Effectiveness of the Sellick maneuver for painless gastroscopy in patients with esophageal hiatal hernia: a Randomized, self-control trial

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Research Article

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Abstract

Background

Sellick maneuver is used for endotracheal intubation to prevent the occurrence of gastroesophageal reflux. Our study was to observe the effect of the Sellick maneuver on safety, esophageal closure status, gastric mucosal fold extension status, and positive detection rate of lesions in patients with esophageal hiatal hernia under painless gastroscopy.

Methods

Forty patients with esophageal hiatal hernia who underwent painless gastroscopy were screened for the Sellick maneuver, in which the operator applied pressure to the cervical cricoid cartilage during the examination. Compared with no-Sellick maneuver, we observed and recorded the status of esophageal closure at the pressing area, examination time, gastric mucosal fold extension score, positive rate of lesion detection, reflux of gastric juice or gastric contents, etc.

Results

After using the Sellick maneuver, the state of esophageal closure during gastroscopy was significantly better than the no-Sellick maneuver (P < 0.05), and the extension scores of the greater curvature folds of the gastric body, the lateral folds of the lesser curvature of the gastric body, and the mucosal folds of the fundus were significantly higher than that of the no-Sellick maneuver (P < 0.05). The number of gastric polyps examined with the Sellick maneuver was significantly more than no-Sellick maneuver (P < 0.01), and the number of gastric lesions examined (gastric ulcers, mucosal hyperplasia, etc.) was also significantly higher with the Sellick maneuver than no-Sellick maneuver (P < 0.01). The examination time was shorter with the Sellick maneuver than no-Sellick maneuver (p < 0.01). Reflux of gastric juice or gastric contents was superior to the no-Sellick maneuver (p < 0.01). The Sellick maneuver did not increase the degree of choking, as well as SPO₂ variability and heart rate variability.

Conclusions

The Sellick maneuver effectively improved the extension of gastric mucosal folds during gastroscopy in patients with esophageal hiatal hernia, increased the positive detection rate of gastric lesions, and shortened the endoscopy time, while not increasing the incidence of cardia lacerations and didn’t affect the patient’s voluntary breathing.

Trial registration:
The clinical trial was registered on (14/9/2022, ChiCTR2200063683)

**Background**

Sellick maneuver is a technique used for endotracheal intubation in which the operator applies pressure to the cervical cricoid cartilage (at the level of the cervical 6th vertebrae) to directly compress and obstruct the posterior esophagus to prevent the occurrence of gastroesophageal reflux.

During the painless gastroscopy procedure, gas is pumped into the stomach to fully extend the gastric folds, allowing the endoscopist to detect mucosal lesions in the stomach. The effect of gastric inflation is related to the function of the cardia, if the patient has a disease such as esophageal hiatal hernia [1], the normal contraction and closing function of the cardia sphincter will be affected. Because gas can leak into the esophagus through the cardia during gastroscopy inflation, the mucosa of the gastric folds cannot be fully expanded, thus affecting the endoscopist's observation of gastric mucosal lesions and resulting in a missed diagnosis[2]. In addition, gastroesophageal reflux disease, upper gastrointestinal bleeding, intestinal obstruction, and insufficient fasting time may lead to the aspiration of gastric contents during painless gastroscopy, which may cause aspiration pneumonia in severe cases [3, 4].

The Sellick maneuver can close the upper esophagus, whether it is beneficial to promote gastric insufflation during gastroscopy and promote gastric mucosal extension while reducing the occurrence of aspiration pneumonia caused by gastric reflux, its clinical application deserves further investigation. Therefore, our study aims to evaluate the effectiveness of the Sellick maneuver in painless gastroscopy of patients with esophageal hiatal hernia.

**Methods**

This study was approved by the institutional review board of our hospital (no. W202208-1) and registered before patient enrollment at Chinese Clinical Trials Registry. Gov (ChiCTR2200063683, principal investigator: Li Zhang, date of registration: September 14, 2022, registry Url: http://www.chictr.org.cn/edit.aspx?pid=177929&htm=4). After written informed consent was obtained, adult patients (ASA 1–3, aged 30–65 years) scheduled for elective painless gastroscopy under general anesthesia were recruited for the study (Age, gender, and other general information are shown in Table 1). Exclusion Criteria: Poor gastric emptying with residual food in the stomach; active bleeding in the upper gastrointestinal tract; severe cardiopulmonary disorders. Patients signed the study informed consent form before the painless operation. After admission to the gastroscopy suite, routine blood pressure, heart rate, and oxygen saturation monitoring was performed, and peripheral venous access was established. Slowly administer propofol 1.5-3mg/kg intravenously until the patient loses consciousness and eyelash reflex, then the gastrointestinal endoscopist starts the gastroscopy. All cases were performed by the same experienced gastrointestinal endoscopist.
A patient was formally included in this study if the gastrointestinal endoscopist proposed to diagnose a hiatal hernia in the esophagus during painless gastroscopy. First, the gastroscopy is performed from the upper esophagus without the Sellick maneuver, after which the anesthesiologist performs the Sellick maneuver, which involves the application of 30 Newton pressure to the cricoid cartilage[5, 6], and the gastroscopist performs the gastroscopy again. After the operation, the patient was sent to the anesthesia recovery room until awakening.

Observed indicators

Closed status of the esophagus at the location of compression (0–2 points): complete closure of the esophagus without air leakage: 2 points; partial closure of the esophagus with small air bubbles seen: 1 point; poor closure of the esophagus: 0 points. Stomach mucosal fold extension score (0–3 points): Stomach body major curvature fold extension: 1 point; stomach body minor curvature lateral fold extension: 1 point; gastric fundic mucosal fold extension: 1 point; corresponding parts not extended: 0 points. The positive detection rate of lesions in the gastric lumen (Number of polyps or number of lesions). Operating time of gastroscopy with and without Sellick maneuver in the same patient (seconds). Scoring of the number of times the patient coughed during the examination: no cough: 0 points; 1 to 2 times: 1 point; 3 to 4 times: 2 points; ≥ 5 times: 3 points. Reflux of gastric juice or stomach contents during a gastroscopy (yes/no). Blood oxygen saturation $SPO_2$ (%) variability, heart rate (beats/min) variability; Wake time (minutes).

Statistical methods

The measurement data will be statistically described by mean ± standard deviation, median, minimum, and maximum values using paired t-test or two related samples non-parametric test, and the count data will be statistically described by frequency and percentage, and the repeated measures data will be analyzed by repeated measures ANOVA. IBM SPSS26.0 statistical analysis software will be used for the statistical analysis of this experiment.

Results

A total of 45 patients were recruited in September 2022. Among them, 5 who did not meet the inclusion criteria were excluded, and 40 were included in the final analysis (Fig. 1). Patient characteristics are as follows (Table 1).

The esophageal closure status and gastric mucosal spreading score are shown in Table 2. When the gastroscope passed behind the cricoid cartilage of the esophagus, the esophageal closure status score was $0.025 \pm 0.16$ without the Sellick maneuver and $1.95 \pm 0.22$ with the Sellick maneuver, ($p < 0.01$). The extension scores of the greater curvature folds, the lateral folds of the lesser curvature of the gastric body, and the mucosal folds of the fundus were significantly higher with the Sellick method than without it ($1.0 \pm 0$ vs. $0.375 \pm 0.49$, $p < 0.01$; $1.0 \pm 0$ vs. $0.475 \pm 0.51$, $p < 0.01$; $1.0 \pm 0$ vs. $0.375 \pm 0.49$, $p < 0.01$. Figure 2).
The total gastric mucosal fold extension score was also significantly higher after the Sellick maneuver than without the Sellick maneuver (3.0 ± 0 vs. 1.23 ± 0.70, p < 0.01. Figure 2).

The number of gastric polyps examined with the Sellick method was 0.725 ± 1.13, significantly more than 0.325 ± 0.57 without the Sellick method (p < 0.01), the number of gastric lesions (gastric ulcers, mucosal metaplasia, etc.) detected by the Sellick method was also significantly higher than that by the no-Sellick method (2.475 ± 1.80 vs. 1.4 ± 1.13, p < 0.01. Table 2). Painless gastroscopy time was shorter with the Sellick method than without the Sellick method (97.93 ± 15.74 seconds vs. 117.48 ± 18.84 seconds, p < 0.01. Table 2). Reflux of gastric juice or gastric contents was better with the Sellick method than without it (13/40 vs 0/40, p < 0.01. Table 3). Choking scores were also significantly lower in the Sellick maneuver than in the non-Sellick maneuver (0.125 ± 0.33 vs 0.55 ± 0.60, p < 0.01. Table 3).

SPO2 variability and heart rate variability were also significantly different between the Sellick maneuver and the non-Sellick maneuver (0.85 ± 1.23 vs 2.72 ± 2.01, 3.63 ± 2.16 vs 5.0 ± 2.29, p < 0.01. Table 3).

**Discussion**

Cricoid pressure (CP) is commonly used during the induction of general anesthesia to prevent passive reflux of gastric contents, also known as the Sellick maneuver. Dr. Sellick demonstrated in 1961 that occlusion of the esophagus by cricoid cartilage compression on a cadaver could prevent the flow of barium from the stomach to the pharynx, and he reported the successful use of this technique in 26 "satiated" cases [7–9]. The Sellick maneuver prevents gas from entering the stomach during mask ventilation and prevents gastric contents from flowing back into the trachea. Although its efficacy remains controversial [3, 10, 11], the Sellick maneuver has become more commonly used to prevent gastric reflux in the induction of anesthesia in patients with a full stomach in the emergency setting[12]. The results of Rice et al. also strongly support the efficacy of the Sellick maneuver in occluding the digestive tract after compression of the cricoid cartilage[13].

In a before-and-after comparison of 40 patients diagnosed with cardia relaxation or esophageal hiatus hernia during painless gastroscopy, we found that the state of esophageal closure was significantly better with the Sellick maneuver than without the Sellick maneuver. The extension scores of the greater curvature of the gastric body fold, the lateral folds of the lesser curvature of the gastric body, and the mucosal folds of the fundus were significantly higher than those without the Sellick maneuver (Fig. 2). The number of gastric polyps and gastric lesions (gastric ulcers, mucosal metaplasia, etc.) detected with the Sellick maneuver was significantly higher than without the Sellick maneuver. Inspection time using the Sellick maneuver is shorter than the no-Sellick maneuver. The reflux of gastric juice or gastric contents is also better with the Sellick maneuver than without it. Studies have shown that in the absence of cricoid cartilage pressure, the esophagus is lateral to the cricoid cartilage in more than 50% of people, and that pressure on the cricoid cartilage further moves the esophagus and larynx laterally [14]. A recent study suggests that cricoid pressure was more effective than paratracheal pressure in occluding the esophagus[6]. In the present study, we also observed that the gastroscope usually enters the esophagus
from the side of the tracheal opening, and through the cricoid cartilage compression, we very clearly saw that the compressed esophageal area was tightly wrapped with the gastroscope, and from the extension state of the gastric mucosa, the gas was tightly sealed in the esophagus and stomach below the cricoid cartilage compression site, thus making the stomach of the patient with hiatal hernia distended and easy for the endoscopist to operate and observe. The previous experience of the endoscopist was to increase the flow rate and flow of gas to compensate for the gas leakage through the esophageal hiatal hernia, which often did not improve the degree of gastric mucosal extension. After using the Sellick maneuver, the gastric lumen filled well and the extension of the folds improved the efficiency of the endoscopist and shortened the examination time.

Similarly, since the Sellick maneuver resulted in complete esophageal closure, there were fewer incidents of gastric contents and acid reflux than in endoscopic procedures without the Sellick maneuver, which is consistent with the results of previous studies [15], however, some studies believe that the use of Sellick maneuver in clinical guidelines cannot prevent pulmonary aspiration in all patients[3]. In addition, in this study, the Sellick method did not increase the degree of choking, as well as changes in SPO$_2$ and heart rate, etc. There is no need to worry about the suppression of the patient's breathing by compressions.

This study also has some limitations in terms of the intensity of compression, which requires appropriate pressure according to the physiology of the patient's cricoid cartilage and esophagus, and training of those who must perform this operation is essential [16]. In addition, during the operation, the anesthesiologist needs to cooperate with the endoscopist to prevent the occurrence of cardia laceration due to overinflation of the stomach.

Conclusions

The use of the Sellick maneuver in painless gastroscopy of patients with esophageal hiatal hernia can improve the extension of the gastric mucosa, reveal a clearer view of the endoscope, and increase the detection rate of gastric polyps and lesions. It also did not increase the incidence of cardiac lacerations and did not affect the patient's voluntary breathing, making it a simple maneuver worthy of clinical promotion.

Abbreviations

ASA: American Society of Anesthesiologists
SPO$_2$: Peripheral capillary oxygen saturation
ANOVA: Analysis of variance
SPSS: Statistical Package for Social Sciences
CP: Cricoid pressure
Declarations

Ethics approval and consent to participate

The experimental protocol was established, according to the ethical guidelines of the Helsinki Declaration and was approved by the Human Ethics Committee of Wuhan No.1 Hospital. Written informed consent was obtained from individual or guardian participants.

Consent for publication

Not applicable.

Availability of data and material

The datasets used or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable

Authors’ contributions

Li Zhang: Conceptualization, Methodology, Data Curation, Writing - Original Draft. Shu Lei: Investigation, Data Curation. Zhaohong Shi: Methodology. Zhijun Chen: Writing - Review & Editing.

Acknowledgments

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References


Tables

Table 1. General Information
<table>
<thead>
<tr>
<th>Patient characteristic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (male/female)</td>
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</tr>
<tr>
<td>Age (years)</td>
<td>56.40±12.87</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>167.10±9.73</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>69.98±7.51</td>
</tr>
<tr>
<td>Systolic blood pressure mmHg</td>
<td>132.9±12.09</td>
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<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>70.53±12.09</td>
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<tr>
<td>Heart rate (beats/min)</td>
<td>75.05±9.55</td>
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<tr>
<td>SPO₂ (%)</td>
<td>99.28±1.01</td>
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<tr>
<td>Propofol dosage (mg)</td>
<td>137.75±15.77</td>
</tr>
<tr>
<td>Wake-up time (min)</td>
<td>5.71±0.85</td>
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</table>

Table 2. Comparison of esophageal closure status and gastric mucosal spreading score, number of polyps/lesions detected

<table>
<thead>
<tr>
<th></th>
<th>No Sellick maneuver</th>
<th>Sellick maneuver</th>
<th>T-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophageal closure status</td>
<td>0.025±0.16</td>
<td>1.95±0.22</td>
<td>-45.64</td>
<td>0</td>
</tr>
<tr>
<td>Gastric greater curvature fold spreading score</td>
<td>0.375±0.49</td>
<td>1.0±0</td>
<td>-8.06</td>
<td>0</td>
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<tr>
<td>Gastric lesser curvature fold spreading score</td>
<td>0.475±0.51</td>
<td>1.0±0</td>
<td>-6.57</td>
<td>0</td>
</tr>
<tr>
<td>Gastric fundic mucosal fold spreading score</td>
<td>0.375±0.49</td>
<td>1.0±0</td>
<td>-8.06</td>
<td>0</td>
</tr>
<tr>
<td>The total score of gastric mucosal fold spreading</td>
<td>1.23±0.70</td>
<td>3.0±0</td>
<td>-16.09</td>
<td>0</td>
</tr>
<tr>
<td>Number of polyps detected</td>
<td>0.325±0.57</td>
<td>0.725±1.13</td>
<td>-3.57</td>
<td>0.001</td>
</tr>
<tr>
<td>Number of lesions</td>
<td>1.4±1.13</td>
<td>2.475±1.80</td>
<td>-7.65</td>
<td>0</td>
</tr>
<tr>
<td>Operating time (sec)</td>
<td>117.48±18.84</td>
<td>97.93±15.74</td>
<td>10.66</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3. Comparison of choking, regurgitation, SPO₂, and heart rate variability.
### Figures

**Assessed for eligibility (n = 45)**

- Excluded (n = 5)
  - Not meeting inclusion criteria (n = 5)
  - Declined to participate (n = 0)
  - Other reasons (n = 0)

**Randomized (n = 40)**

- Administer propofol 1.5-3 mg/kg intravenously, the gastrointestinal endoscopist starts the gastroscopy. No Sellick maneuver first, the Sellick maneuver second (n = 40)

**Data collection (n = 40)**
- Excluded cases (n = 0)

**Analysed (n = 40)**
- Excluded analysis (n = 0)

**Figure 1**

CONSORT flow diagram of participants.
Figure 2

Comparison of gastroscopic extension of gastric mucosa under the No Sellick maneuver and Sellick maneuver.