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Ultrasound-Guided Modified Anterior Approach Superior Laryngeal Nerve Block Combined with Remimazolam in Bronchoscopic diagnosis and Therapeutic Bronchoscopy: A Randomized controlled Trial

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ABSTRACT

Background: Bronchoscopy is essential for diagnosis and therapy, yet conscious procedures cause significant patient discomfort, potentially leading to procedure termination, while general anesthesia brings risks like airway obstruction and delayed recovery. Ultrasound-guided superior laryngeal nerve block via the anterior approach (UG-MAA-SLNB) offers precise anesthesia with fewer complications and reduces the number of manipulation attempts. Remimazolam provides rapid, controllable sedation. This study assesses their combination to enhance patient comfort and hemodynamic stability during bronchoscopy.

Methods: A total of 60 patients scheduled for bronchoscopy were randomly assigned into two groups. The experimental group (n=30) received UG-SLNB combined with remimazolam, while the control group (n=30) underwent conventional conscious anesthesia. Patient comfort was evaluated using a grading scale, and vital signs, including heart rate and blood pressure, were monitored throughout the procedure, and adverse events were recorded.

Results: Patients in the experimental group exhibited significantly better vocal cord mobility, reduced cough severity, and improved comfort levels compared to the control group. Furthermore, hemodynamic parameters remained more stable in the experimental group post-intervention.

Conclusion: UG-MAA-SLNB combined with remimazolam demonstrates significant clinical benefits in bronchoscopy, effectively stabilizing heart rate and mean arterial pressure. This approach shows promise for broader application in clinical practice. Future studies are warranted to explore the stability of this technique during tracheal intubation in bronchoscopy.

Keywords: Anesthesia; Bronchoscopy; Superior Laryngeal Nerve Block; Remimazolam

Introduction

In recent years, the technology and application of bronchoscopy have made rapid advancements and play a key role in the diagnosis of bronchopulmonary diseases [1]. During bronchoscopic procedures may lead to severe cough, chest tightness, and laryngospasm during the process [2]. Therefore, in order to alleviate the discomfort and anxiety of patients during diagnosis and treatment, and create better operating conditions for doctors, anesthesiologists are required to continuously improve the standards of anesthesia techniques used in bronchoscopy [3]. Due to the uneven development among different regions and different levels of hospitals, there is still a lack of unified standards for the anesthesia regimen of bronchoscopy in academia [4]. At present, conventional anesthesia methods include trachea topical anesthesia and general anesthesia [5]. However, there are

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some problems in the above anesthesia methods, such as imperfect block effect, airway obstruction, mechanical trauma, bronchospasm, laryngospasm [6, 7]. But now, ultrasound-guided superior laryngeal nerve block (UG-SLNB) has a high implementation value and is widely used. It has been successfully applied to awake fiber optic bronchoscopy-guided intubation and can provide comprehensive airway anesthesia [8]. Meanwhile, the rapid sedative induction and short recovery time of remazolam have been confirmed in clinical trials [9]. Therefore, the purpose of this study was to explore whether ultrasound-guided superior laryngeal nerve block combined with remazolam can become a new anesthesia method for bronchoscopy.

At the same time, our study adopted a bilateral block different from the traditional superior laryngeal nerve, and tried to use a simpler modified anterior superior laryngeal nerve block (UG-MAA-SLNB).

Materials and Methods

Patients

Sixty patients aged from 50–75 years, with American Society of Anesthesiologists (ASA)physical status of I–II who underwent bronchoscopy in Anyang Tumor Hospital from October 7,2024 to October 30,2024 were selected and divided into study group and control group according to the random number table method, with 30 cases in each group. Patients and their families signed informed consent. This was a single-center study designed according to the CONSORT statement [Fig.1] and approved by the Institution Review Board (Ethics Commission of Anyang Tumor Hospital, review number:2024KY20J01; Registered at the China Clinical Trial Registry Center, registration number: ChiCTR2400090103).

Inclusion and Exclusion Criteria

- The inclusion criteria for the study were:

1. requirement for bronchoscopic examination, including but not limited to suspected lung cancer, bronchial stenosis, or suspected hemoptysis;
2. no known allergy to anesthetic drugs;
3. no severe coagulopathy or bleeding tendency.

- The exclusion criteria were:

1. allergy to local anesthetic drugs, presence of severe cardiovascular disease, respiratory failure, or impaired consciousness;
2. BMI>30 or anatomical abnormalities of the neck or throat that may interfere with ultrasound
3. localization;
4. pregnant or breastfeeding women.

Anesthesia

All patients were instructed to maintain nil per os (NPO) status for 8 hours and restrict fluid intake for 2 hours prior to the procedure. Premedication with opioids or sedatives was omitted. After being transferred to the treatment room, patients received supplemental oxygen via nasal cannula at 5 L/min, and standard monitoring including electrocardiogram, pulse oximetry, and blood pressure was initiated to establish baseline hemodynamic parameters. Both groups underwent intravenous administration of 5 mg remazolam (with a supplementary dose of 2.5 mg as needed) for procedural sedation [10-12]. During the procedure, symptomatic treatment was administered as follows: when mean arterial pressure (MAP) decreased by >30% from baseline, 0.25 mg m-hydroxylamine was given; when MAP increased by >30% from baseline, 10 mg urapidil was administered; and when heart rate (HR) exceeded 110 beats/min, 20 mg esmolol was administered with repeat dosing allowed as clinically indicated. All ultrasound procedures were performed by qualified physicians.

Control group (Group C): Conventional tracheal surface anesthesia was administered to patients. 2%lidocainewassprayed using fiberoptic bronchoscopy (FOB).

Experimental group (group N): UG-MAA-SLNB was performed on the basis of the control group, and 2%lidocaine5-6mlwas injected.

Modified anterior UG-SLNB: During the modified ultrasound-guided anterior superior laryngeal nerve block (UG-MAA-SLNB), patients were placed in the supine position. After surgical site cleaning and sterile draping, a 38-mm high-frequency linear transducer was transversely positioned ver the tracheal cartilage (TC) (Figure 1) [13]. The probe was then moved cephalad until the thyroid incisura notch was clearly visualized. Bilateral SLNB was performedusinga22G50-mm nerve block needle via an out-of-plane approach: a single injection of 5-6mL2%lidocaine was administered at the midline, targeting the space above the thyrohyoid membrane (TH-Mb), with the needle tip superficial to the TH-Mb. Following lidocaine injection, the TH-Mb and pre-epiglottic space were observed to displace downward due to fluid diffusion (Figure 2) [14-15].

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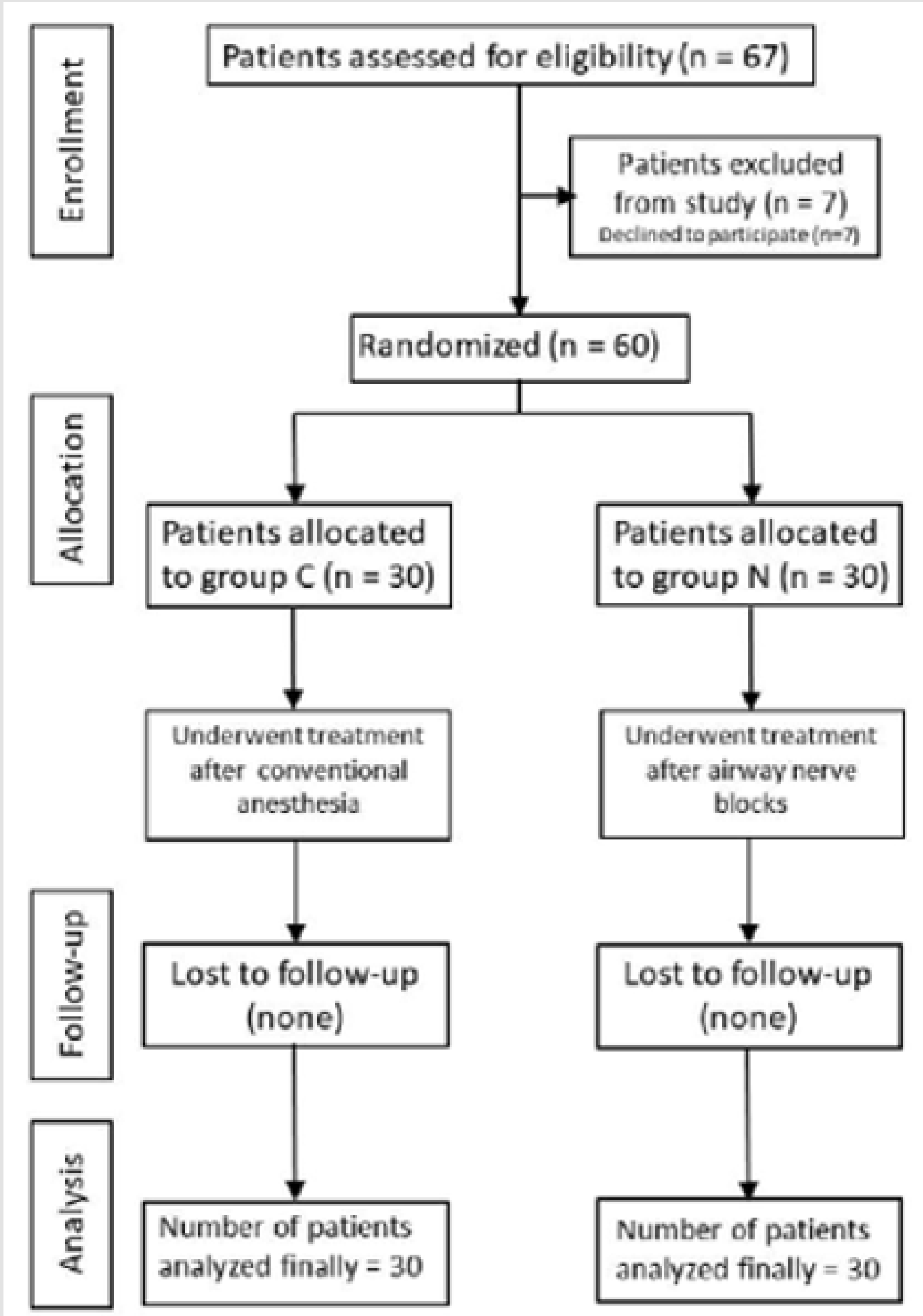

Figure 1: CONSROT Flow diagram.

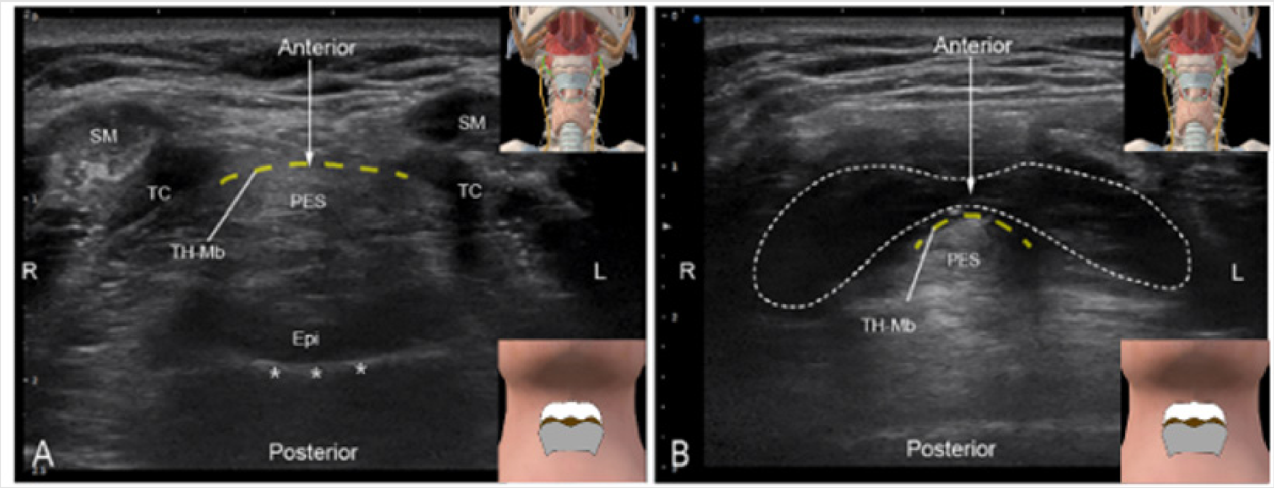

Figure 2: Transverse sonography of the modified ultrasound-guided anterior superior laryngeal nerve block (UG-MAA-SLNB). (A) Midline transverse plane ultrasound image at the level of the thyroid notch. The thyrohyoid muscle (TH-Mb) is identified on ultrasound, bounded anteriorly by the thyroid cartilage (TC) and posteriorly by the posterior belly of the digastric muscle (Pes). (B) During performance of SLNB via the modified anterior approach, lidocaine was injected into the space anterior to the TH-Mb. Lidocaine was visualized pushing the TH-Mb and rapidly diffusing into the lateral Para glottic space.

Observation Indexes

We recorded the mean arterial pressure (MAP) and heart rate (HR) of the patient sat baseline (T0), when the fiberoptic bronchoscope entered the glottis (T1), and when it passed through the glottis into the trachea (T2). Meanwhile, independent observers recorded the patients' vocal cord movement, coughing, and comfort during the procedure (Table 1).

Table 1: Grade System.

	Vocal cord position	Cough severity	Comfort during operation
Grade 1	Relaxed	No cough	Cooperative
Grade 2	Glottis open Moving	Slight (2≤ coughs)	Grimacing
Grade 3	Glottis Partially open	Moderate (3-5 coughs)	Defensive movements
Grade 4	Glottis Closed	(serve >5 cough)	

Results

Statistical analysis was performed with SPSS version 23.0 (SPSS, Inc., Chicago, Illinois, USA), and a value of $P<0.01$ was considered statistically significant. Measurement data conformed to normal distribution and were expressed as mean ± standard deviation with paired t-test between groups and repeated measures analysis of variance (Time Bonferroni correction) within groups; count data were expressed as rate (%) with chi-square test. In the results section, we will introduce the content of data analysis in detail, present the data picture, and help readers understand the meaning and value of data.

Patient Demographics

There was no significant difference in sex, age, BMI index and ASA physical status between the two groups. The general data of the two groups were consistent ($P>0.01$) and comparable.

Hemodynamic parameters (MAPs and HRs)

We initially conducted descriptive statistical analyses to gain insights into the basic characteristics of Mean Arterial Pressure (MAP) and Heart Rate (HR) within each group a teach experimental phase. Subsequently, we performed statistical tests to assess the mean differences among different groups across various stages. For each stage and group, we calculated descriptive statistics (such as means, standard deviations, etc.), and then applied independent t-tests to compare MAP and HR between Group C and Group Nat each stage (Table 2). Repeated measures ANOVA was also used to evaluate whether significant differences existed in MAP and HR within Group C and Group N across different stages (Table 3). Inter-group comparisons showed minimal differences in experimental data between the two groups at T0, with statistical analysis indicating no significance ($p > 0.01$). By contrast, significant differences in experimental data were observed at T1 and T2 ($p < 0.01$). These results suggest that Group N exhibited more stable hemodynamic parameters than Group Cunder the intervention of laryngeal nerve block. However, when plotting the estimated marginal means of MAP, we found that MAP at T2 was higher than that at T0 and T1. This observation implies that the effectiveness of laryngeal nerve block may be insufficient when the bronchoscope enters the bronchus.

Table 2: Comparison of hemodynamics parameters between two groups.

Index	Group	Time		
		T0	T1	T2
HR	C	91.23±4.64	103.90±8.65	104.07±10.24
	N	88.80±7.21	86.97±5.77	90.47±9.19
P		0.119	0.000	0.000
MAP	C	89.77±8.59	102.20±7.92	102.50±11.14
	N	86.17±7.25	86.67±7.69	89.37±5.71
P		0.107	0.000	0.000

Table 3: Comparison of hemodynamics parameters within the group.

Index	Group	Time			F	P
		T0	T1	T2		
HR	C	91.23±4.64	103.90±8.65	104.07±10.24	31.34	0.000
	N	88.80±7.21	86.97±5.77	90.47±9.19	1.94	0.153
MAP	C	89.77±1.57	102.20±1.45	102.50±2.04	23.59	0.000
	N	86.17±7.25	86.67±7.69	89.37±5.71	4.38	0.045

Vocal Cords, Cough Severity and Satisfaction

We compared vocal cord movement, cough severity, and patient comfort between the two groups, and the differences were statistically significant (p<0.01). During the operation, patients in group N showed better vocal cord movement, milder cough severity, and higher comfort levels than those in group C (Table 4).

Table 4: Vocal cords, cough severity and satisfaction.

	Vocal cord position	Cough severity	Comfort during operation
Group C	1.87±0.63	2.40±0.93	2.00±0.64
Group N	1.40±0.50	1.63±0.76	1.33±0.48
t	2.97	4.04	4.82
p	0.006	0.000	0.000

Discussion

The present study demonstrates that UG-MAA-SLNB combined with remimazolam provides superior airway anesthesia during bronchoscopy compared with conventional techniques. The experimental group exhibited significantly improved vocal cord mobility (P<0.05), reduced cough severity (P<0.05), and higher patient comfort (P<0.05). These findings align with previous reports showing that regional nerve blockage enhances procedural conditions [3]. Hemodynamic stability in the UG-MAA-SLNB group (mean arterial pressure fluctuations within 10% baseline) may be attributed to the dual mechanism of remimazolam's sedative effect and reduced laryngeal irritation. Remimazolam, a short-acting benzodiazepine with rapid ester hydrolysis [16], enables titratable sedation without cumulative toxicity [17]. This pharmacokinetic profile may explain why the experimental group showed less sympathetic activation during bronchoscopy, as evidenced by stable heart rate and blood pressure parameters. Anatomically, the superior laryngeal nerve' s internal branch inner vates the laryngeal mucosa above the vocal cords [18], making it a key target for suppressing the cough reflex. The "spray-as-you-go" technique, while widely used [19], relies on anesthetic diffusion that can be impaired by mucus or laryngeal spasm [20]. In contrast, ultrasound guidance allows precise needle placement near the nerve, ensuring effective local anesthetic spread [21]. This precision likely contributed to the experimental group's reduced cough frequency (P<0.01).

Notably, previous studies have shown that SLN blockage is more effective than topical anesthesia in blunting the stress response to airway manipulation [22, 23]. The present data extend this finding by demonstrating that combined UG-MAA-SLNB and remimazolam further attenuates hemodynamic changes, possibly by synergizing regional anesthesia with central sedation. This approach may be particularly beneficial for high-risk patients (e.g., those with cardiovascular comorbidities), who require minimized procedural stress. The study has several limitations. First, the sample size was relatively small, and long-term outcomes (e.g., post-procedure dysphonia) were not evaluated. Second, the protocol includes a comparison with other regional blocks (e.g., transtracheal anesthesia). Future research should assess the technique's efficacy in larger cohorts and across different patient populations [24,25].

Conclusion

This randomized controlled trial demonstrates that ultrasound-guided modified anterior approach superior laryngeal nerve block (UG-MAA-SLNB) combined with remimazolam significantly enhances airway anesthesia during bronchoscopic procedures. Compared with conventional conscious anesthesia, the combined approach remarkably improves vocal cord mobility, reduces cough severity, and elevates patient comfort levels, while maintaining superior hemodynamic stability, as evidenced by less fluctuation in mean arterial pressure (MAP) and heart rate (HR) during critical procedural stages (glottisen try and tracheal passage). The synergistic effect of UG-MAA-SLNB and remimazolam likely stems from the precise regional anesthesia provided by ultrasound guidance—targeting the internal branch of the superior laryngeal nerve to suppress the cough reflex—and the rapid, titratable sedation of remimazolam, which minimizes sympathetic activation. This approach may offer particular advantages for high-risk patients, such as those with cardiovascular comorbidities, by reducing procedural stress. Notably, the study has several limitations. The sample size is relatively small, and long-term outcomes (e.g., post-procedure dysphonia or delayed recovery) remain unevaluated. Additionally, the protocol does not compare UG-MAA-SLNB with other regional blocks (e.g., transtracheal anesthesia). Future investigations should enroll larger cohorts, assess long-term safety profiles, and explore the technique's stability during tracheal in tubation in bronchoscopy to further validate its clinical utility.

In conclusion, UG-MAA-SLNB combined with remimazolam represents a safe and effective anesthesia strategy for bronchoscopy, warranting broader clinical application and further research.

Author Contributions

Yuenan Hou: Data curation; formal analysis; investigation; project administration(equal); writing – original draft. Jinwen Ma: project administration (lead)

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Conflict of Interest Statement

The authors have no conflict of interest.

Data Availability Statement

All raw data and code are available upon request.

Funding Information

There was no financial support for this study.

Ethics Statement

Ethical approval was granted by the Ethics Committee of Anyang Tumor Hospital(2024KY20J01).

References

1. Russell J Miller, Roberto F Casal, Donald R Lazarus, David E Ost, George A Eapen (2018) Flexible bronchoscopy". In: Clinics in Chest Medicine 39(1): 1-16.
2. Zhang Hong Lv, Niu Yuan (2020) Construction of a risk prediction model for fever after painless bronchoscopy". In: Medical Science Monitor: International Medical Journal of Experimental and Clinical Research 26: e924911-1.
3. Sultan Qanash, Osamah A Hakami, Faisal Al Husayni, Abdul Ghafoor Gari (2020) Flexible fiberoptic bronchoscopy: indications, Diagnostic Yield and Complications". In: Cureus 12(10).
4. Nanjin Chen, Xiaodan Wang, Lingyang Chen, Mingcang Wang, Yongpo Jiang (2022) Estimation of the median effective dose and the 95%effectivedoseof alfentanil required to inhibit the bronchoscopy reaction during painless bronchoscopywith i-gel supraglottic airway device: an Up and-Down Sequential Allocation Trial". Journal of Thoracic Disease 14(5): 1537.
5. D Honey Bourne (2001) British Thoracic Society guidelines on diagnostic flexible bronchoscopy". In: Thorax 56(1): i1-i21.
6. Chris Lentini, Brianna Granlund (2023) Anesthetic Considerations for Bronchoscopic Procedures". In: Stat Pearls Publishing.
7. Pooja Rawat Mathur, Neena Jain, Aji Kumar, Beena Thada, Veena Mathur, et al. (2018) Comparison between lignocaine nebulization and air way nerve block for awake fiberoptic bronchoscopy-guided nasotracheal intubation: a single-blind randomized prospective study". In: Korean journal of anesthesiology 71(2): 120-126.
8. Andrew Sawka, Raymond Tang, Himat Vaghadia (2015) Sonographically guided superior laryngeal nerve block during awake fiberoptic intubation". In: A&A Practice 4(8): 107-110.
9. Arnold Lee, Matt Shirley (2021) Remimazolam: a review in procedural sedation". In: Drugs 81(10): 1193-1201.
10. Nicholas J Pastis, Lonny B Yarmus, Frank Schippers, Randall Ostroff, Alexander Chen, et al. (2019) Safety and efficacy of remimazolam compared with placebo and midazolam for moderate sedation during bronchoscopy". In: Chest 155(1): 137-146.
11. Douglas K Rex, Raj Bhandari, Taddese Desta, Michael P DeMicco, Cynthia Schaeffer, et al. (2018) A phase III study evaluating the efficacy and safety of remimazolam (CNS 7056) compared with placebo and midazolamin patients undergoing colonoscopy". In: Gastrointestinal endoscopy 88(3): 427-437.
12. Douglas K Rex, Raj Bhandari, Daniel G Lorch, Michael Meyers, Frank Schippers, et al. (2021) Safety and efficacy of remimazolam in highrisk colonoscopy: a randomized trial". In: Digestive and Liver Disease 53(1): 94-101.
13. Tatjana Stopar Pintaric, Kamen Vlassakov, Josip Azman, Erika Cvetko (2015) The thyrohyoid membrane as a target for ultrasonography-guided block of the internal branch of the superior laryngeal nerve". In: Journal of clinical anesthesia 27(7): 548-552.
14. G Barberet, Y Henry, L Tatu, F Berthier, G Besch, et al. (2012) Ultrasound description of a superior laryngeal nerve space as an anatomical basis for echo guided regional anesthesia". In: British journal of anesthesia 109(1): 126-128.
15. Qiyuan Huang, Yusi Hua, Ruihao Zhou, Guo Chen, Tao Zhu (2023) Modified anterior approach versus traditional posterior approach for ultrasound-guided superior laryngeal nerve block in awake endotracheal intubation: a randomized non-inferiority clinical trial". In: Annals of Medicine 55(2): 2264856.
16. Janette Brohan, Basavana G Goudra (2017) The role of GABA receptor agonists in anesthesia and sedation". In: CNS drugs 31: 845-856.
17. J Colao, Rodriguez Correa (2016) Rapidly metabolized anesthetics: novel alternative agents for procedural sedation". In: J Anesth Clin Res 7(11): 1000690.
18. Christopher F Durham, Timothy S Harrison (1964) The surgical anatomy of the superior laryngeal nerve. Surgery, gynecology & obstetrics 118: 38-44.
19. Changlin Chen, Di Wen, Yizheng Wang, Hongqiong Li, Qi Yu (2022) A spray-as-you-go airway topical anesthesia at attenuates cardiovascular responses for double-lumen tube tracheal intubation". In: BMC anesthesiology 22(1): 203.
20. Babita Gupta, Santvana Kohli, Kamran Farooque, Gopal Jalwal, Deepak Gupta (2014) Topical airway anesthesia for awake fiberoptic intubation: Comparison between airway nerve blocks and nebulized lignocaine by ultrasonic nebulizer". In: Saudi journal of anesthesia 8(1): S15-S19.
21. Martin Stockwell, S Lozanoff, S A Lang, J Nyssen (1995) Superior laryngeal nerve block: an anatomical study. Clinical Anatomy 8(2): 89-95.
22. Yongbin Wang, Chang Feng, Jia Fu, Dongyi Liu (2023) Clinical Application of Ultrasound-Guided Internal Branch of Superior Laryngeal Nerve Block in Patients with Severe COPD Undergoing Awake Fibreoptic Nasotracheal Intubation: A Randomized Controlled Clinical Trial. International Journal of Chronic Obstructive Pulmonary Disease 18: 521-532.
23. Jianqiao Zheng, Li Du, Bin Du, Weiyi Zhang, Lu Zhang, et al. (2023) Airway nerve blocks for awake tracheal intubation: Ameta-analysis of randomized control trials and trial sequential analysis". In: Journal of Clinical Anesthesia 88: 111122.

24. Sten Lennquist, Christian Cahlin (1987) The superior laryngeal nerve in thyroid surgery. Surgery 102(6): 999-1008.

25. Kyung Mi Kim (2022) Remimazolam: pharmacological characteristics and clinical applications in anesthesiology". In: Anesthesia and Pain Medicine 17(1): 1-11.

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