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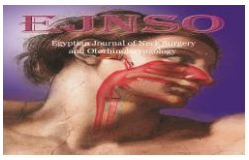

Lingual nerve paresthesia after endoscopic laryngeal surgery

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Abstract:

Objective: To investigate demographic, anatomical, procedural, and intraoperative variables associated with the development of LNP.

Patients and Methods: A total of 196 adult patients who underwent SL were retrospectively analyzed. Patients were divided into two groups: those who developed LNP (n = 38) and those who did not (n = 158). The two groups were compared regarding the demographic, anatomical, procedural, and intraoperative variables under investigation.

Results: Among 196 patients, 38 (19.4%) developed lingual nerve paresthesia (LNP), significantly more common in females (71.1% vs. 34.8%, $p < 0.001$). LNP was associated with a two-finger inter-incisor gap (68.4%, $p = 0.004$), large tongue size (68.4%, $p < 0.001$), and higher Mallampati scores (Class III–IV in 63.2%, $p < 0.001$). Difficult airway management was more frequent in the LNP group during preoperative (57.9% vs. 7.0%, $p < 0.001$) and intraoperative phases (28.9% vs. 6.3%, $p < 0.001$). LNP patients had longer surgeries (≥21 minutes in 84.3%, $p < 0.001$), and more often had the tube on the affected side (76.3%, $p < 0.001$).

Conclusion: Female gender, limited inter-incisor gap, large tongue size, high Mallampati score, procedural difficulties, prolonged operation time, ipsilateral tube placement, and smaller tube size are significant risk factors for lingual nerve paresthesia following suspension laryngoscopy.

Keywords: Endoscopic Laryngeal Surgery, Lingual Nerve, Lingual Nerve Paresthesia, Suspension Laryngoplasty.

Introduction

Suspension laryngoscopy (SL) is routinely utilized in laryngeal surgeries. However, the complications associated with this procedure have been sparsely addressed in the literature. [1] One notable extra-laryngeal complication is lingual nerve injury (LNI), whose reported incidence varies across studies from an uncommon event to a relatively frequent event. [2,3] SL involves the insertion of a rigid laryngoscope into the throat of an anesthetized patient, along with an endotracheal tube. The laryngoscope blade is typically positioned against the tongue base, exerting considerable pressure.[4] This pressure, stretching caused by cricoid manipulation or instrumentation, and compression between the medial and lateral pterygoid muscles during mandibular movement, contribute to LNI. [2]

Patients with LNI may experience distressing symptoms such as numbness, tingling, burning sensation, dysgeusia

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(altered taste), and, less frequently, speech disturbances or drooling. [3] These symptoms can be both troubling for the patient and challenging for the surgeon. Fortunately, most cases are transient and resolve within a few weeks.[5] Nevertheless, such complications have medical-legal implications, underscoring the importance of identifying and minimizing potential risks. Several studies have highlighted factors potentially associated with post-laryngeal suspension lingual nerve injury (PLSLNI), including patient gender, relative tongue size, inter-incisor gap, difficulty in preoperative flexible fiberoptic examination, challenging intubation, prolonged operation time, intraoperative laryngeal compression, and Mallampati classification. [3-5]

Therefore, this study aimed to identify the potential risk factors associated with PLSLNI following suspension laryngoscopy to predict, prevent, and manage this complication.

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Patients and methods:

This observational case-control study was conducted at the Otorhinolaryngology Department of Menoufia University Hospital and MOC Private Hospital between March 2018 and June 2022. The study was conducted after the approval of the institutional review board. Informed consent was obtained from all participants. Confidentiality and patient rights were maintained throughout the study.

A total of 196 adult patients more than 18 years old who underwent micro-laryngeal surgery (MLS) using the standard suspension laryngoscopy (SL) technique under general anesthesia were included. All procedures were performed by surgeons with over 10 years of experience in MLS. Patients who had undergone any dental procedure within the preceding three months were excluded to avoid confounding factors related to lingual nerve injury (LNI).

Preoperative assessments included documentation of age, sex, inter-incisor gap, relative tongue size, Mallampati classification, and any difficulties encountered during preoperative flexible fiberoptic laryngeal examination. The inter-incisor gap was measured in the sitting position using finger breadth (≤1, 2, or 3 fingers). Relative tongue size was classified as small, average, large, or very large. Mallampati scores were recorded for all patients. Difficulties during preoperative flexible fiberoptic laryngeal examination were noted, including the need for topical anesthesia or failure to perform the procedure despite anesthesia. Difficult intubation was defined as the need for special techniques due to poor glottic visualization in standard positioning. Laryngeal suspension was considered difficult when adequate exposure could not be achieved despite maximum suspension and external laryngeal pressure, requiring more than one adjustment of the laryngoscope. Operative procedures involved various endoscopic laryngeal surgeries, including biopsies, excision of small lesions, and phonomicrosurgeries. All surgeries were performed using cold steel instruments without laser energy. Standard operating laryngoscopes (Kleinsasser type, medium and large; Karl Storz, Tuttlingen, Germany) were selected based on the patient's anatomy. Laryngoscope holders and chest supports (Göttingen model, Karl Storz) were used in all cases. Medical gauze was used to protect the teeth in dentate patients, while silicone dental guards were applied for edentulous patients. Operation time was recorded from the point of suspension setup to the removal of the suspensor and was categorized as follows: <5 minutes, 5–10 minutes, 10–

15 minutes, 15–20 minutes, 20–25 minutes, and >25 minutes. Tube size and position (same side vs. opposite) were also documented. Postoperatively, lingual nerve function was assessed 48 hours after surgery. Patients reporting unilateral or bilateral paresthesia, numbness, tingling, burning, altered taste sensation (dysgeusia), or anesthesia of the tongue were considered to have LNI.

Statistical analysis:

Data was analyzed using IBM SPSS Statistics 28.0 software (IBM Corp., Armonk, NY, USA). Qualitative variables were expressed as numbers and percentages. The chi-squared test was used to compare qualitative data. An independent t-test was used to compare quantitative variables. An initial p-value less than 0.05 was considered statistically significant, which was adjusted with Bonferroni Correction to be 0.00625.

Results

Demographic and Preoperative Airway Assessment Characteristics

Among the 196 adult participants, 38 patients (19.4%) developed lingual nerve paresthesia (LNP), while 158 (80.6%) did not. There was a non-significant difference between the two groups regarding age ($p = 0.222$). Female patients had a significantly higher incidence of LNP (71.1%) compared to males (28.9%) ($p < 0.001$). An inter-incisor gap of two fingers was the most common among the LNP group (68.4%), while three fingers were more common in those without LNP (46.2%) ($p = 0.004$). A large tongue size was present in 68.4% of LNP patients versus 27.8% in the non-LNP group ($p < 0.001$). High Mallampati scores were more frequent in the LNP group, with 50.0% scoring Class III and 13.2% Class IV, compared to 7.0% and 1.3% respectively in the non-LNP group ($p < 0.001$) (Table 1).

Difficulties Encountered During Airway Management

The preoperative flexible fiberoptic examination was difficult in 57.9% of patients who developed LNP, while only 7.0% of those without LNP experienced such difficulty ($p < 0.001$). Similarly, intraoperative difficulties during intubation or laryngeal suspension were encountered in 28.9% of the LNP group compared to only 6.3% in the non-LNP group ($p < 0.001$). These findings suggest a strong association between challenging airway management and the occurrence of LNP (Table 2).

Operative Characteristics and Tube Position

A significantly longer operation time was observed in the LNP group, with 63.2% undergoing procedures lasting 21–25 minutes and 21.1% exceeding 25 minutes, compared to only 1.9% and 3.2% respectively in the non-LNP group ($p < 0.001$). Regarding tube site, 76.3% of LNP cases had the tube inserted on the same side as the affected nerve, versus 51.1% in the non-LNP group ($p < 0.001$). There was a non-significant difference between LNP and Non-LNP groups regarding tube size ($p=0.078$) (Table 3).

Table 1. Demographic and Preoperative Airway Assessment Characteristics of Study Participants

Variable	Category	LNP (N = 38)	No LNP (N = 158)	p-value
Age (Mean ± SD)	-----	40.59 ± 1.32	43.05 ± 11.49	0.222
Gender	Male	11 (28.9%)	103 (65.2%)	**<0.001**
	Female	27 (71.1%)	55 (34.8%)	
Inter-incisor gap with denture (in edentulous patients, fingers)	<1 Finger	0 (0.0%)	1 (0.6%)	**0.004**
	1 Finger	4 (10.5%)	17 (10.8%)	
	2 Fingers	26 (68.4%)	67 (42.4%)	
	3 Fingers	8 (21.1%)	73 (46.2%)	
Relative Tongue Size	Small	0 (0.0%)	5 (3.2%)	**<0.001**
	Average	7 (18.4%)	104 (65.8%)	
	Large	26 (68.4%)	44 (27.8%)	
	Very Large	5 (13.2%)	5 (3.2%)	
Mallampati Score	Class I	2 (5.3%)	67 (42.4%)	**<0.001**
	Class II	12 (31.6%)	78 (49.4%)	
	Class III	19 (50.0%)	11 (7.0%)	
	Class IV	5 (13.2%)	2 (1.3%)	

LNP: Lingual Nerve paresthesia.
SD: Standard Deviation

Table 2. Difficulties Encountered During Airway Management

Variable	Response	LNP (N = 38)	No LNP (N = 158)	p-value
Difficulties in preoperative flexible fiberoptic examination	Yes	22 (57.9%)	11 (7.0%)	**<0.001**
	No	16 (42.1%)	147 (93.0%)	
Difficulties during intraoperative intubation/laryngeal suspension	Yes	11 (28.9%)	10 (6.3%)	**<0.001**
	No	27 (71.1%)	148 (93.7%)	

LNP: Lingual Nerve Paresthesia.

Table 3. Operative Characteristics and Tube Position

Variable	Category	LNP (N = 38)	No LNP (N = 158)	p-value
Operation Time (minutes) ***(from fixation to removal of the direct laryngoscope)***	5–10	0 (0.0%)	29 (18.4%)	**<0.001**
	11–15	5 (13.2%)	71 (44.9%)	
	16–20	1 (2.6%)	50 (31.6%)	
	21–25	24 (63.2%)	3 (1.9%)	
	>25	8 (21.1%)	5 (3.2%)	
Tube Site (Oral)	Same	29 (76.3%)	72 (51.1%)	**<0.001**
	Opposite	9 (23.7%)	69 (48.9%)	
Tube Size (Mean ± SD)	—	5.9 ± 0.3	6.1 ± 1.3	0.078

LNP: Lingual Nerve Paresthesia.

Discussion:

Lingual nerve paresthesia is an uncommon yet significant complication following endoscopic laryngeal surgery. It is primarily attributed to mechanical pressure, traction, or prolonged instrumentation during airway management. [6] Identifying potential risk factors is essential for prevention and improved patient safety. This study aimed to investigate the clinical and procedural variables associated with postoperative lingual nerve injury.

Our study found that female patients and those with larger tongue size, reduced inter-incisor gap, and higher Mallampati scores were more likely to develop lingual nerve paresthesia. Difficulties during preoperative airway assessment and intraoperative intubation were significantly associated with increased risk of nerve injury. Additionally, prolonged operation time, use of smaller endotracheal tubes, and placing the tube on the same side as the affected nerve were strongly linked to the incidence of paresthesia. These findings highlight the importance of careful airway evaluation, surgical techniques, and equipment selection to minimize the risk of lingual nerve damage.

Our study demonstrated a significant association between female gender and the development of lingual nerve paresthesia after endoscopic laryngeal surgery. This finding aligns with previous research suggesting that anatomical and hormonal differences may predispose females to nerve injuries during airway instrumentation. [7] A study by **de Sousa et al**. has reported higher rates of tongue-related sensory disturbances in females, which may be linked to tissue compliance and mucosal sensitivity differences between sexes. [8]

Our study also found that patients with a reduced inter-incisor gap and larger tongue size were more likely to experience lingual nerve injury. These anatomical characteristics have been previously recognized as predictors of difficult airway, which increases the risk of mechanical pressure on the lingual nerve during instrumentation. Literature from **Chaudhary, and Singh et al.** supported this observation, emphasizing that limited oral access and larger tongue volume challenge laryngoscope insertion, potentially leading to compressive nerve injury. [9-10]

Our findings indicated that higher Mallampati scores were more prevalent in patients who developed lingual nerve paresthesia. This supports prior work by **Merola et al.,** who found that patients with higher Mallampati classes were more likely to experience airway-related complications due to suboptimal visualization and increased force during intubation. [11] These mechanical factors may contribute to nerve compression, especially in procedures requiring prolonged oropharyngeal manipulation.

Our study further revealed that preoperative fiberoptic airway assessment was more difficult in patients who developed lingual nerve paresthesia. This is consistent with research by **Ozdamar et al.** and **Shah et al.,** who highlighted that anatomical variations leading to preoperative examination challenges were often the same factors that predispose to airway trauma and neuropathy.[12] Moreover, our observation that intraoperative intubation and laryngeal suspension were more difficult in affected patients supports earlier findings by **Ozdamar et al.,** suggesting that increased manipulation during difficult intubation may contribute to lingual nerve injury. [6]

Our study showed a clear link between prolonged operative duration and the development of lingual nerve paresthesia. Previous studies by **Węgiel et al**. have similarly concluded that extended laryngoscope use exerted sustained pressure on the tongue base and floor of the mouth, increasing the risk of nerve compression and ischemia.

[13] These findings emphasize the importance of minimizing laryngoscope time to reduce postoperative complications.

Our study also identified that placing the endotracheal tube on the same side as the injured nerve was significantly more common among affected patients. This observation is supported by reports from **Tikka et al.,** who suggested that tube positioning, especially when combined with lateral tongue compression, could result in asymmetric nerve pressure. [14]

Our findings highlight the potential for developing a comprehensive risk assessment score to predict the likelihood of lingual nerve paresthesia following endoscopic laryngeal surgery. By integrating key factors such as gender, tongue size, inter-incisor gap, Mallampati class, preoperative and intraoperative airway management difficulties, operative duration, tube size, and tube position, clinicians can better stratify patients according to their risk level. Such a scoring system would aid in preoperative planning, guide airway management strategies, and inform surgical teams of the need for extra precautions in high-risk cases, ultimately improving patient safety and reducing the incidence of nerve injury.

The strength of our study lies in its detailed evaluation of multiple preoperative and intraoperative variables and their association with lingual nerve paresthesia. The use of a well-defined patient cohort and clear outcome measures enhanced the reliability of our results. Although we initially aimed to develop a predictive risk assessment score for lingual nerve paresthesia based on the identified variables, the dataset did not fulfill the statistical assumptions required for logistic regression modeling, such as linearity of log odds, adequate sample size per outcome variable, and absence of multicollinearity. As a result, we were unable to construct a reliable multivariable prediction model. Future studies with larger and more diverse cohorts may allow for the development and validation of such a risk scoring system.

Conclusion

Our study identified several significant risk factors associated with LNI occurrence, including female gender, limited inter-incisor gap, large tongue size, high Mallampati scores, difficult preoperative and intraoperative airway management, prolonged operative time, ipsilateral tube placement, and smaller endotracheal tube size.

Although LNP is often transient, its impact on patient comfort and surgeon responsibility highlights the need for thorough preoperative assessment and careful intraoperative technique.

Recognizing these risk factors can help clinicians anticipate and minimize the likelihood of LNP, thus improving surgical outcomes and reducing medico-legal concerns.

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