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Review

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A Literature Review of Factors Related to Postoperative Sore Throat

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Abstract

Postoperative sore throat can occur as a complication in patients who have undergone surgery under general anesthesia. The incidence of postoperative sore throat ranges from 12.1% to 70%, and its effects include damage to the epithelium and mucosal cells caused by airway securement, damage to the vocal cords, congestion, blood clots, and factors such as an inappropriately large tube, cuff shape, cuff pressure, and airway securement. Notably, there are individual differences in pain thresholds, and the sensation of pain is affected by mental states, such as anxiety, and varies from person to person. Therefore, we conducted a literature review using PubMed to clarify patient factors related to the development of postoperative sore throat. The extracted keywords were "postoperative sore throat," "anesthesia," and "patient factors." We found 16 articles that met our search criteria. We expanded the search period and retrieved 19 cases from 1990 to 2020. We also included references that were judged to be closely related to the list of citations of the retrieved references. The study designs included were randomized controlled trials, clinical trials, meta-analyses, reviews, and systematic reviews. The results showed that female sex, smoking, and age were the most common patient factors. However, we could not find any literature that studied the relationship between postoperative sore throat and mental states such as anxiety.

Keywords: Postoperative sore throat; Anesthesia; Patient factors

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Introduction

Postoperative sore throat (POST) is one of the most common postoperative complications. The incidence of POST ranges from 12.1% to 70% [1-3]. POST has been shown to decrease postanesthesia recovery and inpatient satisfaction [4]. In addition, POST can cause aspiration pneumonia [5-7]. The mechanisms of POST include damage to the epithelium and mucosal cells due to airway secretion, damage to the vocal cords, and congestive blood loss [8]. In recent years, research has been conducted on the factors that cause POST; and it has been reported that the shape of intubation tubes [6, 9], cuffs size [10], endotracheal intubation technique [8], cuff pressure [11, 12], and use of inhalation anesthesia [13] are among such factors. In addition, the efficacy of topical dexamethasone [7] and magnesium [14] as POST prophylaxis, as well as the ineffectiveness of lidocaine spray [15, 16], have been demonstrated. Complications were scored preoperatively to predict postoperative complications. For example, for postoperative nausea and vomiting (PONV), Apfel et al [17] scored the preoperative risk. However, no study has scored the preoperative risk factors for POST. Notably, pain as a sensation is related to attributes such as time, space, pressure, and temperature, and the emotional nature of pain as a sensation, including tension and fear, has been described. Furthermore, when confronted with pain, if we want to evaluate the organic cause of the pain, we must exclude pain as an emotion to evaluate it; however, if the pain is strong despite little organic damage, we may have to focus on pain as an emotion. In pain assessment, it is often useful to divide pain into sensory and emotional pain. Therefore, we focused on the tension and anxiety of patients in response to POST and reviewed the literature to determine whether POST has an emotional nature, but we could not find any relevant studies [18]. Therefore, in this study, we aimed to systematically collect and integrate information through a review to clarify the patient factors associated with POST.

Research Methods

Literature review methods

We searched PubMed for articles on patient factors associated with POST. For PubMed, the literature extraction period was

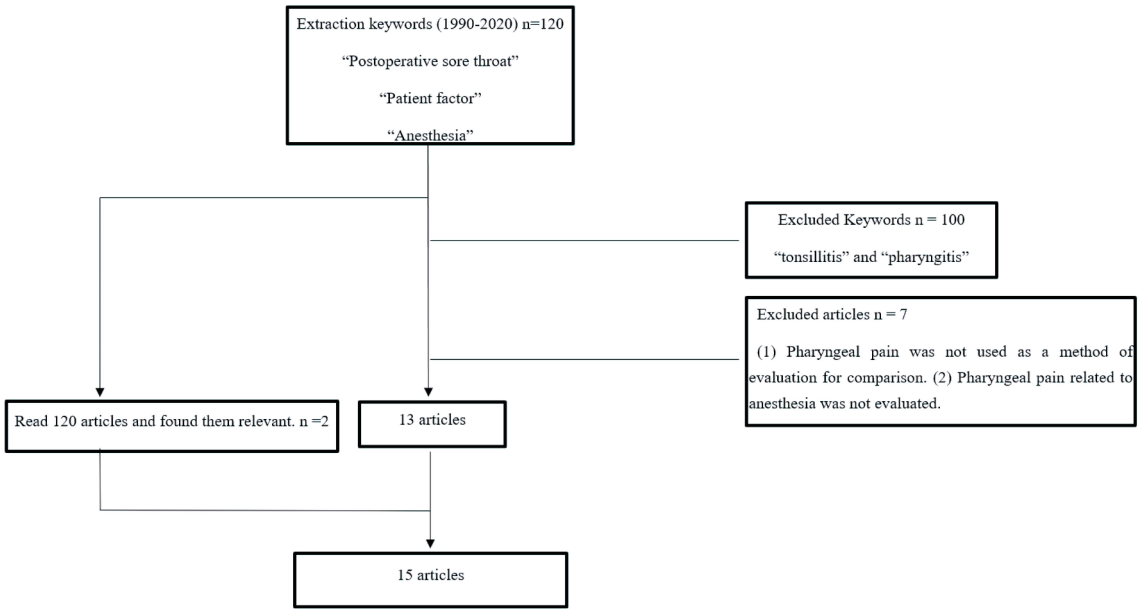

Figure 1. Flowchart of literature review.

2010 - 2020, and the extraction keywords were "postoperative sore throat," "anesthesia," and "patient factors." We excluded patients with "tonsillitis" and "pharyngitis" from our search. We expanded the search period and retrieved 19 cases from April 1990 to March 2020. Because there were not enough papers and cases, we also included references that were judged to be closely related to the list of citations of the retrieved references. The study designs included were randomized controlled trials (RCTs), clinical trials, meta-analyses, reviews, and systematic reviews.

Literature review methods

The titles and abstracts were reviewed to determine if they described sore throat as a complication of surgical anesthesia. Finally, 15 articles that met the following criteria were selected for analysis: 1) studies investigating factors associated with PONV; and 2) those in which pharyngeal pain related to anesthesia was evaluated.

Results

Literature analysis

A total of 120 articles were identified using the keyword search. Of these, 20 were RCTs, clinical trials, meta-analyses, reviews, and systematic reviews with human subjects in the study design. Then, seven articles were excluded based on the exclusion criteria, leaving 13 articles that met all the criteria. Finally, two hand-searched articles were added to create a total of 15 articles in this study (Fig. 1). The common patient characteristics in the literature were American Society of Anesthesiologists (ASA) grades I - III in adults, height, weight, and sex. There were 10 device factors for securing the airway, and five of them had significant differences in sore throat. Among them, "tube insertion time" was extracted as a factor in four articles. Among the articles that showed significant factors associated with a sore throat, "age" was extracted as a factor in two articles, and "female" and "smoking history" were also extracted in two articles (Table 1 [2, 19-32]).

Relationship between anesthesia techniques and POST

Regarding the relationship between anesthesia technique and POST, the incidence of POST associated with different types of airway management tubes, cuff pressures, and cuff contents has been reported. In nine articles, the incidence of POST was associated with different types of airway management tubes. Depending on the type of airway management tube, the average time to successful airway clearance ranged from 12 to 60 s, and the incidence of POST ranged from 6.8% to 50% [19-26, 33] (Table 2 [19-24, 30]). Two articles examined the incidence of POST associated with differences in cuff pressure and cuff contents (Table 3) [27, 28].

Association between POST and characteristics of patients undergoing surgery

Regarding the relationship between POST and characteristics of patients undergoing surgery, the incidence of POST according to sex and age, according to the ASA preoperative status classification (ASA physical status), and due to previous respiratory disease and smoking have been reported. Biro et al [29] evaluated the incidence of POST by using a visual analog scale at 12 to 24 h postoperatively and found that 40% of the patients had

Table 1. Studies Included in the Analysis

Author	Number of patients	Comparison groups (POST incidence rate, median)	Results
Shariffuddin et al, 2017 [24]	147 patients	Ambu®AuraGain™ (10%)	There was a significant reduction in the incidence of POST in the Ambu®AuraGain™ group
	ASA-PS = I - III	LMA Supreme™ (38%)	
Tan et al, 2005 [20]	135 patients	LMA Classic™ (41%)	SoftSeal™ group had the highest incidence of mucosal trauma; LMAUnique™ group had the lowest incidence of POST
	ASA-PS = I - II	LMA Unique™ (14%)	
		SoftSeal™ (42%)	
Teoh et al, 2009 [30]	140 patients	Pentax AWS (0%)	Mucosal bleeding, lip bleeding, and POST were significantly more common in the Glidescope group.
	ASA-PS = I - II	Glidescope (18.6%)	
Bein et al, 2004 [21]	80 patients	ILM (3, 0 - 6)	The incidences of POST and hoarseness were lower in the Bonfils group.
	ASA-PS = I - III	Bonfils (0, 0 - 4)	
Chen et al, 2014 [19]	144 patients	FAST (21.2%)	The incidence of POST was higher in the FAST group.
	ASA-PS = I - II	IT (6.8%)	
Higgins et al, 2002 [2]	5,264 patients	ETT (45.5%)	Age, gender, ASA, BMI, duration of surgery, type of airway management, and surgical technique were factors.
	ASA-PS = I - III	LMA (17.5%)	
		FM (3.3%)	
		Women: men = 13.4%: 9.1%	
Biro et al, 2005 [29]	809 patients	POST occurrence (40%)	Female, history of smoking or lung disease, anesthesia for prolonged denture, PONV, and bloodstains on the intubation tube were related factors.
		No POST occurrence (60%)	
Jaensson et al, 2014 [25]	297 patients	ETT (32%)	ETT had a higher incidence of POST than LMA; there was no significant difference in the incidence of POST between ETT and LAM.
	ASA-PS = I - III	LMA (19%)	
Griffiths et al, 2013 [26]	102 patients	ETT (32.7%)	There was no significant difference in POST occurrence between the two groups.
	ASA-PS = I - II	LMA ProSeal (23.5%)	
Amini et al, 2007 [27]	100 patients	RLT (8 patients)	Cuff pressure at the end of surgery was significantly lower in the DLT group.
	ASA-PS = I - II	DLT (12 patients)	There was no significant difference in POST occurrence between the two groups.
Andrews et al, 2009 [22]	90 patients	Cobra PLA™ (17 patients)	Insertion time was longer in Cobra PLA.
	ASA-PS = I - IV	LMA (8 patients)	There was no significant difference in POST occurrence between the two groups.
Kihara et al, 2000 [23]	120 patients	ILM-BL (5%)	There was no difference in POST incidence and severity or hoarseness in the two groups.
	ASA-PS = I - II	ILM-LW (6.6%)	
Bennett et al, 2000 [28]	126 patients	Contents of the cuff	There was no significant difference in the occurrence of POST.
	ASA-PS = I - II	Air (15.6%)	There was no significant difference between intubation time and cuff pressure and the occurrence of POST.
		Saline solution (14.5%)	Gastric tube insertion was a confounding factor in the occurrence of POST.
Lomax et al, 2011 [31]	110 patients	GlideRite® (2: 0 - 3)	There was no significant difference in the incidence of POST.
	ASA-PS = I - II	Pre-rotated RAE™ (2: 0 - 5)	
Schaefer et al, 1994 [32]	100 patients	Laryngoscopic (16%)	There was no significant difference in complications between the two groups.
	ASA-PS = I - II	Fiber optic (14%)	

POST: postoperative sore throat; ASA-PS: American Society of Anesthesiologists physical status; LMA: laryngeal mask airway; AWS: airway scope; ILM: intubating laryngeal mask; FAST: Foley Airway Stylet Tool; IT: introducer tool; ETT: endotracheal tube; FM: facemask; RLT: reusable laryngeal tube; DLT: disposable laryngeal tube; PLA: Cobra perilaryngeal airway; LM-BL: blind intubation through the intubating laryngeal mask; ILM-LW: light wand-guided intubation through the intubating laryngeal mask; RAE: right angle endotracheal; BMI: body mass index; PONV: postoperative nausea and vomiting.

Table 2. Relationship Between Anesthesia Techniques and Postoperative Sore Throat

Author	Time to secure airway	POST occurrence status
Chen et al, 2014 [19]	FAST: 17.1 ± 6.1 s	FAST (21.2%), IT (6.8%)
	IT: 12.6 ± 4.7 s	
Tan et al, 2005 [20]	LMA Classic™: 32.9 s (15 - 65 s)	LMA Classic™ (41%)
	LMA Unique™: 39.6 s (16 - 130 s)	LMA Unique™ (14%)
	SoftSeal™: 49.4 s (13 - 300 s)	SoftSeal™ (42%)
Bein et al, 2004 [21]	Bonfils, mean: 40 s	Bonfils, median: 4 (0 - 4)
	LMA, mean: 28 s	LMA, median: 3 (0 - 6)
Teoh et al, 2009 [30]	Pentax AWS, mean: 18.9 s	Pentax AWS: (0%)
	Glidescope, mean: 27.8 s	Glidescope: (18.6%)
Andrews et al, 2009 [22]	Cobra PLA™: 39 ± 21 s	Cobra PLA™ (17 patients)
	LMA: 27 ± 10 s	LMA: (8 patients)
Kihara et al, 2005 [23]	ILM-BL: 66 s	ILM-BL (5%)
	ILM-LW: 46 s	ILM-LW (6.6%)
Shariffuddin et al, 2017 [24]	Three levels of tube insertion ease (easy, acceptable, and difficult)	Ambu®AuraGain™ (10%)
	Ambu®AuraGain™ (48%:40%:12%)	LMASupreme™ (38%)
	LMASupreme™ (74%:18%:10%)	

POST: postoperative sore throat; FAST: Foley Airway Stylet Tool; IT: introducer tool; LMA: laryngeal mask airway; AWS: airway scope; PLA: Cobra perilaryngeal airway; ILM-BL: blind intubation through the intubating laryngeal mask; ILM-LW: light wand-guided intubation through the intubating laryngeal mask.

POST. There were significant differences in age, sex, presence of airway or lung disease, smoking history, pharyngeal temperature sensor, PONV, and anesthesia duration. Logistic analysis revealed seven significant factors: female sex, bloodstains on the intubation tube after extubation, use of dentures, history of respiratory disease, young age, PONV, and anesthesia duration. Higgins et al [1, 2] evaluated the incidence of POST in the postanesthesia care unit 24 h postoperatively in the tracheal intubation, laryngeal mask airway (LMA), and facemask (FM) groups. The incidence of POST was higher in the endotracheal tube (ETT) group (45.5%), followed by the LMA group (17.5%) and FM group (3.3%). Predictors of POST included female sex, age (mean 47 years), current smoker status, ASA, and gynecological and ophthalmic surgery (Table 4 [2, 29]).

Discussion

In this study, we reviewed patient factors related to POST. Most of the studies we identified were concerned with devices and anesthesia techniques for securing the airway, but there were also some references to patient factors.

Relationship between anesthesia techniques and POST

The results of the present study reveal that the devices and procedures necessary for securing the airway can cause POST [19-21, 24, 25, 30]. Physical agents such as tubes irritate the airway during intubation and surgery, causing sore throat [34, 35]. The cuff of the tube, dryness of the mucosa, and abrasion of the airway mucosa during intubation, caused by the rubbing of the intubation tube against the airway mucosa, are thought to be the etiological factors of POST. In addition, the damage to the airway mucosa caused by the strong stimulation by the laryngoscope and the movement of the intubation tube excites the C fibers related to secondary pain, and the subsequent release of neurotransmitters is related to POST. El-Boghdadly

Table 3. Relationship Between Cuff Pressure and Postoperative Sore Throat

Author	Cuff pressure	Occurrence of POST
Amini et al, 2007 [27]	LT-R: 55.1 cm H_2O	LT-R (8 patients)
	LT-D: 61.7 cm H_2O	LT-D (12 patients)
Bennett et al, 2000 [28]	The air group: in the air group mean intra-cuff pressure increased significantly (start: 14.0 mm Hg, end: 40.9 mm Hg)	Air (15.6%), saline solution (14.5%)
	The saline solution group: in the saline group there was no significant increase (start: 12.7 mm Hg, end: 14.6 mm Hg).	

POST: postoperative sore throat; LT-R: reusable laryngeal tube; LT-D: disposable laryngeal tube.

Table 4. Predictors of Postoperative Sore Throat

Author	Predictors	OR	95% CI	P value
Higgins et al, 2002 [2]	Age (in 10-year increments)	0.92	0.85 - 0.98	0.05
	Sex, male/female	0.76	0.59 - 0.99	0.05
	ASA-PS III vs. I/II	0.45	0.21 - 0.94	0.05
	Postoperative stay, every 30 min	1.05	1.01 - 1.10	0.05
	Succinylcholine	1.67	1.25 - 2.23	0.0005
	ETT vs. FM	12.4	8.83 - 17.39	0.0001
	LMA vs. FM	5.26	3.79 - 7.29	0.0001
	Ophthalmic surgery	0.58	0.40 - 0.84	0.01
	Gynecologic surgery	1.52	1.14 - 2.03	0.01
Biro et al, 2005 [29]	Female	1.66		0.003
	Bloodstain on intubation tube	4.81		0.001
	Artificial tooth	0.46		0.001
	History of respiratory disease	3.12		0.02
	Young patients (per year)	0.98		0.001
	Anesthesia time	1.27		0.001
	History of PONV	0.29		0.001

POST: postoperative sore throat; ASA-PS: American Society of Anesthesiologists physical status; ETT: endotracheal tube; FM: facemask; LMA: laryngeal mask airway; PONV: postoperative nausea and vomiting; OR: odds ratio; CI: confidence interval.

et al [3] also cited blood contamination of the tube after removal as a risk factor for sore throat. Therefore, we believe that the persistence of physical irritation from intubation to the completion of surgery may cause POST. To address this, we believe that minimizing physical stimulation, for example, choosing a device that takes into account the operative time and intubation as well as extubation techniques, can help prevent the risk of sore throat. The insertion time of the tube was also mentioned as a factor in these studies [19-21, 24, 29]. Hsu et al [36] found that the shorter the time to secure the airway, the lower the incidence of POST in their study using a video laryngoscope to insert a double-lumen endotracheal tube into the correct position. Hence, a short time to airway clearance can minimize the invasion of the airway mucosa [24, 30]. This may have been a factor causing POST in much of the current literature. There was a difference in the incidence of POST depending on the shape and nature of the device used to secure the trachea. However, we were not able to clarify the relationship between the number of risk factors (number of physical stimuli and procedural factors) and the occurrence of POST as well as the severity and duration of POST.

Association between preoperative factors and POST

The patient factors were "smoking history," "female sex," and "age." The relationship between smoking and respiratory diseases has been clarified in many studies [37, 38]. The mechanism is generally known to be inflammation of the bronchi and alveoli and eventual destruction of the alveoli. As reported by Tanaka et al [1] and Piriyapatsom et al [39], POST is thought to be triggered by material stimuli (device factors) to the airways where chronic inflammation occurs, causing abrasion of the airway mucosa and release of neurotransmitters. Pain, on the other hand, is a sensation felt when one's own body is injured and is subjective. Anxiety and psychological stress have been reported to increase pain [40], and the threshold of pain varies from person to person. Feine et al [41] stated that when men and women are given the same pain stimulus, women evaluate the degree of pain more strongly. Lautenbacher et al [42] measured pain tolerance thresholds and found that men tended to have higher thresholds than women. This suggests that "women" became a factor influencing POST by recognizing and expressing POST. However, Jaensson et al [25] did not find any significant difference in the occurrence of POST between men and women, suggesting that POST is more likely to occur when several factors overlap. As for age, "young age" has been cited as a factor associated with POST. The experimental pressure pain detection thresholds showed that the intensity and unpleasantness of the pain stimulus were significantly rated lower in the older than in the younger patient population [43]. After investigating changes in pain perception, Lautenbacher et al [44] also found that aging decreases pain sensitivity and intensity. These findings suggest that age is a factor in POST.

Limitations

In this study, we conducted a literature review to clarify patient factors associated with the occurrence of POST. We found factors related to the anesthesia technique and patients, but these

factors were not independent of each other and worked in combination to cause POST. However, it was not clear how many of these factors worked in combination to cause POST and whether the combination of factors affected the severity and duration of POST. In addition, since pain is related to both sensory and emotional aspects, it was not clear whether the emotional aspect was a factor causing POST or whether it affected the severity and duration. The present review did not find any reports related to POST or emotional factors. Therefore, there is a need for further research on POST and psychological factors.

Conclusions

In this study, we reviewed the literature and examined the factors contributing to POST. Besides the most common patient factors like woman, smoking, and age, this study found that POST may be associated with mental states such as anxiety.

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Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

YY designed the study. KN, TI, and TY participated in data acquisition, extraction, and analysis, and drafted the final work. KK and YB supervised this manuscript's preparation and writing. The authors reviewed the final version of the manuscript and approved it for publication.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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