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Comparison of the incidence and severity of postoperative sore throat and subglottic airway injury with cylindrical versus tapered cuff endotracheal tubes in women undergoing surgery for breast cancer: a randomized controlled trial

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Abstract

Background Postoperative sore throat (POST) is a minor complication of general anesthesia with tracheal intubation but may negatively affect patient satisfaction and postoperative recovery. The shape of the endotracheal tube (ETT) cuff may influence the incidence and severity of POST.

Methods This prospective, randomized, double-blinded study was conducted on 174 female patients with breast cancer. They were randomized into the cylindrical (CYL) (group C) and tapered (TAP) (group T) cuff ETT groups. Data on patient demographics, surgical characteristics, and factors related to tracheal intubation were collected. Furthermore, the incidence and severity of POST at the selected time points were duly recorded for analysis. Other adverse events and anesthesia satisfaction were also documented.

Results During the 48-h evaluation period, group T exhibited reduced overall incidence of POST compared with group C. The incidence and severity of POST at 1, 6, 12, 24, and 48 h postoperatively were also significantly lower in group T than in group C. No significant difference in subglottic airway injury was observed between the two groups. Postoperative anesthesia satisfaction was higher in group T.

Conclusions The present study demonstrates that the utilization of a TAP cuff ETT rather than a CYL cuff ETT in patients undergoing breast cancer surgery reduced the incidence and severity of POST. The selection of an appropriate ETT for surgical patients could play a pivotal role in alleviating airway complications, enhancing postoperative recovery, and improving anesthesia satisfaction.

Trial registration The study was registered at ClinicalTrials.gov (NCT06505850) on 2024-07-17.

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Keywords Breast cancer, Endotracheal tube cuff, Postoperative sore throat, Subglottic airway injury, Tracheal intubation

Background

Postoperative sore throat (POST) is considered a minor complication of general anesthesia (GA); however, it remains as one of the most common patient complaints following tracheal intubation, with reported incidences between 14% and 40% [1–4]. The identified risk factors for POST following tracheal intubation include female gender, younger age, preexisting lung disease, longer anesthesia duration, and blood-stained endotracheal tube (ETT) at extubation [5]. The ETT size [6], intubation techniques [7, 8], and muscle relaxant use [9] are also associated with POST development. Although post-GA throat complications can resolve spontaneously, prophylactic management for decreasing POST incidence and severity is recommended to improve patient satisfaction and postoperative function [10].

Owing to the multifactorial nature of POST, its precise mechanism remains unclear. However, mucosal irritation and inflammation caused by the presence of an ETT in the trachea are considered potential contributors to POST. Factors such as tube size, intracuff pressure, and intubation duration have been implicated in its development [11]. Furthermore, the cuff design of an ETT, which can determine the cuff–mucosal contact area, has been reported to affect POST development [12–14]. Notably, an earlier randomized controlled trial compared the effect of ETTs with a cylindrical (CYL) or a tapered (TAP) cuff on post-GA throat complications and reported that the use of a TAP cuff ETT could reduce POST incidence and severity due to a smaller cuff–mucosal contact area [15]. Thus, an appropriate ETT for surgical patients may help improve the quality of postanesthesia care.

To the best of our knowledge, no study has investigated the impact of different ETT cuff shapes on throat complications in patients undergoing breast cancer surgery. To examine the hypothesis that tracheal intubation with a TAP cuff ETT may decrease POST incidence following breast cancer resection, we conducted a randomized controlled study comparing POST incidence and severity following tracheal intubation with a CYL or TAP cuff ETT in patients with breast cancer. This study aimed to assess the effectiveness of a TAP cuff ETT in preventing POST and to evaluate the impact of ETT cuff shapes on subglottic injury following GA for breast cancer surgery.

Methods

Study population

This prospective, randomized, and double-blinded study was conducted at the Tri-Service General Hospital, Taiwan, Republic of China. It was approved by the relevant institutional review board (TSGHIRB No. A202405086) and registered in the ClinicalTrials.gov database (Registration No. NCT06505850). We enrolled 176 adult female patients aged 18 to 80 years who were scheduled to undergo elective breast cancer surgery requiring tracheal intubation between July and December 2024. We obtained written informed consent from the patients after providing detailed information about the study. Patients who had diseases or anatomic abnormalities in the neck, larynx, or pharynx; underwent combined surgery, such as breast reconstruction; had active pulmonary disease; were edentulous; had morbid obesity (body mass index ≥ 40 kg/m^2); were pregnant; and refused to participate in the study were excluded. Patients with an increased risk of aspiration or requiring postoperative mechanical ventilation were also excluded.

Randomization

The patients were randomized into group C, tracheal intubation with a CYL cuff ETT (Shiley™ Hi-Lo; Covidien, Mansfield, MA, USA; Fig. 1), and group T, tracheal intubation with a TAP cuff ETT (Shiley™ TaperGuard; Covidien, Mansfield, MA, USA; Fig. 1) using a parallel design with an allocation ratio of 1:1 and a computer-generated randomization program with a block size of 4. The randomization sequence was concealed in sequentially numbered, opaque, and sealed envelopes and determined by an investigator who was not involved in the perioperative care. The anesthesiologist was informed of the group allocation before surgery. The investigator who followed up with patients in the postoperative period was unaware of the group allocation.

Study protocol

Upon arrival at the operating room, three-lead electrocardiography, noninvasive blood pressure measurement, pulse oximetry, and bispectral index (BIS) monitoring (BIS™ Complete 2-Channel Monitor; Medtronic, Minneapolis, MN, USA) were instituted on the patients. The hemodynamic values and BIS data were recorded every 5 min. Premedication was not administered before GA induction. After preoxygenation, GA was induced with intravenous fentanyl (2 mcg/kg), 2% lidocaine (1 mg/kg), and propofol at an effect-site concentration (Ce) of 3.0–5.0 mcg/mL delivered by a target-controlled infusion (TCI) pump (Orchestra® Base Primea; Fresenius Kabi AG, Bad Homburg, Germany), following the Schnider model. After loss of consciousness, rocuronium (0.6–1.0 mg/kg) was administered to facilitate tracheal intubation.

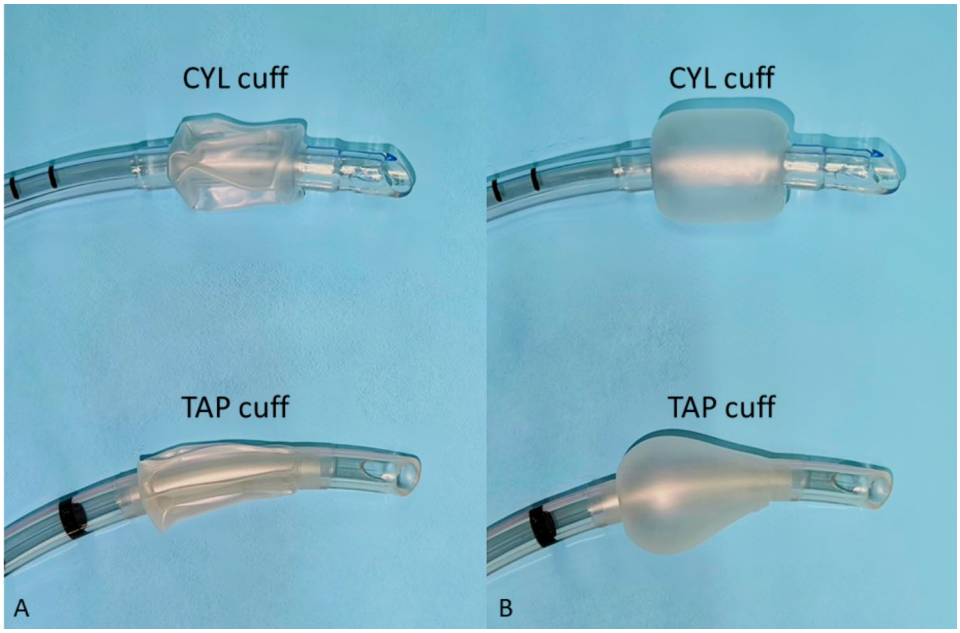

Fig. 1 Two different types of endotracheal tube cuffs in (**A**) deflated and (**B**) inflated states. CYL, cylindrical; TAP, tapered

Two board-certified anesthesiologists, each with more than ten years of clinical experience, performed tracheal intubation using a video laryngoscope (GlideScope® Titanium with LoPro T3; Verathon, Bothell, WA, USA) with an unlubricated ETT (6.5-mm internal diameter). A TAP cuff ETT plus a malleable stylet was used for group T and a CYL cuff ETT plus a malleable stylet for group C. Before intubation, intravenous dexamethasone (5 mg) was routinely administered in the absence of contraindications. Correct tracheal intubation was confirmed by capnography, and the optimal insertion length was determined using a formula from our institute [16]. The ETT was secured with a tape at the right corner of the patient's mouth. The ETT cuff was inflated with air and the intracuff pressure maintained at 20–30 cmH_2O using a handheld aneroid manometer (Cuff Manometer; VBM Medizintechnik GmbH, Sulz am Neckar, Germany), with monitoring and adjustment performed every 30 min. Immediately after intubation, the patient's lungs were ventilated in a volume-controlled mode with a tidal volume of 8 mL/kg of predicted body weight, a positive end-expiratory pressure of 5 cmH_2O, and a mixture of oxygen and air ($FiO_2 = 0.5$). An adequate respiratory rate was utilized to maintain an $EtCO_2$ level between 35 and 40 mmHg.

During surgery, the patient was placed in a supine position, and GA was maintained using TCI of propofol at a Ce of 2.0–3.0 mcg/mL, which was titrated to maintain BIS values within 40–60. Neuromuscular monitoring (Stimpod NMS450X; Xavant Technology, Pretoria, South Africa) was performed at the adductor pollicis muscle in response to ulnar nerve stimulation, and additional rocuronium doses (0.2 mg/kg) were administered to maintain a train-of-four count of 1. Additional fentanyl (0.5–1.0 mcg/kg) was administered as clinically indicated. At the end of surgery, a fiberoptic bronchoscope (Flexible Tracheal Intubation Fiberscope LF-GP; Olympus, Tokyo, Japan) with a 4.1-mm outer diameter was introduced through the ETT before emergence from GA. After gently removing the oropharyngeal secretions and pulling out the ETT to the proximal end of the insertion cord of the bronchoscope, an independent investigator blinded to the group allocation conducted fiberoptic examination from the carina to the glottis to determine the severity of subglottic injury, either none (no subglottic injury), mild (mucosal hyperemia and edema and/or slight submucosal hematoma), moderate (moderate submucosal hematoma), or severe (mucosal laceration and/or mucosal bleeding) [17]. Subsequently, the TCI of propofol was terminated, and neostigmine (50 mcg/kg) and glycopyrrolate (20 mcg/kg) were administered to reverse residual neuromuscular blockade. Manual ventilation using a face mask was performed until the patient fully recovered from GA.

Afterwards, the patients were transferred to the post-anesthesia care unit for 30-min postoperative observation and were discharged after demonstrating stable vital signs and acceptable pain scores (numeric rating scale ≤ 4). Intravenous tramadol (50 mg) and droperidol (1.25 mg) were administered as required for analgesic rescue and postoperative nausea and vomiting (PONV), respectively.

Data collection

Patient demographics (age, height, weight, and comorbidities) and clinical data (American Society of Anesthesiologists [ASA] status, procedure type, total anesthetic and analgesic consumption, Ce values at unconsciousness and awareness, and surgical and anesthetic time) were obtained from medical records. Factors related to tracheal intubation (Mallampati score, number of attempts, intubation time, intubation duration, blood-stained ETT, and degree of subglottic injury) were also recorded for analysis. In addition, the occurrence of other postoperative adverse events, including dizziness, PONV, and others (e.g., sedation, shivering), during the first 24 h postoperatively and patient satisfaction with GA (1 = very unsatisfactory, 2 = unsatisfactory, 3 = neutral, 4 = satisfactory, 5 = very satisfactory) after the 48-h postoperative observation were recorded.

The primary outcome was the overall incidence of POST in the 48-h postoperative period in the two groups. At 1, 6, 12, 24, and 48 h postoperatively, an observer blinded to the group allocation investigated the POST incidence among the patients. POST was graded using a 4-point scale (1–4): 1, none; 2, mild (complains of sore throat only upon asking); 3, moderate (complains of sore throat on her own); and 4, severe (change of voice or hoarseness, associated with throat pain) [18]. The secondary outcomes included POST incidence and severity at selected time points postoperatively and the degree of subglottic injury related to tracheal intubation.

Statistical analysis

Statistical analysis was conducted using SPSS for Windows, version 23.0 (IBM SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as mean ± standard deviation and categorical variables as numbers and percentages. The POST scale as an ordinal variable was expressed as median with interquartile range. The Shapiro–Wilk test was employed to check data normality before statistical analysis. Student's *t*-test and the Mann–Whitney *U* test were employed to compare normally and nonnormally distributed continuous variables, respectively. Categorical variables were analyzed using either the χ^2 test or Fisher's exact test. The Mann–Whitney *U* test was used to compare the POST scales between the groups. The Kruskal–Wallis test was also used to assess the sequential POST incidence and severity in the 48-h postoperative evaluation period in each group. A P value < 0.05 was considered statistically significant.

Power and sample size

The sample size was calculated based on previous data from our institute that the incidence of POST with a CYL cuff ETT in patients undergoing breast cancer surgery was 39.6%. To assume a 20% reduction in POST incidence in breast cancer patients undergoing tracheal intubation with a TAP cuff ETT for GA, at least 80 patients in each group were required, with α and β values of 0.05 and 0.2, respectively. Considering a possible dropout rate of 10%, 176 patients were enrolled.

Results

A total of 180 patients were initially recruited (Fig. 2). Of them, 176 fulfilled the inclusion criteria and were randomly assigned to the aforementioned groups. One patient each in groups T and C were excluded due to bronchospasm during surgery requiring postoperative mechanical ventilation and rocuronium-induced anaphylactic shock, respectively. Ultimately, 174 patients were included in the final analysis.

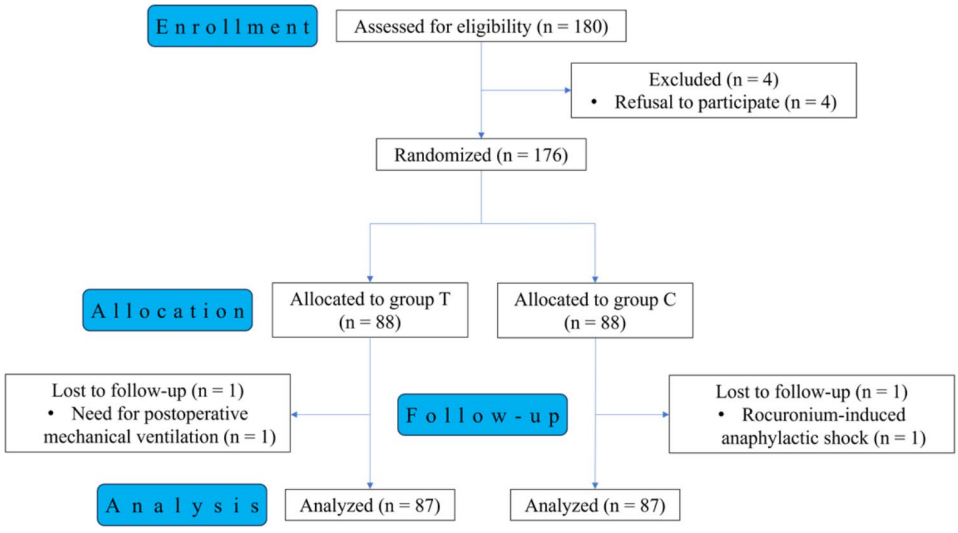

Fig. 2 Flow diagram of patient recruitment according to the study protocol. Group C, cylindrical cuff group; Group T, tapered cuff group

Table 1 Patient demographics and surgical characteristics

Variables	Group T (*n* = 87)	Group C (*n* = 87)	*P* value
Age (years old)	56.28 ± 10.19	57.87 ± 10.58	0.312
Height (cm)	157.95 ± 4.75	157.91 ± 6.21	0.956
Weight (kg)	59.84 ± 11.66	58.17 ± 8.97	0.290
BMI (kg/m^2)	23.95 ± 4.30	23.33 ± 3.42	0.295
Comorbidities			
Hypertension	19 (21.8%)	22 (25.3%)	0.721
Diabetes mellitus	10 (11.5%)	15 (17.2%)	0.388
Cardiac disease	2 (2.3%)	6 (6.9%)	0.278
Respiratory disease	1 (1.1%)	2 (2.3%)	1.000
Hepatic disease	5 (5.7%)	1 (1.1%)	0.211
Renal disease	1 (1.1%)	2 (2.3%)	1.000
ASA class, II/III (n [%])	84/3 (96.6%/3.4%)	79/8 (90.8%/9.2%)	0.211
Cancer staging			0.993
Carcinoma in situ	20 (23.0%)	20 (23.0%)	
Stage I	31 (35.6%)	32 (36.8%)	
Stage II	29 (33.3%)	29 (33.3%)	
Stage III	7 (8.1%)	6 (6.9%)	
Procedure type			0.171
BCS	52 (59.8%)	42 (48.3%)	
MRM	35 (40.2%)	45 (51.7%)	
Tumor site, left/right (n [%])	41/46 (47.1%/52.9%)	49/38 (56.3%/43.7%)	0.288
Surgical time (min)	63.86 ± 17.34	68.22 ± 18.80	0.114
Anesthetic time (min)	89.46 ± 20.01	94.52 ± 21.53	0.110
Emergence time (min)	8.38 ± 3.77	8.61 ± 3.66	0.684
Anesthetic consumption			
Fentanyl (mcg)	110.92 ± 34.88	113.22 ± 29.49	0.639
Propofol (mg)	554.25 ± 182.84	549.17 ± 155.62	0.844
Rocuronium (mg)	50.46 ± 9.69	49.02 ± 8.49	0.300
Ce value of propofol (mcg/mL)			
At conscious loss	3.48 ± 0.39	3.44 ± 0.40	0.577
At conscious recovery	0.78 ± 0.11	0.77 ± 0.12	0.893
Intraoperative NSAID use	38 (43.7%)	34 (39.1%)	0.644

Data are expressed as mean ± standard deviation and case numbers (percentage). ASA, American Society of Anesthesiologists; BCS, breast conserving surgery; BMI, body mass index; Ce, effect-site concentration; Group C, cylindrical cuff group; Group T, tapered cuff group; MRM, modified radical mastectomy; NSAID, non-steroidal anti-inflammatory drug.

Demographic data and Surgery-Related information

No significant difference in patient demographics and surgical characteristics, including age, habitus, underlying disease, ASA physical status, breast cancer stage, procedure type, and tumor site, were observed between the groups (Table 1). Moreover, the surgical and anesthetic time and intraoperative pharmacological requirements were similar between the groups (Table 1).

Factors related to tracheal intubation

The two groups had similar Mallampati scores, number of intubation attempts, time to achieve intubation, and intubation duration (Table 2). The proportion of blood-stained ETT and the degree of subglottic injury observed via fiberoptic bronchoscopy did not significantly differ between the groups (Table 2). No coughing or bucking events that may cause airway irritation and injury at the time of extubation were observed.

Table 2 Factors related to tracheal intubation

Variables	Group T (*n* = 87)	Group C (*n* = 87)	*P* value
Mallampati score			0.797
I	27 (31.1%)	23 (26.4%)	
II	49 (56.3%)	52 (59.8%)	
III	11 (12.6%)	12 (13.8%)	
Number of attempts			1.000
1	85 (97.7%)	84 (96.6%)	
2	2 (2.3%)	3 (3.4%)	
Intubation time (sec)	14.84 ± 2.59	15.11 ± 2.65	0.488
Intubation duration (min)	76.13 ± 18.67	80.93 ± 20.69	0.110
Blood stain on the ETT	3 (3.4%)	6 (6.9%)	0.496
Subglottic injury			0.313
None	79 (90.8%)	75 (86.2%)	
Mild	8 (9.2%)	10 (11.5%)	
Moderate	0	2 (2.3%)	
Severe	0	0	

Data are expressed as mean ± standard deviation and case numbers (percentage). ETT, endotracheal tube; Group C, cylindrical cuff group; Group T, tapered cuff group.

Postoperative sore throat incidence and severity

The POST incidence and severity are presented in Table 3. During the 48-h evaluation period, the overall incidence of POST was lower in group T than in group C (48.3% vs. 73.6%; $P = 0.001$). In the groups, the highest POST incidence was observed at the first postoperative hour, and newly-onset POST was not reported afterwards. A significantly lower POST incidence was observed in group T than in group C at each observation time point, although the throat complications in both groups gradually diminished with time (Table 3; Fig. 3). Similarly, the highest POST severity was observed at the first postoperative hour, with the POST severity being significantly lower in group T than in group C at each selected time point, accompanied by the alleviation of throat symptoms in both groups over time (Table 3; Fig. 4).

Other postoperative adverse events and anesthesia satisfaction

No difference was observed between the groups in terms of postoperative adverse events, including dizziness, PONV, and shivering during the first 24 h postoperatively (Table 4). The patients' GA appraisals were at least satisfactory, but group T exhibited significantly better anesthesia satisfaction than group C (Table 4).

Table 3 Incidence and severity of POST

Variables		Group T (*n* = 87)	Group C (*n* = 87)	*P* value
Overall incidence		42 (48.3%)	64 (73.6%)	0.001
1 h after surgery				
	Incidence	42 (48.3%)	64 (73.6%)	0.001
	Severity	1 (1–2)	2 (1–3)	0.002
6 h after surgery				
	Incidence	41 (47.1%)	64 (73.6%)	0.001
	Severity	1 (1–2)	2 (1–3)	< 0.001
12 h after surgery				
	Incidence	40 (46.0%)	61 (70.1%)	0.002
	Severity	1 (1–2)	2 (1–2)	0.001
24 h after surgery				
	Incidence	35 (40.2%)	54 (62.1%)	0.006
	Severity	1 (1–2)	2 (1–2)	0.005
48 h after surgery				
	Incidence	24 (27.6%)	40 (46.0%)	0.018
	Severity	1 (1–2)	1 (1–2)	0.008
P value (among timepoints)				
	Incidence	0.034	< 0.001	
	Severity	0.005	< 0.001	

Data are expressed as case numbers (percentage) and median (interquartile range). Group C, cylindrical cuff group; Group T, tapered cuff group; POST, postoperative sore throat.

Table 4 Other postoperative adverse events and anesthesia satisfaction

Variables	Group T (*n* = 87)	Group C (*n* = 87)	*P* value
Adverse events			
Dizziness	10 (11.5%)	6 (6.9%)	0.432
PONV	2 (2.3%)	4 (4.6%)	0.682
Shivering	3 (3.4%)	2 (2.3%)	1.000
Satisfaction			0.023
Satisfactory	21 (24.1%)	36 (41.4%)	
Very satisfactory	66 (75.9%)	51 (58.6%)	

Data are expressed as case numbers (percentage). Group C, cylindrical cuff group; Group T, tapered cuff group; PONV, postoperative nausea and vomiting.

Discussion

This study evaluated the impact of different ETT cuff shapes on throat complications in patients undergoing breast cancer surgery. The findings demonstrated that using a TAP cuff ETT significantly reduced the overall incidence of POST within the 48-h postoperative period compared with a CYL cuff ETT. At 1, 6, 12, 24, and 48 h after surgery, the incidence of POST was consistently lower in group T than in group C. Additionally, TAP cuff ETTs alleviated the severity of POST throughout the postoperative assessment period compared with CYL cuff ETTs. These results aligned with those of a previous randomized controlled trial, which reported that TAP cuff ETTs improved both the incidence and severity of POST in patients undergoing tracheal intubation [15]. Interestingly, our study revealed that the incidence

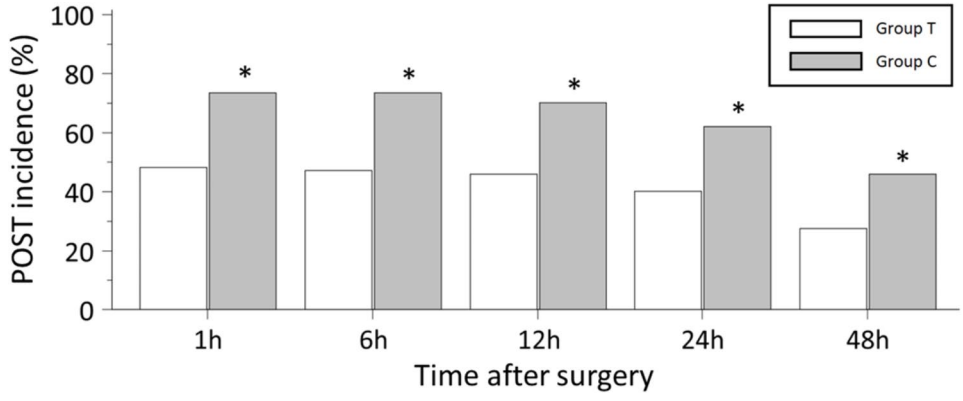

Fig. 3 Incidence of postoperative sore throat at selected time points following surgery. Data are expressed as case numbers (percentage). Group C, cylindrical cuff group; Group T, tapered cuff group; POST, postoperative sore throat; *, $P < 0.05$

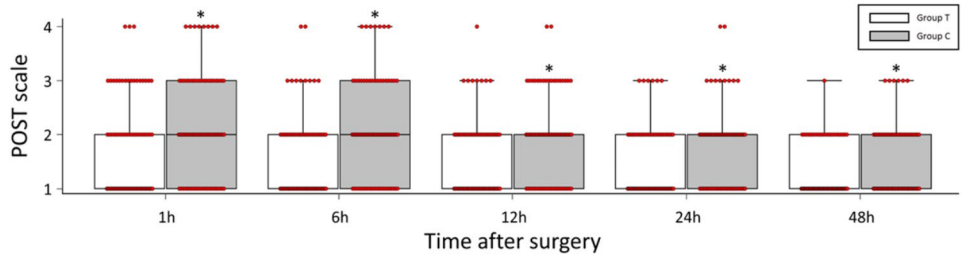

Fig. 4 Severity of postoperative sore throat at selected time points following surgery. Data are expressed as median with interquartile range. Group C, cylindrical cuff group; Group T, tapered cuff group; POST, postoperative sore throat; *, $P < 0.05$

and severity of POST peaked immediately after surgery. A previous study suggested that residual anesthetic and analgesic effects might mask throat complications in the early postextubation period [18]. However, in our study, patients experienced enhanced recovery from GA and were able to clearly express any discomfort within the first postoperative hour, likely due to comprehensive monitoring.

POST is a common complication of GA with tracheal intubation. Although typically self-limiting and resolving within a week [4], POST can negatively affect patient satisfaction and recovery [10]. Tracheal mucosal irritation and inflammation during intubation have been identified as primary contributors to POST development [11]. In our study, the use of a TAP cuff ETT was associated with a lower incidence of POST, which may be attributed to differences in the cuff–mucosal contact area. Previous studies have reported that high-volume ETT cuffs were linked to a higher incidence of POST due to their larger cuff–trachea contact area; therefore, minimizing the contact area has been recommended to reduce the risk of tracheal mucosal injury [12–14]. The TAP cuff inflation creates a sealing zone in which the outer cuff diameter conforms to the internal tracheal diameter [15]. Within this zone, the lower portion of the cuff remains unfolded inside the trachea, limiting the cuff–mucosal contact primarily to the sealing zone and the upper part of the cuff. Moreover, TAP cuffs generally have a smaller diameter than CYL cuffs. As a result, using a TAP cuff ETT produces a reduced cuff–trachea contact area and potentially decreases the incidence of POST.

In the present study, 73.6% of patients intubated with a CYL cuff ETT developed POST, a rate significantly higher than those reported in previous studies [15, 18–20]. This finding may be attributed to the gender-specific design of our study, as female gender is a known predisposing factor for POST following tracheal intubation [5]. Notably, a cancer diagnosis can profoundly affect a patient's mental well-being, particularly among individuals with breast cancer. Besides concerns related to physical health, breast cancer patients often experience body image distress due to the nature of the disease and its treatments [21]. These psychological stressors may heighten anxiety and reduce tolerance to discomfort, including POST [22]. Therefore, in addition to pharmacological interventions, the adoption of more proactive nonpharmacological strategies, such as careful selection of intubation equipment, is essential for mitigating POST and promoting postoperative recovery in this vulnerable population.

GlideScope® is a video laryngoscope that requires minimal head manipulation and positioning, enables rapid visualization of the larynx, and provides a superior view of the glottis during tracheal intubation compared with conventional direct laryngoscopy, particularly in patients with potentially difficult airways [23]. Additionally, it has been reported to require less force on soft tissues and improve intubation success rates [24, 25]. However, concerns have been raised that the use of GlideScope® may increase the incidence of POST due to its hyperangulated blade and the need for a supplementary rigid stylet [26]. The primary challenge associated with this device is the difficulty in guiding the ETT toward the vocal cords, even when the ETT is preshaped with a rigid stylet to match the blade curvature. This challenge may increase the risk of airway trauma and contribute to POST [27]. Notably, two clinical trials have investigated the impact of GlideScope® on POST incidence and found that video laryngoscopy not only did not increase POST but also reduced its incidence and severity compared with traditional techniques [28, 29]. In our study, to mitigate pharyngeal injury and minimize the number of intubation attempts, two experienced anesthesiologists used GlideScope® with a malleable stylet instead of a rigid stylet. This approach potentially reduced confounding factors that could contribute to POST development, allowing for a clearer assessment of the impact of ETT cuff shapes on POST.

Subglottic injury is a potential airway complication associated with tracheal intubation. The stiffened tip of an ETT can damage the anterior tracheal wall as it passes through the glottis. Furthermore, upon removal of the stylet, the ETT may curve anteriorly, increasing the risk of subglottic injury by contacting the anterior tracheal wall [17, 27]. Cuff overinflation and prolonged intubation have also been implicated in subglottic injury [30]. In our study, the incidence of subglottic injury following GA for breast cancer surgery was low, regardless of the ETT cuff shape. Among patients who experienced subglottic injury, fiberoptic bronchoscopic examination predominantly revealed mild injury grades. Only two patients in group C encountered difficulty during ETT passage through the glottis, leading to moderate subglottic injury following ETT manipulation and reintubation. A previous prospective study reported a significantly increased incidence of subglottic injury when a stylet was used during video laryngoscopic intubation in patients with high Mallampati scores [17]. However, the proportion of patients with high Mallampati scores in our study was small. Our findings may be attributed to the cautious manipulation and gentle removal of intubation equipment, which helped prevent unintended mucosal injury. Other factors contributing to subglottic injury, including the ETT size and intracuff pressure, were also well controlled. Accordingly, our results suggested that the ETT cuff shape was not a significant determinant of subglottic injury in patients with normal airways undergoing short-duration surgeries, such as breast cancer surgery.

This study had several limitations. First, it was conducted at a single medical center, and further large-scale,

multicenter studies are needed to validate our findings. Second, the anesthesiologists performing tracheal intubation were not blinded to the group allocation, which may cause biases. Third, the study focused solely on throat complications following short-duration surgeries, and no observations were made regarding long-duration procedures. Fourth, patients with potentially difficult airways were excluded, limiting the generalizability of our findings to such patients. Lastly, the study design incorporated a gender-specific consideration, implying that our results may not be directly applicable to male patients.

Conclusions

Using a TAP cuff ETT decreased POST incidence and severity within the 48-h evaluation period in female patients undergoing breast cancer surgery compared with a CYL cuff ETT. In addition, patients intubated with a TAP cuff ETT exhibited improved anesthesia satisfaction postoperatively. Hence, we concluded that an appropriate ETT for surgical patients could help mitigate airway complications, enhance postoperative recovery, and improve anesthesia satisfaction.

Abbreviations

ASA	American Society of Anesthesiologists
BIS	Bispectral index
CYL	Cylindrical
ETT	Endotracheal tube
GA	General anesthesia
PONV	Postoperative nausea and vomiting
POST	Postoperative sore throat
TAP	Tapered
TCI	Target-controlled infusion

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Author contributions

G-C Chen: Data curation; Project administration; Writing– original draftK-L Lo: Data curation; Formal analysis; MethodologyZ-F Wu: Conceptualization; Formal analysis; InvestigationS-M Chan: Data curation; Project administrationS-Y Cheng: Data curation; Project administrationC-L Ko: Formal analysis; MethodologyC-M Chu: Formal analysis; MethodologyW-C Tseng: Conceptualization; Data curation; Project administration; Writing– review & editingAll authors reviewed the manuscript and approved the submission.

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Data availability

The data analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was conducted after the approval from the Institutional Review Board of Tri-Service General Hospital (TSGHIRB No. A202405086) and the registration in the ClinicalTrials.gov database (Registration No. NCT06505850). The clinical trial was performed according to the Declaration of Helsinki, and all patients provided written informed consent for participation in this study. Our manuscript adhered to the CONSORT guidelines for reporting clinical trials.

Consent for publication

No personal data were involved in this clinical study.

Competing interests

The authors declare no competing interests.

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