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SCIENTIFIC ARTICLE

Comparative study between benzydamine hydrochloride gel, lidocaine 5% gel and lidocaine 10% spray on endotracheal tube cuff as regards postoperative sore throat

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Abstract Postoperative sore throat is a common complication after endotracheal intubation. After tracheal intubation, the incidence of sore throat varies from 14.4% to 50%. The aim of the study was to compare between benzydamine hydrochloride gel, lidocaine 5% gel and lidocaine 10% spray on the endotracheal tube cuff as regards postoperative sore throat. The present study was carried out on 124 patients admitted to Alexandria university hospitals for lumbar fixation surgery requiring general anesthesia. Patients were randomly allocated into 4 groups. Benzydamine hydrochloride gel, 5% lidocaine hydrochloride gel, 10% lidocaine hydrochloride spray, or normal saline were applied on endotracheal tube cuffs before endotracheal intubation. The patients were examined for sore throat (none, mild, moderate, or severe) at 0, 1, 6, 12, and 24 h after extubation. The results were collected, analyzed and presented in table and figure. The highest incidence of postoperative sore throat occurred at 6 h after extubation in all groups. There was a significantly lower incidence of postoperative sore throat in the benzydamine group than 5% lidocaine gel, 10% lidocaine spray, and normal saline groups. The benzydamine group had significantly decreased severity of postoperative sore throat compared with the 10% lidocaine, 5% lidocaine, and normal saline groups at observation time point. Compared with the 5% lidocaine the 10% lidocaine group had significantly increased incidence and severity of postoperative sore throat after extubation. Compared with normal saline the 10% lidocaine group had increased incidence of postoperative sore throat. There were no significant differences among groups in local or systemic side effects. So in conclusion, benzydamine hydrochloride gel on the endotracheal tube cuff is a simple and effective method to reduce the incidence and severity of postoperative sore throat. Application of 10% lidocaine spray should be avoided because of worsening of postoperative sore throat where incidence increased but

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not the severity in relation to 5% lidocaine gel. Applying 5% lidocaine on the endotracheal tube cuff does not prevent postoperative sore throat but its application is better than lidocaine 10% spray or saline.

PALAVRAS-CHAVE
Dor de garganta;
Benzidamina;
Lidocaína;
Tubo endotraqueal

Estudo comparativo entre cloridrato de benzidamina em gel, lidocaína a 5% em gel e lidocaína a 10% em spray no balonete do tubo endotraqueal em relação à dor de garganta pós-operatória

Resumo A dor de garganta pós-operatória (DGPO) é uma complicação comum após a intubação traqueal. Em seguida a esse procedimento, a incidência de dor de garganta varia de 14,4 a 50%. O objetivo do estudo foi comparar os efeitos da aplicação de cloridrato de benzidamina em gel, lidocaína a 5% em gel, e lidocaína a 10% em spray no balonete do tubo endotraqueal, no que diz respeito à dor de garganta pós-operatória. O presente estudo foi realizado em 124 pacientes internados em hospitais universitários de Alexandria para cirurgia de fixação lombar necessitando de anestesia geral. Os pacientes foram aleatoriamente alocados em quatro grupos. Procedeu-se à aplicação de cloridrato de benzidamina em gel, cloridrato de lidocaína a 5% em gel, cloridrato de lidocaína a 10% em spray, ou salina normal nos balonetes do TET antes da intubação endotraqueal. Os pacientes foram examinados para dor de garganta (nenhuma, leve, moderada ou intensa) a 0, 1, 6, 12 e 24 horas após a extubação. Os resultados foram coletados, analisados e apresentados em tabelas e figuras. A maior incidência de DGPO ocorreu 6 horas após a extubação em todos os grupos. Houve incidência significativamente menor de DGPO no grupo de benzidamina versus grupos de lidocaína a 5% em gel, lidocaína a 10% em spray, e salina normal. O grupo tratado com benzidamina exibiu redução significativa na intensidade da DGPO, em comparação com os grupos de lidocaína a 10%, lidocaína a 5% e salina normal no ponto no tempo de observação. Em comparação com lidocaína a 5%, o grupo tratado com lidocaína a 10% exibiu incidência e intensidade significativamente aumentadas na DGPO após a extubação. Em comparação com salina normal, o grupo tratado com lidocaína a 10% exibiu maior incidência de DGPO. Não foram observadas diferenças significativas entre grupos quanto a efeitos colaterais locais ou sistêmicos. Assim, em conclusão, o uso de cloridrato de benzidamina em gel no balonete do TET é um método simples e eficaz para reduzir a incidência e gravidade da DGPO. Deve-se evitar a aplicação de lidocaína a 10% em spray, devido ao agravamento da DGPO, visto ter ocorrido aumento na incidência, mas não na severidade, em relação à lidocaína a 5% em gel. A aplicação de lidocaína a 5% no balonete do TET não impede a ocorrência da DGPO, mas a sua aplicação oferece melhores resultados do que lidocaína a 10% em spray, ou solução salina.

Introduction

Sore throat is a common postoperative complaint. After tracheal intubation, the incidence of sore throat varies from 14.4% to 50% and after laryngeal mask insertion from 5.8% to 34%. The highest incidence of sore throat and other airway related symptoms tends to occur in patients who have undergone tracheal intubation.[1]

Complications of tracheal intubation can be classified as immediate, early and late. It is well recognized that prolonged intubation can have serious consequences, but it is less well recognized that uneventful intubation for routine surgical procedures can also cause pathological changes that may provide an organic basis for patients' postoperative throat symptoms.[2]

Several pharmacological methods have been suggested to reduce postoperative sore throat (POST) including inhaling beclomethasone; applying lidocaine spray or lidocaine gel to the endotracheal tube (ETT); administering aspirin, ketamine, or benzydamine hydrochloride.[3]

Local anesthetic drugs act by producing a reversible block to the transmission of peripheral nerve impulses. Lidocaine is used commonly for infiltration in concentrations of 0.5–1.0% and for peripheral nerve blocks if an intermediate duration is required. Lidocaine 2–4% is used by many anesthetists as a topical solution for anesthesia of the upper airway before awake intubation.[3]

In most cases, postoperative throat complaints resolve spontaneously without specific treatment. In moderate to severe cases it may be beneficial to treat pain and dysphagia

with a gargle containing a drug such as benzydamine hydrochloride, which is approved for the symptomatic treatment of acute sore throat pain.[4]

Benzydamine hydrochloride is a topical non-steroidal anti-inflammatory agent that also has local anesthetic activity.[5] It has an alkaline pH, which means that it becomes concentrated in inflamed tissue and has minimal systemic absorption.[5]

It has been reported that moderate to severe sore throat may be resolved with gargling benzamine hydrochloride.[6] Preventive topical benzamine hydrochloride applied to the oropharyngeal cavity before endotracheal intubation or before endotracheal intubation and continuously for 48 h postoperatively has been reported to decrease the incidence and severity of POST after ETT insertion and laryngeal mask airway insertion.[6]

Aim of the work

The aim of the study was to compare between benzydamine hydrochloride gel, lidocaine 5% gel and lidocaine 10% spray on the ETT cuff as regards POST.

Methods

The present study was carried out on 124 patients admitted to Alexandria university hospitals undergoing lumbar fixation surgery requiring general anesthesia.

Inclusion criteria

Patients of American Society of Anesthesiologists (ASA) physical status I or II 2, Lumbar fixation surgery requiring general anesthesia.

Exclusion criteria

History of preoperative sore throat, More than one attempt at intubation, Mallampati grade more than 2, Known allergies to benzydamine hydrochloride or lidocaine and smoking.

After approval of the local ethical committee and having an informed written consent from every patient, they were randomly categorized; by closed envelope method; into four groups (31 each):

Group I: where the ETT cuffs were lubricated with benzydamine hydrochloride gel.
Group II: where the ETT cuffs were lubricated with lidocaine hydrochloride 5% gel.
Group III: where the ETT cuffs were sprayed with lidocaine hydrochloride 10% spray.
Group IV: where the cuffs were sprayed with normal saline as a control group.

Anesthesia was induced with fentanyl 2–3 microgram/kg and propofol 2–2.5 mg/kg. Tracheal intubation was facilitated by rocuronium 0.6 mg/kg, and the trachea was intubated with a low pressure cuffed sterile polyvinyl chloride ETT. The cuff was inflated with air and cuff pressure was maintained at 20 cmH_2O using cuff pressure gauge. We kept the cuffs pressure uniform for the 4 groups using cuff pressure gauge. Anesthesia was maintained using isoflurane MAC 1.2% and increments of fentanyl and rocuronium.

Monitoring consisted of 5-lead electrocardiography, non-invasive arterial blood pressure, pulse oximetry, nasopharyngeal temperature, and end tidal carbon dioxide, which was kept between 30 and 35 mm Hg. At the end of surgery, the muscle relaxation was reversed by a combination of neostigmine 0.05 mg/kg and atropine 0.02 mg/kg. After gentle suctioning of oral secretions by a 12 F suction catheter, patients were extubated and transferred to the post-anesthesia care unit.

The following were recorded:

- Age, sex, weight and height of the patients.
- Duration of surgery.
- Total fentanyl consumption.
- Vital signs.
- Postoperative analgesia.
- Potential side effects associated with tracheal intubation.

POST was graded at (0 h) after full recovery and thereafter at 1, 6, 12 and 24 h after extubation, on a 4-point scale (0–3) as shown below[7]: 0 – No sore throat; 1 – Mild sore throat (complains of sore throat only on asking); 2 – Moderate sore throat (complains of sore throat on his/her own); 3 – Severe sore throat (change of voice or hoarseness, associated with throat pain).

Results

The age in group I ranged from 35.0 to 60.0 years with a mean of 48.74 ± 6.21 years; in group II; it ranged from 39.0 to 61 years with a mean of 49.55 ± 6.81 years; in group III it ranged from 35.0 to 60.0 years with a mean of 48.39 ± 6.49 years and in group IV it ranged from 40.0 to 61.0 years with a mean of 49.84 ± 6.08 years. There was no significant difference between mean ages in the four groups.

The sex of patients in group I was as follows: 67.7% males and 32.3% females; in group II: 58.1% males and 41.9% females; in group III: 61.3% males and 38.7% females and in group IV: 58.1% males and 41.9% females. There was no significant difference between groups as regards sex.

The weight of patients in group I ranged from 82.0 to 130.0 kg with a mean of 97.77 ± 10.57 kg; in group II ranged from 82.0 to 120.0 kg with a mean of 97.32 ± 9.36 kg; in group III ranged from 70.0 to 120.0 kg with a mean of 93.90 ± 11.30 kg; while in group IV ranged from 79.0 to 120.0 kg with a mean of 95.32 ± 8.87 kg. There was no significant difference between groups as regards weight.

The height of patients in group I ranged from 160.0 to 189.0 cm with a mean of 173.13 ± 8.10 cm; in group II ranged from 160.0 to 184.0 cm with a mean of 171.94 ± 7.51 cm; in group III ranged from 160.0 to 183.0 cm with a mean of 172.19 ± 6.95 cm; while in group IV ranged from 163.0 to 185.0 cm with a mean of 173.26 ± 6.56 cm. There was no significant difference between groups as regards height.

The duration of surgery in group I ranged from 60.0 to 110.0 min with a mean of 77.74 ± 12.30 min; in group II ranged from 63.0 to 113.0 min with a mean of

76.29 ± 8.94 min; in group III ranged from 65.0 to 110.0 min with a mean of 74.65 ± 8.85 min; while in group IV ranged from 70.0 to 100.0 min with a mean of 80.65 ± 9.64 min. There was no significant difference between groups as regards duration.

The total fentanyl dose in group I ranged from 200.0 to 350.0 μg with a mean of 245.81 ± 39.73 μg; in group II ranged from 200.0 to 300.0 μg with a mean of 245.81 ± 41.78 μg; in group III ranged from 200.0 to 300.0 μg with a mean of 237.10 ± 34.08 μg; while in group IV ranged from 200.0 to 350.0 μg with a mean of 251.61 ± 45.61 μg. There was no significant difference between groups.

The heart rate of patients in group I ranged from 70.0 to 80.0 beats per minute with a mean of 74.03 ± 4.17 beat per minute; in group II ranged from 68.0 to 83.0 beats per minute with a mean of 74.90 ± 5.26 beats per minute; in group III ranged from 70.0 to 78.0 beat per minute with a mean of 74.06 ± 3.24 beats per minute; while in group IV ranged from 70.0 to 80.0 beats per minute with a mean of 76.23 ± 3.29 beats per minute. There was no significant difference between groups as regards heart rate.

The systolic blood pressure in group I ranged from 100.0 to 120.0 mmHg with a mean of 110.97 ± 8.31 mmHg; in group II ranged from 100.0 to 120.0 mmHg with a mean of 115.16 ± 5.70 mmHg; in group III ranged from 100.0 to 120.0 mmHg with a mean of 111.29 ± 7.18 mmHg; while in group IV ranged from 100.0 to 120.0 mmHg with a mean of 110.32 ± 8.36 mmHg. There was no significant difference between groups as regards systolic blood pressure.

The diastolic blood pressure of patients in group I ranged from 70.0 to 80.0 mmHg with a mean of 73.87 ± 4.95 mmHg; in group II ranged from 60.0 to 80.0 mmHg with a mean of 73.55 ± 6.61 mmHg; in group III ranged from 70.0 to 90.0 mmHg with a mean of 75.81 ± 5.64 mmHg; while in group IV ranged from 70.0 to 84.0 mmHg with a mean of 76.94 ± 4.81 mmHg. There was no significant difference between groups as regards diastolic blood pressure.

The temperature in group I ranged from 35.80 to 36.50 degrees with a mean of 36.15 ± 0.27 degrees; in group II ranged from 35.80 to 36.50 degrees with a mean of 36.18 ± 0.27 degrees; in group III ranged from 35.90 to 36.50 degrees with a mean of 36.18 ± 0.21 degrees; while in group IV ranged from 35.70 to 36.50 degrees with a mean of 36.24 ± 0.26 degrees. There was no significant difference between groups as regards temperature.

The SpO_2 of patients in group I ranged from 98.0 to 100.0 mm Hg with a mean of 99.03 ± 0.87 mmHg; in group II ranged from 98.0 to 100.0 mmHg with a mean of 98.97 ± 0.71 mmHg; in group III ranged from 98.0 to 100.0 mmHg with a mean of 99.19 ± 0.79 mmHg; while in group IV ranged from 98.0 to 100.0 mmHg with a mean of 98.90 ± 0.83 mmHg. There was no significant difference between groups as regards SpO_2.

The sore throat incidence in group I patients was as follows: at 0 h 6.5% +ve, at 1 h 9.7% +ve, at 6 h 16.1% +ve, at 12 h 6.5% +ve and at 24 h 3.2% +ve. All cases are of grade 1 severity. The sore throat incidence in group II patients was as follows: at 0 h 9.7% +ve, at 1 h 19.4% +ve, at 6 h 32.3% +ve, at 12 h 19.4% +ve and at 24 h 16.1% +ve. Cases are grade 1 severity except at 6 and 12 h where all cases were of grade 2 severity. The sore throat incidence in group III patients was as follows: at 0 h 19.4% +ve, at 1 h 32.3% +ve, at 6 h 45.2% +ve, at 12 h 38.7% +ve and at 24 h 25.8% +ve. Cases are grade 1 severity except at 6 and 12 h where all cases were of grade 2 severity. The sore throat incidence in group IV patients was as follows: at 0 h 19.4% +ve, at 1 h 25.8% +ve, at 6 h 38.7% +ve, at 12 h 32.3% +ve and at 24 h 19.4% +ve. Cases are grade 1 severity at 0 h and at 1, 6, 12 and 24 h were of grade 2 severity.

There was no significant difference between groups as regards sore throat incidence at 0 h although the relation between groups was groups I < II < III = IV. There was significant difference between groups I and III at 1 h but non-significant difference between the others although the relation between groups was groups II < III > IV. There was significant difference between groups I, III and IV at 6, 12 h where there were less cases in group I but non-significant difference between the others although the relation between groups was groups II < III > IV. The highest incidence of POST occurred at 6 h after extubation in all groups.

There was no significant difference between groups at 0 h where all the cases were of grade 1. There was significant difference at 1 h between the first three groups and group IV where all cases in this group were of grade 2 and in the others were of grade 1. There was significant difference at 6, 12 h between the groups where all cases in group I were of grade 1 and in the others were of grade 2. There was significant difference between groups at 24 h where all cases in group IV were of grade 2 and in the others were of grade 1.

The Pethidine dose in group I ranged from 40.0 to 60.0 mg with a mean of 48.87 ± 6.02 mg; in group II ranged from 40.0 to 60.0 mg with a mean of 48.23 ± 5.71 mg; in group III ranged from 35.0 to 60.0 mg with a mean of 47.26 ± 6.56 mg; while in group IV ranged from 40.0 to 60.0 mg with a mean of 47.10 ± 4.79 mg. There was no significant difference between groups as regards Pethidine as postoperative analgesia.

The adverse effects in group I patients were as follows: 19.4% nausea and vomiting; 9.7% cough; 29.5% hoarseness and 58.1% dry mouth. Group II: 30% nausea and vomiting; 20% cough; 50% hoarseness and 70% dry mouth. Group III: 32% nausea and vomiting; 25% cough; 55% hoarseness and 72% dry mouth. Group IV: 33% nausea and vomiting; 26% cough; 57% hoarseness and 73% dry mouth. There was no significant difference between groups as regards adverse effects.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0.[8,9] Comparison between different groups regarding categorical variables was tested using Chi-square test. When more than 20% of the cells have expected count less than 5, correction for chi-square was conducted using Fisher's Exact test or Monte Carlo correction.

The distributions of quantitative variables were tested for normality using Kolmogorov-Smirnov test, Shapiro–Wilk test and D'Agstino test, also Histogram and QQ plot were used for vision test. If it reveals normal data distribution, parametric tests were applied. If the data were abnormally distributed, non-parametric tests were used.

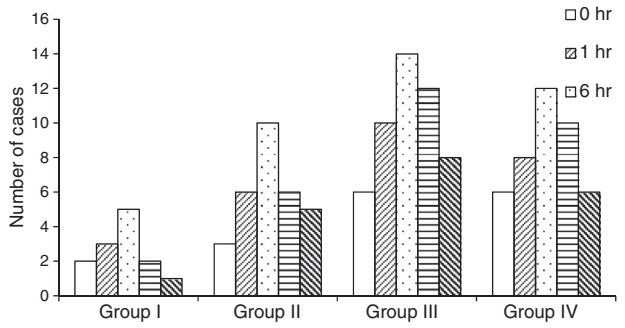

Figure 1 Comparison between the different studied groups according to sore throat incidence at intervals 0, 1, 6, 12 and 24 h.

For normally distributed data, comparison between different groups were analyzed using *F*-test (ANOVA) and Post Hoc test (Scheffe) for pair wise comparison, while for abnormally distributed data, Kruskal–Wallis test was used to compare between different groups and Post Hoc test was assessed using Mann–Whitney Test.

Significance test results are quoted as two-tailed probabilities. Significance of the obtained results was judged at the 5% level.

Discussion

According to the results of this study, the highest incidence of POST occurred at the sixth hour after extubation, but not the first hour. Sore throat at the first few hours after extubation might be masked by residual analgesic effects after general anesthesia or postoperative pain control.

There was no significant difference between groups as regards sore throat incidence at 0 h. There was significant difference between group I and III at 1 h. There was significant difference between groups I, III and IV at 6, 12 h. The highest incidence of POST occurred at 6 h after extubation in all groups (Fig. 1 and Table 1).

There were more cases with severe degree of sore throat in our study in group III than group II in the other one that might be attributed to our smaller sample size. Also, there were more cases with severe degree of sore throat in group III in our study than group II in the other one which might be related to our smaller sample size and different mode of application of lidocaine with mucosa irritation with ethanol and others.[10,11]

There was no significant difference between groups as regards severity at 0 h where all the cases were of grade 1. There was significant difference at 1, 6, 12, 24 h between groups where there were less severity with benzydamine and highest severity with lidocaine 10%. Other workers findings showed significant difference between benzydamine and other 3 groups in all the studied hours. There was significant between lidocaine 10% and lidocaine 5%. Also, there was significant difference between lidocaine 10% and saline. There was more cases with severe grade in our groups III and IV in relation to the other study where.[10,11]

The side effects of topical use of benzydamine hydrochloride include local numbness or burning, stinging sensation, nausea or vomiting, cough, dry mouth, throat discomfort, drowsiness, and headache, which may be evident before induction of anesthesia. To avoid these adverse effects, we applied benzydamine hydrochloride on the ETT cuff instead of perioperative topical application to the oral pharyngeal cavity. We found that this maneuver provided excellent prevention of POST and reduced its incidence from saline group or 10% lidocaine spray by 50%.[12]

Therefore, the application of benzydamine hydrochloride on the ETT cuffs may provide a simple and effective method to attenuate the incidence and severity of POST after tracheal intubation. Application of lidocaine spray to the oral pharyngeal cavity before intubation seems to increase the incidence of sore throat.[13,14] In this study, we also found that spraying 10% lidocaine on the ETT cuff also increased the severity of POST compared with 5% lidocaine gel or saline. Ten percent lidocaine solution contains ethanol, polyethylene glycol 400, menthol and saccharin as additives in the solvent, whereas the 5% lidocaine solution we used contained sodium chloride as an additive. In fact, both menthol and ethanol can irritate tracheal mucosa, potentially causing tracheal mucosa damage, thus leading to increased severity of POST. However, Soltani[15] reported that using intra-cuff lidocaine (ETT cuffs prefilled with 7–8 mL of 2% lidocaine for 90 min before intubation and refilled with enough 2% lidocaine after intubation) was superior to spraying topical 10% lidocaine on laryngo-pharyngeal structures or on the distal end of the ETT for decreasing the incidence of POST. Lidocaine as lubricating agent causing increase adverse effects on anesthesia wake up. Even the cuff rupture sometimes. Local anesthetic cuff injected is a technique for less pain on swallowing. The alkalinization of LA by adding $NAHCO_3$ increase LA diffusion through cuff wall.[15]

Theoretically, chemical irritation from the additives may be avoided by using intra-cuff lidocaine. We also found that 5% lidocaine gel did not attenuate the incidence and severity of POST compared with normal saline. The duration of the analgesic effect of lidocaine spray applied to oral mucosa is 15 min.[16] In this study, at the end of surgery (averaging 180 min after tracheal intubation), the analgesic effect of lidocaine spray might have already disappeared. This probably explains why we found the incidence of POST to be no different between the 5% lidocaine and normal saline groups.

One limitation of our study is that there was no record of coughing at the time of extubation. Although the extubation protocol was the same in all groups, we did not evaluate the correlation between the frequency of coughing at the time of extubation and the incidence of POST. The second limitation is that the additives to 5% and 10% lidocaine solution are different, which may have influenced the result.

This study demonstrated that applying benzydamine hydrochloride on an ETT cuff may reduce the incidence and severity of POST compared with applying 10% lidocaine, 5% lidocaine, and normal saline. Application of 10% lidocaine spray should be avoided because of worsening of POST where incidence and severity were increased in relation to 5% lidocaine or saline. Applying 5% lidocaine on the ETT cuff does not prevent POST but better than saline.

One limitation of our study is that there was no record of coughing or bucking at the time of extubation. Although the extubation protocol was the same in all groups, we did not

Table 1 Comparison between the different studied groups according to sore throat incidence.

Sore throat incidence	Group I	Group II	Group III	Group IV	χ^2	p
0 h						
−ve	29 (93.5%)	28 (90.3%)	25 (80.6%)	25 (80.6%)	3.477	$^{MC}p = 0.346$
+ve	2 (6.5%)	3 (9.7%)	6 (19.4%)	6 (19.4%)		
p_1		$^{FE}p = 1.000$	$^{FE}p = 0.255$	$^{FE}p = 0.255$		
p_2			$^{FE}p = 0.473$	$^{FE}p = 0.473$		
p_3			$p = 1.000$			
1 h						
−ve	28 (90.3%)	25 (80.6%)	21 (67.7%)	23 (74.2%)	5.066	$p = 0.149$
+ve	3 (9.7%)	6 (19.4%)	10 (32.3%)	8 (25.8%)		
p_1		$^{FE}p = 0.473$	$p = 0.029$[a]	$p = 0.096$		
p_2			$p = 0.246$	p = 0.544		
p_3			$p = 0.576$			
6 h						
−ve	26 (83.9%)	21 (67.7%)	17 (54.8%)	19 (61.3%)	6.522	$p = 0.078$
+ve	5 (16.1%)	10 (32.3%)	14 (45.2%)	12 (38.7%)		
p_1		$p = 0.138$	$p = 0.013$[a]	$p = 0.046$[a]		
p_2			$p = 0.297$	$p = 0.596$		
p_3			$p = 0.607$			
12 h						
−ve	29 (93.5%)	25 (80.6%)	19 (61.3%)	21 (67.7%)	10.377[a]	$p = 0.016$[a]
+ve	2 (6.5%)	6 (19.4%)	12 (38.7)	10 (32.3%)		
p_1		$^{FE}p = 0.255$	$p = 0.002$[a]	$p = 0.010$[a]		
p_2			$p = 0.093$	$p = 0.246$		
p_3			$p = 0.596$			
24 h						
−ve	30 (96.8%)	26 (83.9%)	23 (74.2%)	25 (80.6%)	6.200	$p = 0.071$
+ve	1 (3.2%)	5 (16.1%)	8 (25.8%)	6 (19.4%)		
p_1		$^{FE}p = 0.195$	$^{FE}p = 0.026$[a]	$^{FE}p = 0.104$		
p_2			$p = 0.349$	$p = 0.740$		
p_3			$p = 0.544$			

χ^2, value of Chi square for comparing between the different studied groups; p_1, p value for comparing between group I and each other group; p_2, p value for comparing between group II with groups III and IV; p_3, p value for comparing between groups III and IV; MC, Monte Carlo test; FE, Fisher Exact test.

[a] Statistically significant at $p \leq 0.05$.

evaluate the correlation between the frequency of coughing or bucking at the time of extubation and the incidence of POST. The second limitation is that benzydamine hydrochloride is available under different trade names in different countries, its formulations are quite different in each country, and the additives might also vary. Moreover, the safety and dosage of benzydamine hydrochloride applied to the trachea need further investigation, even though we did not find any adverse effects in our patients. The third limitation is that the additives to 5% and 10% lidocaine solution are different, which may have influenced the result.

Conclusions

Benzydamine hydrochloride gel on the ETT cuff is a simple and effective method to reduce the incidence and severity of POST in relation to lidocaine and saline. Application of 10% lidocaine spray should be avoided because of worsening of POST where incidence and severity is increased. Applying 5% lidocaine gel on the ETT cuff does not prevent POST but better than lidocaine 10% spray or saline.

Conflicts of interest

The authors declare no conflicts of interest.

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