bronchial symptoms and general symptoms. Baseline characteristics accounted for in the study were gender, mean age, residence (northern/central/western Japan), employment status, smoking habits, influenza vaccination and URI frequency in the preceding year. When the multivariate analysis was performed using Cox's proportional hazard model, including other baseline factors, the results were essentially unaltered: the hazard ratios were 0.60 (95% CI=0.38-0.93) for water gargling and 0.88 (95% CI=0.58-1.34) for povidone-iodine gargling. Even when symptoms of those with URI were compared among groups, the saltwater gargling group seemed to have better attenuation of bronchial symptoms than the povidone-iodine group (p=0.055). The claim of this study is a 36% decrease in the incidence of URI among those who gargled tap water versus those who did not.[3]

STUDY 3: A pilot, open-labeled, randomized controlled trial of hypertonic saline nasal irrigation and gargling for the common cold

This pilot, non-blinded, randomized controlled trial compared hypertonic saline nasal irrigation and gargling (HSNIG) to standard care on healthy adults within 48 hours of URI onset to determine recruitment as a primary outcome. Secondary outcomes measured were acceptability and compliance with HSNIG, quality of life, duration of symptoms and viral shedding. Participants maintained a daily symptom diary until they recorded "not unwell" (e.g., score of 0) on two consecutive days or for a maximum of 14 days or until the individual needed further treatment for URI. The participants were given instructions on how to prepare the HSNIG and asked to record the number of times per day used and side effects. A trial nurse collected mid turbinate swabs on day 0 and then taught participants how to collect the swabs themselves. On day 0, all samples were tested using PCR for the identification of the virus. Subsequently, the following days were tested in parallel, and the cycle threshold value (CT value) was converted to log10 to estimate the change in viral shedding. The study did demonstrate the difference between baseline and end-point samples for the intervention group was larger than the control, but that this data was not statistically significant (although the study was not powered to detect differences in those measures). However, the claim is that participants who stopped HSNIG before day four had increased viral shedding and increased or stabilization of symptoms before symptoms resolved. These findings, along with decreased household contact transmission, raise the question of whether HSNIG could help reduce viral replication, shedding and transmission. This study also demonstrated a 36% decrease in over-the-counter medications in the treatment arm (p=0.004). Among participants not living alone, 35% fewer individuals in the intervention arm had household contacts developing URIs after them (p=0.006). This study demonstrated the ability to recruit and retain participants for a full trial of HSNIG with 3% HSNIG and reduce the duration of illness by 1.9 days (p=0.01).[10]

COMMENT

These studies have many shortcomings but also many promising takeaways for the conduction of future studies. They also lend some credibility for recommending saltwater gargle in the prevention and treatment of URI. One similarity between them included symptom diaries. Although they can be a subjective form of bias, symptom diaries can supplement more objective data, such as PCR in Study 3. Studies 1 and 2 used clinical diagnoses based on symptomology rather than rapid tests. Although rapid tests would increase the cost of these studies, they would also improve the accuracy and may benefit a larger study in the future. The use of both quantitative and qualitative PCR in Study 3 may eliminate the need for rapid tests. At the same time, add more objective data regarding viral shedding and identification of individual viruses.

The pathophysiologic mechanisms underlying saltwater gargle and possible prevention of URIs lacks conclusive evidence. However, studies are demonstrating physiologic and molecular changes that potentially aid in the prevention of viral propagation.[4,5] These studies suggest that there is molecular and physiological evidence to support the need for future clinical trials in evaluating the effectiveness of saltwater gargle and URI prevention. Study 2 discusses the theory of essentially washing out pathogens from the pharynx and oral cavity during a viral incubation period with the potential of disrupting the propagation period of the virus. However, Study 2 also admits this theory remains questionable as evidence for this is lacking.[7] Another proposed mechanism from Study 2 is the inactivation of viruses by chlorine added to the tap water. Sodium has also been noted to have antimicrobial properties and thus use of saltwater gargle rather than tap water would be a worthy future study.[10]

Economically, the use of saltwater gargle as a preventative measure could potentially be substantial. Study 2 claims that if mere gargling with tap water could reduce URI incidence by up to 36%, as much as 200 billion Yen ($1,869,071,600.00 USD) could be saved per year.[3,11] Study 2 also addresses these economic issues in another paper.[3,11] In the United States, URIs have resulted in an estimated increase of 12.5% inpatient visits per month during cold and flu season. [12] The common cold alone resulted in an estimated $17 billion a year in 1997 related to physician visits, secondary infections and medication costs. An estimated $25 billion in indirect costs from missed work because of illness or caring for a sick child has also been noted.[2] These studies show statistically significant evidence for saltwater gargle and the prevention of URIs, as well as several takeaways that can be used to construct larger studies evaluating a potentially economically impactful preventative technique.

These studies could all use larger sample sizes, blinding of participants and more objective data to increase the accuracy of results. Along with symptom diaries, more objective data could be obtained using PCR for qualitative and quantitative purposes. Although, the use of PCR in a study evaluating the prevention of URIs may not be as beneficial. Perhaps one could do a combination study measuring both prevention and duration of illness, using PCR to identify the virus at symptom onset and then subsequently tracking viral shedding while continuing the saltwater gargle. Study 3 also stated that human DNA testing for housekeeping genes would ensure samples collected for PCR were collected correctly. This would add to the accuracy of the study. However, Study 3 measured the duration of illness rather than prevention of the URI, the components of the study are still considered potentially relevant to prevention. The demonstration of a reduction in viral shedding could mean that prophylactically gargling saltwater theoretically has the potential to reduce the propagation of the virus in the incubation phase, ultimately preventing symptomatic URI. Study 3 did evaluate the combination of nasal saline irrigation with gargling but was still included in this review because of the study design and use of gargling.

CONCLUSION

Overall, the comparison and review of these studies demonstrate tremendous potential for larger randomized controlled trials evaluating the effectiveness of saltwater gargle in preventing and treating URIs. Each of these studies has shortcomings and promising conclusions that can be used to formulate future studies evaluating this economically feasible and potentially effective method for preventing and treating URIs.

Additionally, this review intends to offer a timely discussion pertinent to the current COVID-19 pandemic. Although notably the highest titers of SARS-CoV-2 have been detected in the nasopharynx, the entire upper respiratory tract still contains high amounts of the virus overall.[13] Considering this, saltwater gargle remains a serious prevention and/or treatment option worth further evaluation and discussion. Recently, the same group that conducted Study 3 conducted a post-hoc secondary analysis evaluating the potential for hypertonic saline nasal irrigation and gargling as a potential treatment for COVID-19. As stated previously, Study 3 demonstrated a lower duration of illness in a subset of patients infected with other alpha and beta coronaviruses. Although these interpretations must be visited with caution, the lack of current definitive treatment for COVID-19 calls for additional exploration of other potential treatments and/or preventative measures.[14]

TABLE 1.

Comparison of the studies

STUDY	STUDY TYPE	SAMPLE SIZE	MAJOR FINDINGS	TAKEAWAYS FOR FUTURE STUDIES
1	Nested Case-Control	338	32/338 with URI. Univariable logistic regression analysis demonstrated the prevention of respiratory tract infections with a saltwater gargle. Odds ratio of 2.4 (p=0.08).	It needs a larger sample size. The diagnosis was made clinically (no use of rapid testing.) It did not include the common cold. Potential for subjective biases with use of symptom diary. Potential for recall bias.
2	RCT	387	130/387 with URI. The incidence rate of the first URTI was 0.26 episodes/30 person-days among control subjects. The rate decreased to 0.17 episodes/30 person-days in the water gargling group and 0.24 episodes/30 person-days in the povidone-iodine group.	It needs a larger sample size. The diagnosis was made clinically (no use of rapid testing.) Not blinded. Potential for subjective biases with a symptom diary. Tap water (not saline) was used.
3	Pilot, open-labeled, RCT	68	32/66 in the treatment arm. Duration of illness was lower by 1.9 days (p = 0.01), over-the-counter medications (OTCM) use by 36% (p = 0.004), transmission within household contacts by 35% (p = 0.006) and viral shedding by ≥0.5 log10/day (p = 0.04).	It needs a larger sample size. Not blinded. Potential for subjective biases with use of symptom diary.* Used combination nasal irrigation and gargling. Did not measure prevention of URI.

*WURSS-21 (Wisconsin upper respiratory tract symptoms survey) is a validated survey.

AUTHOR DISCLOSURES:

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