BMJ Open

Development of a nomogram for prediction of postoperative sore throat in patients under general anaesthesia: a single-centre, prospective, observational study

Jingjing Jiang,[1,2] Zhonghan Wang,[1,2] Qiancheng Xu,[1,2] Qun Chen,[1,2] Weihua Lu [1,2]

To cite: Jiang J, Wang Z, Xu Q, *et al*. Development of a nomogram for prediction of postoperative sore throat in patients under general anaesthesia: a single-centre, prospective, observational study. *BMJ Open* 2022;**12**:e059084. doi:10.1136/bmjopen-2021-059084

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-059084).

Received 10 November 2021
Accepted 05 April 2022

[1]Department of Critical Care Medicine, The First Affiliated Hospital of Wannan Medical College (Yijishan Hospital of Wannan Medical College), Wuhu, Anhui
[2]Anhui Province Clinical Research Center for Critical Respiratory Medicine, Wuhu, Anhui

Correspondence to
Weihua Lu; lwh683@126.com

ABSTRACT

Objectives Postoperative sore throat (POST) is very common in patients under general anaesthesia. However, there is no effective clinical predictive model for reducing its occurrence. The objective of this study was to estimate the risk factors for POST in patients after general anaesthesia by designing a nomogram.

Design A prospective study.

Setting This study was conducted in a large tertiary hospital.

Participants Patients aged 18–85 years old who received general anaesthesia with either an endotracheal tube or supraglottic airway and of American Society of Anesthesiologists classification level I–III.

Results A total of 442 patients were enrolled in this study, with a POST incidence of 44.1%. The results showed that younger age (≤55 years), surgical site (head and neck surgery), duration of anaesthesia (≥4 hours) and history of chronic pharyngitis were independent risk factors for POST in general anaesthesia patients. Receiver operating characteristic (ROC) curves and calibration curves were used to evaluate the nomogram. The area under the ROC curve was 0.784 and the C-index was 0.779.

Conclusion A nomogram combining age, surgical site, duration of anaesthesia and history of chronic pharyngitis is potentially useful in predicting POST under general anaesthesia.

Trial registration number ChiCTR-ROC-17013258; Post-results.

Strengths and limitations of this study

- ⇒ The study design for the development of our nomogram was highly targeted to patients with postoperative sore throat (POST).
- ⇒ The score on the nomogram for predicting the development of POST is easy to calculate.
- ⇒ The area under the receiver operating characteristic curve and a calibration curve were created and a decision curve analysis was performed to evaluate the performance of this novel nomogram model in both the primary cohort and a validation cohort.
- ⇒ The number of cases in our study was small and a larger number of participants would be better.
- ⇒ This is a single-centre study without external validation, which is required before the model can be applied.

INTRODUCTION

Postoperative sore throat (POST) is a common complication of general anaesthesia. Although POST is less harmful than other complications, it reduces patients' postoperative hospitalisation comfort and prolongs hospital stay. It is considered an unsatisfactory postoperative complication in patients, with an incidence as high as 62%.[1]

In a large prospective cohort study (n=12 276) evaluating postoperative complaints, the incidence of POST after general anaesthesia was second only to postoperative nausea and vomiting.[2] POST is thought to be caused by laryngoscopy, injury during intubation or compression of the tracheal mucosa by cuff inflation.[3] It is important to note that severe POST may cause difficulty in breathing and swallowing. Research has shown that the occurrence of POST is related to several factors. Independent risk factors for POST include large endotracheal tubes (ETTs), age, female sex, long duration of anaesthesia and airway trauma. Intubation lasting longer than 90 min yielded a higher likelihood (OR=1.27) of POST.[4] Various non-pharmacological measures (supraglottic ventilation devices, smaller tracheal tubes, limited cuff pressure and good muscle relaxation) and pharmacological measures (lidocaine, dexamethasone and non-steroidal anti-inflammatory drugs) have been used to prevent or reduce the incidence of this complication.[5]

Accordingly, POST can be delayed or reduced through a series of interventions. However, these require preoperative prediction or early intervention in patients under general anaesthesia. This study aimed to develop a simple predictive model for POST. We further evaluated the model's predictive value in the development of POST.

METHODS

Patient population

Before recruitment, the trial was registered with the Chinese Clinical Trial Registry website (registration date: 6 November 2017). There were no protocol changes after trial commencement. Written informed consent was obtained before patient enrolment.

In this study, we prospectively collected data from 442 consecutive patients who were treated and received general anaesthesia at Yijishan Hospital of Wannan Medical College between June 2020 and March 2021. The inclusion criteria were as follows: (1) patients aged 18–85 years old who received general anaesthesia with either an ETT or supraglottic airway; and (2) American Society of Anesthesiologists classification level I–III. The exclusion criteria were as follows: (1) patients with an inability to communicate or with impaired cognitive function; (2) patients with preoperative upper respiratory tract infection or acute onset of chronic pharyngitis; and (3) patients in whom relevant clinical data were incomplete. Some patients were discharged at follow-up. Outpatient surgery and patients discharged for less than 24 hours were also excluded. Patients were asked if they had any sore throat symptoms 12–24 hours after extubation or after pulling out the laryngeal mask.

The POST questionnaire was used to evaluate the patients, with a score of 1–5 indicating POST and a score of 0 without POST. Severity was scored using the following criteria: 0, the patient reported no pain at all; 1, the patient complained of dryness and discomfort in the oropharynx; 2, the patient complained of sore throat without voice change; 3, the patient complained of sore throat and mild hoarseness; 4, the patient complained of obvious sore throat accompanied by hoarseness and other serious changes; and 5, the patient was unable to speak. All patients with pain scores of 1–5 were categorised into the POST group.

Survey and measurements

Baseline clinical data were derived from medical and follow-up records and included age, sex, body mass index (BMI), thyromental distance (TMD; with the neck fully extended, the distance from the thyroid notch to the chin projection was measured with a tape measure), position during surgery (including supine or non-supine position, with the latter including prone and lateral positions), surgical site (head and neck surgery (HNS) or non-head and neck surgery (NHNS), with the patients divided into the HNS group and the NHNS group), duration of anaesthesia (<4 hours or ≥4 hours), airway management (laryngeal mask or ETT), use of lidocaine cream (lidocaine cream or paraffin oil was used for tube lubrication), use of dexamethasone (prophylactic use of 10 mg within 10 min after intubation), history of smoking, history of chronic pharyngitis (patients with pre-existing sore throat were excluded, which means patients who currently have a sore throat were excluded from the entire study; 'history of chronic pharyngitis' means frequent pharyngitis but not currently active), postoperative analgesia (various medications including analgesics and antiemetics) and placement of a gastric drainage tube. The clinical variables associated with POST were assessed a priori based on clinical importance, scientific knowledge and predictors identified in previously published articles.[6–8]

Statistical analysis

Statistical analysis was performed using SPSS V.23.0. Continuous variables with a normal distribution were presented as mean±SD. Analysis was carried out using Student's t-test. Percentages were calculated for categorical variables and the χ^2 test was used for these analyses. Logistic regression analyses were performed to identify the risk factors associated with POST, the OR and 95% CI were calculated, and a nomogram model was established based on the selected risk factors. The predictive ability and model compliance were evaluated using C-index and calibration curves. Decision curve analysis (DCA) was performed to evaluate the clinical value of the model. R V.4.0.4 software (http://www.r-project.org) was used to generate the nomogram and DCA curves. A two-sided p value <0.5 was considered statistically significant in all statistical analyses.

Patient and public involvement

POST is a common complication of general anaesthesia and can be reduced through interventions. Our anaesthesiologists were often asked about how POST can be prevented. To answer this question, our team proposed to build a model and further evaluate its predictive value in the development of POST. Participants were not paid for their involvement but provided written consent. Patients were not actively involved in the development of the research question but participated in guided interviews, which were conducted to generate items for the survey instrument. The findings of this research suggest that some risk factors can be collected to build a model.

RESULTS

Basic data and univariate analysis

A total of 442 patients were enrolled in this study (figure 1), with a POST incidence of 44.1% (195 of 442). Of the enrolled patients, 253 were women and 189 were men. After univariate logistic regression analysis of patients' clinical data, the following factors were found to be significantly related to POST (p<0.1; table 1): TMD, surgical site, age, position during surgery, duration of anaesthesia, airway management, history of chronic

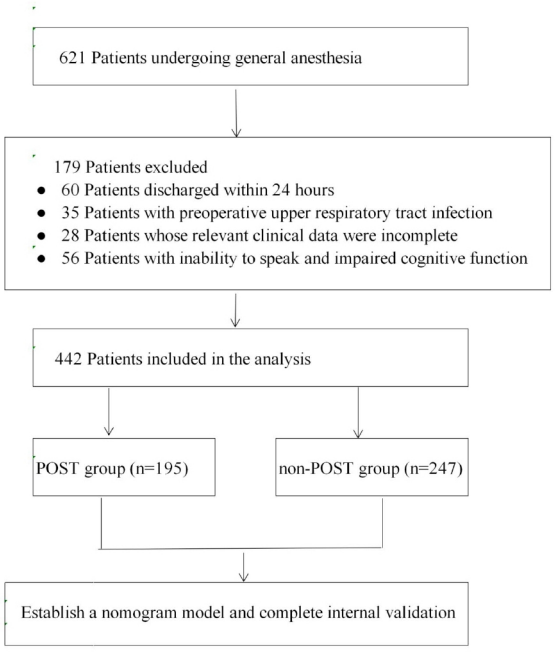

Figure 1 Flow diagram of patients. POST, postoperative sore throat.

pharyngitis, non-administration of dexamethasone, postoperative analgesia and placement of a gastric drainage tube (if the patient had an orogastric or a nasogastric tube placed intraoperatively but removed before emergence from anaesthesia, they were not considered part of this group). No significant relationship with the occurrence of POST was found for sex, BMI, history of smoking or lidocaine cream (p>0.1).

Multivariate logistic regression analysis

The incidence of POST under general anaesthesia was used as the dependent variable. Fourteen variables with statistical significance in the univariate logistic analysis and seven variables reported in other types of literature were used as the independent variables in the multivariate logistic regression analysis. The logistic model screened out four independent risk factors for the occurrence of POST under general anaesthesia. Age ≤55 years (OR=1.66; 95% CI 1.05 to 2.63), surgical site of HNS (OR=2.42; 95% CI 1.18 to 4.94), duration of anaesthesia ≥4 hours (OR=2.26; 95% CI 1.51 to 3.39) and history of chronic pharyngitis (OR=2.01; 95% CI 1.19 to 3.41) were the four independent risk factors for POST in general anaesthesia patients (table 2).

Performance assessment of the nomogram

The risk factors selected by the multivariate logistic regression were used in the nomogram model. All variables that were significantly associated with POST on logistic regression were included in the nomogram (figure 2). Factors with higher coefficient values had greater predictive value in the model.

The nomogram is a graphic depiction of the model in which points are assigned based on the rank order of the effect estimates. Factors assigned the highest number of points included age, surgical site, duration of intubation and history of chronic pharyngitis. According to the nomogram, For example, in a 30-year-old patient who is undergoing colon cancer surgery, without a history of chronic pharyngitis and with the duration of anaesthesia reaching 4.5 hours, the total points on the nomogram would be 155 points and the incidence of POST nears 63%; in our trial, we can reduce the incidence by giving dexamethasone.

Consequently, non-administration of dexamethasone had the highest coefficient value and was the most important factor among all the selected risk factors. The risk of POST in patients can be calculated using the nomogram.

After 1000 bootstrap self-sampling internal validations, the C-index value of the nomogram model was 0.779. The calibration curve is shown in figure 3 and showed excellent agreement between the prediction of POST and the actual probability of POST. Therefore, the prediction curve and the actual curve were consistent and the model was demonstrated to be in agreement with the actual probability of POST.

Clinical value of the nomogram model

Receiver operating characteristic (ROC) curves and calibration curves were used to evaluate the nomogram model. The area under the ROC curve was 0.784 (95% CI 0.74 to 0.83), indicating moderate discrimination (figure 4A).

DCA was used to evaluate the clinical application value of the nomogram model (figure 4B). Within a reliable range of the probability threshold, the net benefit of the prediction model was significantly higher than that of the extreme curve. The DCA indicated that when the predicted probability was between 0.1 and 0.8, the nomogram model had good clinical applicability in predicting POST.

DISCUSSION

This study prospectively analysed the occurrence of POST in patients after general anaesthesia and showed a POST incidence of 47.6%. A prospective study of 809 patients demonstrated an incidence of 40%,[9] which is similar to the results of our study.

Univariate and multivariate logistic regression analyses showed that age (younger), surgical site (HNS), duration of anaesthesia (≥4 hours) and history of chronic pharyngitis were independent risk factors for POST. A clinical nomogram for POST, called the ASDH nomogram model, was built (ASDH: age, surgical site, duration of anaesthesia (≥4 hours) and history of chronic pharyngitis) and validated by calibration curve and ROC curve analyses. In a recent systematic review of POST, younger age, pre-existing lung disease and prolonged duration of anaesthesia were identified as risk factors for POST, consistent with the results of our study.[1] Dexamethasone

Table 1 Univariate analysis of the characteristics related to POST

Variable		Non-POST (n=247)	POST (n=195)	t/χ^2	P value
TMD (cm), x±SD		7.86±0.95	7.61±0.93	2.741	0.006
Age (years), n (%)	≤55	122 (49.4)	123 (63.1)	8.260	0.004
	>55	125 (50.6)	72 (36.9)		
Gender, n (%)	Male	114 (46.2)	75 (38.5)	2.634	0.105
	Female	133 (53.8)	120 (61.5)		
BMI (kg/m^2), n (%)	≤25	174 (70.4)	129 (66.2)	0.931	0.335
	>25	73 (29.6)	66 (33.8)		
Surgical site, n (%)	HNS	42 (17.0)	65 (33.3)	15.837	0.000
	NHNS	205 (83.0)	130 (66.7)		
Position, n (%)	Supine	172 (69.6)	154 (79.0)	4.910	0.027
	Non-supine	75 (30.4)	41 (21.0)		
Duration of anaesthesia (hours), n (%)	<4	221 (89.5)	154 (79.0)	9.341	0.002
	≥4	26 (10.5)	41 (21.0)		
Airway management, n (%)	Laryngeal mask	124 (50.2)	76 (39.0)	5.545	0.019
	ETT	123 (49.8)	119 (61.0)		
History of smoking, n (%)	Yes	81 (32.8)	56 (28.7)	0.846	0.358
	No	166 (67.2)	139 (71.3)		
History of chronic pharyngitis, n (%)	Yes	45 (18.2)	59 (30.3)	8.776	0.003
	No	202 (81.8)	136 (69.7)		
Lidocaine cream, n (%)	Yes	126 (51.0)	113 (57.9)	2.111	0.146
	No	121 (49.0)	82 (42.1)		
Dexamethasone, n (%)	Yes	147 (59.5)	37 (19.0)	73.702	0.000
	No	100 (40.5)	158 (81.0)		
Stomach tube, n (%)	Yes	14 (5.7)	20 (10.3)	3.231	0.072
	No	233 (94.3)	175 (89.7)		
Postoperative analgesia, n (%)	Yes	149 (60.3)	100 (51.3)	3.622	0.057
	No	98 (39.7)	95 (48.7)		

BMI, body mass index; ETT, endotracheal tube; HNS, head and neck surgery; NHNS, non-head and neck surgery; POST, postoperative sore throat; TMD, thyromental distance.

is a long-acting adrenocortical hormone that has anti-inflammatory, antiallergic and antishock effects and is widely used in clinical practice. A single dose has minimal side effects and may reduce the incidence of POST during the recovery process. This mechanism likely involves alleviation of the inflammatory process caused by tissue injury.[10] Two previous meta-analyses have demonstrated that intravenous dexamethasone administration

Table 2 Independent predictors of POST derived from the multivariate regression analysis

Risk factors	β coefficient	SE	Wald value	OR	95% CI	P value
Age (≤55 years)	0.51	0.24	4.62	1.66	1.05 to 2.63	0.032
Surgical site (head and neck surgery)	0.88	0.36	5.88	2.42	1.18 to 4.94	0.015
Duration of anaesthesia (≥4 hours)	1.080	0.22	24.28	2.26	1.51 to 3.39	0.009
History of chronic pharyngitis	0.70	0.27	6.77	2.01	1.19 to 3.41	0.009

POST, postoperative sore throat.

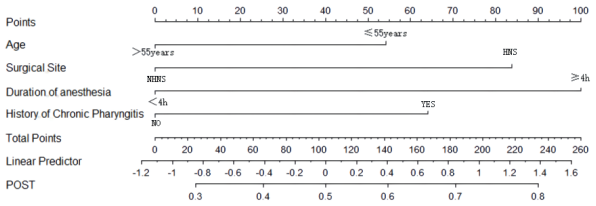

Figure 2 Nomogram model chart of the prognostic factors selected by the multivariate logistic regression. HNS, head and neck surgery; NHNS, non-head and neck surgery; POST, postoperative sore throat.

is effective in reducing the incidence of POST.[10 11] In a randomised controlled trial, dexamethasone, with or without lidocaine, was effective in reducing the incidence of POST in patients requiring prolonged tracheal intubation.[4] Singh *et al*[5] also found that corticosteroids were among the three topical agents most closely associated with reduction of POST. In our study, the lack of dexamethasone use (OR=5.71) was shown to be a significant risk factor for POST. We speculate that dexamethasone can effectively reduce the incidence of POST.

Most studies reported that a long duration of anaesthesia aggravates the incidence of POST.[1 12] Biro *et al*'s[9] study showed that the severity of POST was significantly positively correlated with the duration of anaesthesia. Some studies have indicated that when the duration of anaesthesia is >4 hours, the cellulose in the tracheal cavity exudes will be exuded, and mucosal necrosis and shedding, submucosal congestion and oedema, and inflammatory material exudation will occur. Other studies have shown that intubation can cause extensive damage to the larynx and airway epithelium, even if the duration of intubation is only 1 hour.[12] Previous studies have not found any correlation between smoking and POST, although these

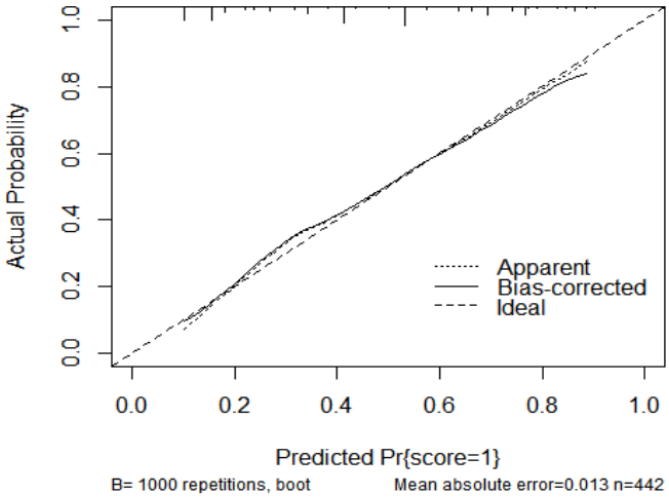

Figure 3 Calibration curve of the nomogram model. The diagonal dotted line represents the ideal curve, the solid line represents the bias correction curve and the dashed line represents the apparent curve.

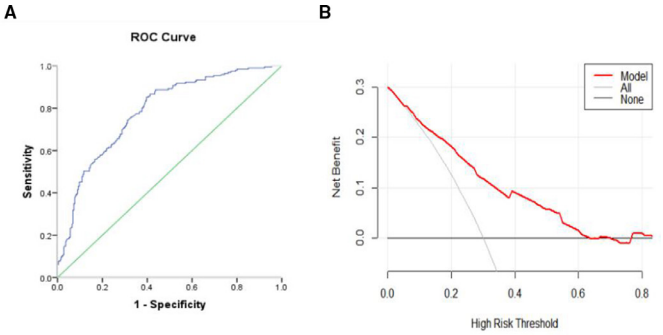

Figure 4 (A) ROC curve of the model. The area under the ROC curve was 0.784 (95% CI 0.74 to 0.83). (B) Decision curve of the nomogram model. The grey line represents the assumption that all patients experienced POST. The black line represents the assumption that no patients experienced POST. The red line represents the risk nomogram. POST, postoperative sore throat; ROC, receiver operating characteristic.

studies were based on small sample sizes (n<200).[13 14] The result is consistent with the findings of the present study. Biro *et al* found that smoking was increasingly accompanied by a long-lasting sore throat.[9] Additionally, surgical site in the oral or nasal cavity or near the neck is an independent risk factor for POST.[15] The incidence of POST was significantly higher in patients undergoing HNS, such as thyroid surgery, than in patients undergoing surgery at other sites,[16] which may be related to the positioning of the thyroid mass during surgery, movement of the tracheal tube during the operation and the increase in cuff pressure during the procedure.

The results of the studies were inconsistent with regard to the influence of age on POST. Most of the current studies report that younger people are more likely to experience POST,[17] while other studies have suggested that older people are more likely to experience POST.[18 19] Some studies have concluded that there is no significant difference with respect to age.[20 21] In our study, the incidence of POST was higher in younger patients. Simultaneously, a history of chronic pharyngitis may have induced a higher incidence of POST. Lee *et al*[22] found that lidocaine cream increased the incidence of POST in 208 patients who underwent general anaesthesia, possibly because it was directly in contact with the airway and its infection-preventing additives stimulated the upper respiratory tract of the patients, causing discomfort. In a meta-analysis of the effect of lidocaine on POST, intracapsular and intravenous injection of lidocaine significantly alleviated the occurrence of POST within 24 hours after surgery, while lidocaine cream and spray had no significant effect.[23] Higher-quality evidence in the literature also supports this view.

Our study has several limitations. First, the results of this study are less reliable than those of multicentre studies. Second, only internal validation was performed in our study and future studies should include more patients for external validation. Third, factors that affect POST

such as cuff pressure, use of tracheal intubation without neuromuscular blockade and whether bleeding occurred during extubation were not included in the study. In future studies, a larger sample size would provide more indicators for analysis.

CONCLUSION

In this study, age (younger), surgical site (HNS), duration of anaesthesia (≥4 hours) and history of chronic pharyngitis were independent risk factors for POST, while use of dexamethasone was a protective factor. The nomogram model can guide clinical prediction of POST, but requires external validation before clinical application.

Acknowledgements We would like to thank the colleagues and staff of the Critical Care Unit at the Affiliated Hospital of Yijishan Hospital of Wannan Medical College for their assistance with the study.

Contributors JJ and WL designed this study and protocol development; QX and WL were responsible for procedure implementation; JJ and ZW were responsible for the data collection and data analysis; JJ conducted the manuscript writing; QX and WL critically revised the manuscript; WL provided final approval for this version to be published; All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding This study was supported by the Anhui Provincial Special Project of Central Government Guiding Local Science and Technology Development of China (201907d07050001), funding from the 'Peak' Training Program for Scientific Research of Yijishan Hospital, Wannan Medical College (GF2019J03, GF2019G08), and the Anhui Provincial Natural Science Foundation (2108085MH300).

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not required.

Ethics approval This study involves human participants and was approved by the Ethical Committee of the Affiliated Hospital of Yijishan Hospital of Wannan Medical College, Wuhu, China (Chairperson Professor Pei Wu; 2013-91) on 7 September 2019. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information. All data generated or analyzed during this study are included in this published article. Available upon request.

ORCID iD

Weihua Lu http://orcid.org/0000-0001-5372-0130

REFERENCES

1 El-Boghdadly K, Bailey CR, Wiles MD. Postoperative sore throat: a systematic review. *Anaesthesia* 2016;71:706–17.
2 Lehmann M, Monte K, Barach P, *et al*. Postoperative patient complaints: a prospective interview study of 12,276 patients. *J Clin Anesth* 2010;22:13–21.
3 Huang Y-S, Hung N-K, Lee M-S, *et al*. The effectiveness of benzydamine hydrochloride spraying on the endotracheal tube cuff or oral mucosa for postoperative sore throat. *[J] Anesth Analg* 2010;111:887–91.
4 Subedi A, Tripathi M, Pokharel K, *et al*. Effect of intravenous lidocaine, dexamethasone, and their combination on postoperative sore throat. *Anesthesia & Analgesia* 2019;129:220–5.
5 Singh NP, Makkar JK, Cappellani RB, *et al*. Efficacy of topical agents for prevention of postoperative sore throat after single lumen tracheal intubation: a Bayesian network meta-analysis. *Can J Anesth/J Can Anesth* 2020;67:1624–42.
6 Yang SS, Wang N-N, Postonogova T, Tatyana P, *et al*. Intravenous lidocaine to prevent postoperative airway complications in adults: a systematic review and meta-analysis. *Br J Anaesth* 2020;124:314–23.
7 Kuriyama A, Maeda H, Sun R, *et al*. Topical application of corticosteroids to tracheal tubes to prevent postoperative sore throat in adults undergoing tracheal intubation: a systematic review and meta-analysis. *Anaesthesia* 2018;73:1546–56.
8 McCarthy DT. Postoperative sore throat: a multifactorial problem. *Br J Anaesth* 2012;108:1037–8.
9 Biro P, Seifert B, Pasch T. Complaints of sore throat after tracheal intubation: a prospective evaluation. *Eur J Anaesthesiol* 2005;22:307–11.
10 Sun L, Guo R, Sun L. Dexamethasone for preventing postoperative sore throat: a meta-analysis of randomized controlled trials. *Ir J Med Sci* 2014;183:593–600.
11 Zhao X, Cao X, Li Q. Dexamethasone for the prevention of postoperative sore throat: a systematic review and meta-analysis. *J Clin Anesth* 2015;27:45–50.
12 McHardy FE, Chung F. Postoperative sore throat: cause, prevention and treatment. *Anaesthesia* 1999;54:444–53.
13 Kloub R. Sore throat following tracheal intubation. *Middle East J Anaesthesiol* 2001;16:29–40.
14 Rieger A, Brunne B, Hass I, *et al*. Laryngo-Pharyngeal complaints following laryngeal mask airway and endotracheal intubation. *J Clin Anesth* 1997;9:42–7.
15 Chen K-T, Tzeng J-I, Lu C-L, *et al*. Risk factors associated with postoperative sore throat after tracheal intubation: an evaluation in the postanesthetic recovery room. *Acta Anaesthesiol Taiwan* 2004;42:3–8.
16 Hisham AN, Roshilla H, Amri N, *et al*. Post-Thyroidectomy sore throat following endotracheal intubation. *ANZ J Surg* 2001;71:669–71.
17 Higgins PP, Chung F, Mezei G. Postoperative sore throat after ambulatory surgery. *Br J Anaesth* 2002;88:582–4.
18 Shrestha S, Maharjan B, Karmacharya RM. Incidence and associated risk factors of postoperative sore throat in tertiary care hospital. *Kathmandu Univ Med J* 2017;15:10–13.
19 Minamiguchi M, Tanaka Y, Kitagawa K, *et al*. [Evaluation of factors associated with postoperative sore throat]. *Masui* 2014;63:401–5.
20 Tazeh-kand NF, Eslami B, Mohammadian K. Inhaled fluticasone propionate reduces postoperative sore throat, cough, and hoarseness. *[J] Anesth Analg* 2010;111:895–8.
21 Ogata J, Minami K, Horishita T, *et al*. Gargling with sodium azulene sulfonate reduces the postoperative sore throat after intubation of the trachea. *Anesthesia & Analgesia* 2005;101:290–3. table of contents.
22 Lee J, Lee Y-C, Son J-D, *et al*. The effect of lidocaine jelly on a taper-shaped cuff of an endotracheal tube on the postoperative sore throat: a prospective randomized study: a consort compliant article. *Medicine* 2017;96:e8094.
23 Li H, Yue Y, Qu Y, *et al*. Lidocaine for postoperative sore throat: a meta-analysis of randomized controlled trials. *Minerva Anestesiol* 2020;86:546–53.