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Effect of Licorice and Green Tea Gargle on Post-Extubation Sore Throat, Cough and Hoarseness in Patients Undergoing Elective Surgery: A Randomized Controlled Trial

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Abstract

Background: Endotracheal extubation is associated with high complications such as sore throat, cough, and hoarseness.

Aim: This study was performed aimed to compare the effect of green tea and licorice gargle on sore throat, cough, and hoarseness after endotracheal extubation.

Method: This randomized controlled clinical trial was performed in the operating rooms and surgical wards of two hospitals in Tehran during 2020-2021. A total of 102 candidates for elective surgery were allocated to licorice, green tea, and control groups by simple random allocation. The scores of sore throat, cough, and hoarseness were assessed one hour after endotracheal extubation. After the gag reflex returned, 30 cc of the prepared solutions was given to the patients to gargle for 30 seconds. The intervention was repeated two hours later. The scores were assessed in the three groups immediately after the first stage of the intervention (post test1), and two hours after the second stage of the intervention (Post-test 2). Data were analyzed by SPSS software (version 16) and One-way Analysis of Variance-ANOVA, Repeated Measure ANOVA and post hoc test. $P<0.05$ was considered statistically significant.

Results: There was significant difference between the three groups regarding sore throat, cough, and hoarseness variables in the post-test 1 and post-test 2 stages ($P<0.05$). The intervention groups had significantly reduced scores in three main variables compared to the control group ($P< 0.05$), but the difference between the two intervention groups was not significant ($P> 0.05$).

Implications for Practice: Gargle of licorice solutions or green tea is recommended as a non-pharmacological and low-cost intervention to reduce post-extubation complications.

Keywords: Cough, Green tea, Hoarseness, Licorice, Sore throat

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Introduction

Endotracheal intubation is performed during general anesthesia to protect the airway and prevent aspiration (1). However, tracheal extubation after the anesthesia damages the airway and can lead to the complications such as sore throat, cough, and hoarseness with an incidence rate of 40-100% (2). In fact, postoperative sore throat due to throat and laryngeal and tracheal mucosal damage during intubation is a common and irritating issue which is recognized by patients as the eighth postoperative complication (3). About 10% of cases have difficulty in swallowing due to this complication which often lasts for 72 hours after extubation (4).

Post-extubation cough with a prevalence of 70% (5) is caused by damage to the larynx, trachea, and accumulation of secretions in the airway. Moreover, post-operative cough leads to the stretching of the sutures and intensified pain, especially in chest and abdominal surgeries (6). In addition, it can increase intracranial, eye, and abdominal pressure and risk of open-globe surgeries or abdominal aortic aneurysm (7). Also, post-extubation hoarseness with a prevalence of 14.4-50% is caused by direct trauma to vocal cords during endotracheal intubation (8). Various pharmacological and non-pharmacological methods have been used to reduce the complications of endotracheal extubation, such as application of Betamethasone gel on the endotracheal tube (9). However, pharmacological medications have always been expensive and also are associated with some complications. Therefore, many have tended to use complementary medicine due to its low cost (10), fewer complications and easy access (11). One of the complementary medicine methods is phytotherapy, which uses the plant or its essential oil (aromatherapy) (12). This method is one of the valuable legacies of Iranian medicine; Iran is one of the three countries with a long history in this regard (13).

Green tea sourced from Camellia Sinensis (L.) O. Kuntze (14) has amazing effects in treatment of heart diseases, diabetes and even cancer (15). The properties of Green tea which is considered by the researchers is the restorative and anti-inflammatory effects (21) due to the presence of 36 polyphenols, especially Catechins (16). Green tea Catechins can be used to treat many inflammatory diseases (e.g., osteoarthritis and rheumatoid arthritis) (17) and reduce allergic reactions to treatment (18). It is even used to heal wounds due to its antioxidant effects (19).

Licorice is the common name of Glycyrrhiza Glabra and a flowering plant of the bean family Fabaceae (20). The main constituents of the extract of licorice include Liquiritigenin, Hispaglabridins, Glycyrrhizic acid, Glycyrrhizin, Liquilitin, and Glabridin (21). Notably, Liquilitin and Liquiritigenin have peripheral and central antitussive properties (22). Glycyrrhizic acid can postpone inflammatory processes by inhibition of Cyclooxygenase activities, Prostaglandin formation, and platelet aggregation (23). Glabridin also has antioxidant properties and can contribute to the improvement of the throat and tracheal mucosal injuries after laryngoscopy, endotracheal intubation, and endotracheal tube cuff pressure (24).

Limited studies have been performed to evaluate the effects of licorice and green tea on reducing post-extubation complications. However, licorice and green tea have been separately evaluated in different studies that showed their beneficial effects on reducing the complications of endotracheal tube removal. Ibrahim and Anis in their study reported that Ketamine and Licorice gargle equally reduced the incidence and severity of sore throat caused by intubation (25). Ghaleb et al. in a study showed the positive effect of Licorice gargle on reducing sore throat and cough after Laminectomy (26). In the study by Ariarifar et al., green tea gargle following extubation in patients undergoing open-heart surgery reduced sore throat and cough, but had no significant impact on hoarseness (27).

According to searches conducted by the researcher, no study was found that compares the effect of green tea and licorice on post-extubation complications. Therefore, the present study was performed aimed to compare the impact of green tea and Licorice gargle on post-extubation complications such as sore throat, cough and hoarseness.

Methods

This randomized controlled clinical trial was performed in the operating rooms and surgical wards of two specialized hospitals in Tehran during 2020-2021. The participants included all patients who were candidates for elective surgery (shoulder dislocation, knee ligament surgery, carpal tunnel syndrome, hydrocelectomy, varicocelectomy). Inclusion criteria were: Patient and surgeon's consent to participate in the study, use of endotracheal tube for anesthesia, the age range of 18-65 years, ability to communicate and answer the questions, no sensitivity to the Licorice and green tea solutions, no airway

infection, no surgery on the head and neck, place the patient in a semi-sitting position to gargle the solution after surgery, no history of sore throat one week before the study, lack of diabetes, no history of intubation in the last 6 months and no history of lung diseases including asthma and diabetes. Exclusion criteria were: unwillingness of the patient or attending physician to cooperate with the researchers, intubation time of more than 30 seconds, a Mallampati score above two, more than once endotracheal intubation, and nausea and vomiting following starting the liquid diet.

The sample size was estimated as 28 patients per group based on the mean of sore throat reported by Ghaleb et al (26) and by considering a 95% confidence interval and 90% test power. However, considering a 20% possibility of loss, 34 patients was allocated to each group. A total of 102 patients candidates of elective surgery were selected by convenient sampling method based on inclusion criteria. The subjects were allocated in three groups (licorice, green tea, and control) by use simple random allocation method using a dice throw method. The numbers 1 and 2 for green tea group, 3 and 4 for the licorice group, and 5 and 6 for the control group, respectively.

According to the medical record and the statements of the operating room nurses, the researcher examined the inclusion criteria and completed the demographic and medical information questionnaire in the operating room. Demographic and medical characteristics of patients included: weight (kg), age (year), BMI (kg/m2), duration of surgery (minute), duration of intubation (minute), time trying for intubation (second). The severity of sore throat was measured using a numerical pain scale, which is a 10-cm tool and score of 0 indicates no pain and score of 10 indicates maximum pain level. This tool has been used in various studies several times and its validity and reliability have been confirmed (28). In addition, patients' cough and hoarseness were assessed by a scoring system designed by Harding and McVey in 1987 (29). Cough scoring based on the system included: No cough: 0; mild (less than a common cold): 1; moderate (similar to a common cold): 2; and severe (more than a common cold): 3. In addition, hoarseness scoring was performed as follows: No hoarseness: 0; mild (previous hoarseness but no hoarseness at the time of the interview): 1; moderate (is only perceived by the patient): 2; and severe (recognizable at the time of interview): 3. Notably, the mentioned scoring system were frequently applied in previous studies and its validity and reliability have been confirmed (9, 27, 30, 31).

The solution used for licorice group was 0.5 g of Licorice root (from Shirin Daroo Company with health license 15/11066) made in 30 cc water (32). Also, for green tea group, 15 mg green tea leave (from Golestan Company with health license 16/19426) made in 30 cc water was used. The solutions were prepared in opaque containers and named A, B, and C. The trained research assistants were blinded to the content of the containers. The three study groups were named with codes A, B, and C and one of the researchers kept the codes secret until the end of data analysis. Therefore, the research assistants, as well as patients and statistical analysts were blinded to the groups.

The patient was extubated about one hour after surgery, then, one hour after the endotracheal tube extubation when the patient was fully conscious and can communicate, the severity of sore throat, cough, and hoarseness was assessed and recorded. Then, the patient was transferred to the surgical ward. According to the routine of the ward, the fluid diet was started as ordered by the physician, following gag reflex return. At this stage, 30 cc of solutions (Licorice, green tea, and plain water) with proper temperature for drinking (25°C) were given to the patients of each groups, to gargle for 30 seconds (Posttest 1). The intervention was repeated two hours later (Posttest 2). The severity of sore throat, cough, and hoarseness of patients in all three groups were recorded immediately after the first stage of the intervention (posttest 1), and two hours after the second stage of the intervention (posttest 2).

Data were analyzed by SPSS software (version 16) using mean, standard deviation, and frequency distribution table (for describing the data), One-way Analysis of Variance-ANOVA (for comparison of demographic characteristics of patients in three groups also intragroup comparison of cough, sore throat, and hoarseness) and Repeated Measure ANOVA (for intergroup comparison of cough, sore throat, and hoarseness. The post hoc test was used to compare the groups two by two. $P<0.05$ was considered statistically significant.

The principles of the Helsinki Declaration are adhered in this study, such as explaining the study's objectives and methods to patients, voluntary participation in the study, no harm caused by the intervention, receiving a written informed consent, receiving permission from the attending physician, and ensuring the confidentiality terms regarding patients' information and the possibility of withdrawing from the study at any time.

Results

A total of 102 patients participated in the study and were followed up. None of the patients were excluded during the follow-up (Figure 1). The mean age of the patients was 34.89±12.03 years (ranging 18-65 years). The mean body mass index (BMI) was 26.09±2.36 kg/m^2 (ranging 19.48-34.10 kg/m^2) and the mean duration of the surgery was 88.48±17.13 minute. Moreover, the mean duration of endotracheal intubation was 14.92±3.36 seconds, and the mean endotracheal tube size was 7.36±0.28 mm. Post-extubation mean score of sore throat was estimated at 5.29±1.89, whereas the mean scores of cough and hoarseness were 1.0±61.89 and 1.70±0.88, respectively. There was no significant difference between the three groups regarding the demographic characteristics of the patients (P>0.05) (Table 1).

One Way ANOVA test results indicated no significant difference among the three groups regarding three variables of the study (Sore Throat, Cough, and Hoarseness) before the intervention (P>0.05). But in the post-test 1 and post-test 2 stages, the differences between the three groups in terms of three main variables of the study were significant (P< 0.05). Post Hoc Tests showed significant difference between each of the intervention groups and the control group (P< 0.001), but the difference between the two intervention groups in terms of three main variables of the study was not significant (P> 0.05). Also, the results of intergroup comparison using the repeated measures ANOVA test showed that all three groups had significant differences during the study stages (P< 0.05). Thus, the rate of sore throat in the first and second stages of the study was significantly lower in the licorice group than in the other two groups (p<0.05) (Table 2).

Also, the rate of cough was significantly lower in the first stage of the intervention in the green tea group and in the second stage in the licorice group compared to the other two groups (p<0.05) (Table 3).

The rate of hoarseness in these two stages was significantly lower in the green tea group than the other two groups (p<0.05) (Table 4).

Figure 2 also showed the trend of changes in the sore throat, cough and hoarseness in three stages of study in three groups.

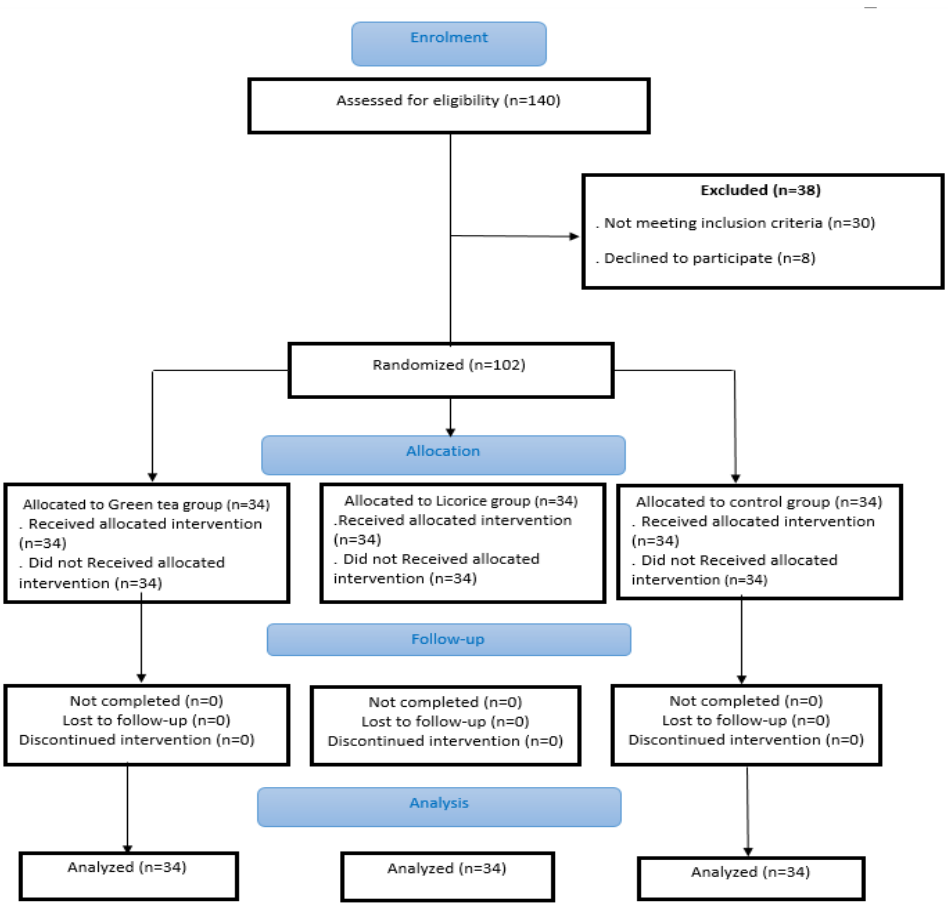

Figure 1. Clinical trial Flow chart

Table 1. Comparison of demographic characteristics of patients in three groups

Groups Parameters	Licorice	Green tea	Control	Test*
	Mean ± Standard deviation			
Age (year)	36.32 ±11.46	33.94 ± 33.07	34.41 ± 11.53	F = 0.36, P = 0.692
Weight (kg)	75.32 ± 8.18	71.85 ± 7.68	71.76 ± 9.06	F = 2.01, P = 0.138
BMI (kg/m^2)	26.70 ± 2.34	25.71 ± 2.41	25.85 ± 2.27	F = 1.76, P = 0.177
Duration of surgery (minute)	90.73 ± 18.67	86.02 ± 17.35	88.67 ± 15.38	F = 0.64, P = 0.529
Duration of intubation (minute)	92.05 ± 19.31	87.50 ± 18.30	90.73 ± 17.19	F= 0.559, P = 0.574

*One Way ANOVA

Table 2. Comparison of sore throat among three study groups (Licorice, Green tea, Control) in three stages of the study

Groups	Pre-test	Post-test 1	Post-test 2	Intergroup (Time)*
	Mean ± Standard deviation			
Licorice	5.82 ± 1.38	2.44 ± 1.10	1.08 ± 1.26	F = 285.22, P < 0.001
Green tea	5.17 ± 1.60	2.58 ± 1.20	1.20 ± 1.03	F = 16.72, P < 0.001
Control	4.88 ± 2.44	3.76 ± 1.55	3.26 ± 1.42	F = 270.15, P < 0.001
Intragroup**	F = 2.25 P = 0.110	F = 10.49 P < 0.001	F = 32.55 P < 0.001	
Post Hoc Test				
A and B		P < 0.001 MD = -1.32	P < 0.001 MD = -2.17	
A and C		P = 0.643 MD = -0.14	P = 0.699 MD = -0.11	
B and C		P < 0.001 MD = 1.17	P < 0.001 MD = 2.05	

Post-test 1: Immediately after the first stage of intervention, Post-test 2: Two hours after the second stage of intervention; *RM-ANOVA, ** One-way ANOVA, A: Licorice, B: control, C: Green tea, MD: Mean Difference

Table 3. Comparison of cough among three study groups (Licorice, Green tea, Control) in three stages of the study

Groups	Pre-test	Post-test 1	Post-test 2	Intergroup (Time)*
	Mean ± Standard deviation			
Licorice	1.82 ± 0.86	0.67 ± 0.63	0.14 ± 0.43	F = 123.06, P < 0.001
Green tea	1.46 ± 0.92	0.52 ± 0.70	0.17 ± 0.38	F = 11.57, P = 0.001
Control	1.58 ± 0.85	1.20 ± 0.72	1.00 ± 0.69	F = 66.94, P < 0.001
Intragroup**	F = 1.61 P = 0.204	F = 8.97 P < 0.001	F = 29.00 P < 0.001	
Post Hoc Test				
A and B		P = 0.002 MD = -0.52	P < 0.001 MD = -0.85	
A and C		P = 0.383 MD =0.14	P = 0.818 MD = -0.02	
B and C		P < 0.001 MD = 0.67	P < 0.001 MD = 0.82	

Post-test 1: Immediately after the first stage of intervention, Post-test 2: Two hours after the second stage of intervention; *RM-ANOVA, ** One-way ANOVA, A: Licorice, B: control, C: Green tea, MD: Mean Difference

Table 4. Comparison of hoarseness among three study groups (Licorice, Green tea, Control) in three stages of the study

Groups	Pre-test	Post-test 1	Post-test 2	Intergroup (Time)*
	Mean ± Standard deviation			
Licorice	1.88 ± 0.76	0.61 ± 0.69	0.26 ± 0.51	F = 120.52, P < 0.001
Green tea	1.76 ± 0.92	0.58 ± 0.60	0.05 ± 0.23	F = 11.93, P < 0.001
Control	1.47 ± 0.92	1.02 ± 0.62	0.88 ± 0.64	F = 105.88, P < 0.001
Within group**	F = 1.989 P = 0.142	F = 4.966 P = 0.009	F = 25.729 P < 0.001	
Post Hoc Test				
A and B		P = 0.01 MD = -0.41	P < 0.001 MD = -0.61	
A and C		P = 0.851 MD =0.02	P = 0.088 MD =0.20	
B and C		P = 0.006 MD = 0.44	P < 0.001 MD = 0.82	

Post-test 1: Immediately after the first stage of intervention, Post-test 2: Two hours after the second stage of intervention; *RM-ANOVA, ** One-way ANOVA, A: Licorice, B: control, C: Green tea, MD: Mean Difference

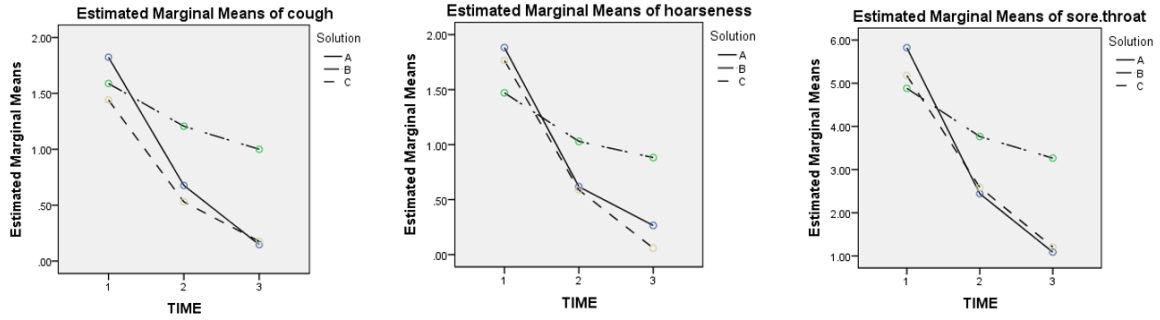

Figure 2. The trend of changes in the sore throat, cough and Hoarseness in three stages of the study in three groups (1: Pre-test, 2: Post-test1, 3: Post-test2; A: Licorice, B: control and C: Green tea)

Effect size (ES)

The Licorice intervention had a high effect size (ES) on the sore throat (ES=0.85), cough (ES=0.73) and hoarseness (ES=1.03) at the post-test 1 and post-test 2 stages (Respectively, ES=1.5; 1.24; 0.96). In addition, the green tea intervention had a high effect size (ES) on the sore throat (ES=0.76), cough (ES= 0.94) and hoarseness (ES= 0.7) at the post-test 1 and post-test 2 stages (Respectively, ES=1.45; 1.2; 1.29).

Also, in this study, no side effects were reported due to consumption of green tea and licorice.

Discussion

The results of the present study indicated that before the intervention, the groups were homogenous in terms of demographic characteristics, sore throat, cough, and hoarseness. However, in post-test 1 and post-test 2 stages, there was a significant difference between the three groups in terms of three variables of sore throat, cough and hoarseness; this difference was significant between the green tea group and the control, as well as between the licorice group and the control. In fact, both green tea and licorice significantly reduced post-extubation complications, but the difference between the green tea and licorice was not significant for the three variables. Intergroup comparisons of the results showed that in all three groups, the rate of complications decreased during the study stages. Even in the control group, the complications decreased over time. But the reduction rate was greater in the intervention groups than in the control group.

In general, in this study, Licorice and green tea gargle had similar impacts on the decrease of post-extubation complications. A literature search revealed no study which evaluated the effect of Licorice and green tea on reduction of post-extubation complications. However, some studies found in this area separately assessed the effects of the two interventions in different ways, and their results were

consistent with the findings of the present study. Gupta et al. evaluated the effect of Licorice lozenges (intervention group) and sugar candy (control group) after anesthesia on cough, sore throat, and hoarseness of 100 smokers presenting for elective surgery. Licorice lozenges reduced all three variables of sore throat and cough (33). Ruetzler et al. also performed a study on 236 patients with elective thoracic surgery to evaluate the effect of preoperative gargling with Licorice and sugar water. The result showed Licorice group experienced 1.7 times (95% CI, 1.1–2.7) lower coughing (P<0.001) and sore throat score (RR [95% CI]: 0.53 [0.32–0.88] (P = 0.003) compared with sugar water group (34). In the study by Ghaleb et al., gargling 500 mg of Licorice diluted in 30 cc of water five minutes before induction significantly decreased sore throat (P=0.0002) and improved swallowing (P=0.001) (26). Kuriyama and colleagues in a meta-analysis and systematic review evaluated the effect of post-operative topical application of Licorice on sore throat. The results showed that Licorice reduced the prevalence (risk ratio, 0.44; 95% confidence interval (CI), 0.28–0.69; $P < 0.001$) and severity (standardized mean difference, −0.69; 95% CI, −0.96, −0.43; $P < 0.001$) of sore throat (35). According to the study by Ibrahim and Anis, pre-operation Licorice and Ketamine gargling significantly decreased the incidence and severity of postoperative sore throat. However, no significant difference was observed between the ketamine and licorice groups (25). In fact, the substances such as Glycyrrhizin, Liquilitin, and Glabridin in Licorice have anti-inflammatory and wound healing properties (32). In this regard, a systematic study by Wahab et al. in 2021 on the properties and toxicology of licorice root showed that it can effectively treat infections of the throat, tuberculosis and other respiratory diseases, due to the antibacterial, anti-inflammatory and immunosuppressive properties (36).

Only two studies were found regarding the effect of green tea on post-extubation complications. Jafari and colleagues reported that gargling 30 cc green tea after an open-heart surgery reduced sore throat 12 hours (P=0.047) and 24 hours (P<0.001) after the intervention (37). In the study by Liu et al., daily drinking of green tea after a robotic or laparoscopic subtotal gastrectomy reduced post-operative pain and complications on the first four post-operative days (38). In the study by Aryaeefar and colleagues, gargling with green tea solution four times a day after anesthesia by patients undergoing open-heart surgery reduced sore throat 12 hours after the intervention. However, no significant change was observed in the hoarseness variable in three stages (27). The reason for the difference of the study by Aryaeefar with the present study on the variable of hoarseness may be due to the average surgical time in the Aryaeefar's study which was much longer (maximum 10 hours) than the present study (maximum 2 hours), so the patients were intubated for a longer period and had more complications such as hoarseness. Probably, for this reason, green tea intervention cannot reduce hoarseness. In fact, green tea's effect on the decrease of postoperative sore throat is related to its anti-bacterial, anti-inflammatory, and anti-oxidative properties (39). The anti-inflammatory properties of green tea have been confirmed as its effectiveness in healing surgical wounds (40).

One of the strengths of the present study is that it is a triple-blind study and the number of samples is relatively high and there was no sample loss.One of the limitation of this study is the short duration of the study for evaluation of the variables due to the limitation of the researcher's presence in the study's environment. It is recommended that in future studies, the variables be evaluated for a longer period (eg. the day after the intervention). It is also suggested that further studies be carried out to compare the effect of green tea and Licorice with pharmacological treatments.

Implications for practice

Gargling with green tea or licorice solutions after endotracheal tube extubation can effectively reduce unpleasant post-extubation complications such as sore throat, cough, and hoarseness. Therefore, it is recommended to use this simple, inexpensive and low-risk intervention.

Acknowledgments

This study was extracted from a research project in Nursing with registration code 998981 on 13 Jul 2019. The study protocol was approved by the Ethics Committee of Aja University of Medical Sciences, Tehran, Iran with code: (IR.AJAUMS.REC.1398.216), and it was then registered at the Iranian Registry of Clinical Trials (ID: IRCT20190729044373N1). The study was sponsored by the Deputy of Research and Technology of Aja University of Medical Sciences. We would like to thank all the people who helped us in performing this project.

Conflicts of interest
The authors declared no conflicts of interest.

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