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Ultrasound guided superior laryngeal nerve block as an adjuvant to generalanesthesia during endoscopic laryngeal surgery: A prospective, randomized, double-blind trial

Rupavath Ramkumar[a,1], Suman Arora[a,*], Nidhi Bhatia[a], Sandeep Bansal[b]

[a] Department of Anesthesia and Intensive Care, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, India
[b] Department of Otolaryngology and Head and Neck Surgery, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, India

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ABSTRACT

Introduction: Blindly administered bilateral (B/L) superior laryngeal nerve (SLN) blocks, have been used to decrease the perioperative stress response of endoscopic laryngosurgeries. Use of ultrasound (USG) for giving these blocks is more likely to be successful, with fewer complications. We evaluated the efficacy of USG guided B/L SLN block in decreasing perioperative cough, sore-throat and hoarseness of voice.

Material and methods: This study was conducted on forty patients undergoing endoscopic laryngosurgery under GA. Patients were randomized into two groups of 20 patients each. Patients in group C received GA, whereas those in group L received USG-guided SLN block bilaterally with 2.5 ml of 2% lignocaine, along with GA. Postoperative cough, sore throat and hoarseness of voice was measured at 30 min, 2 h, 4 h and 24 h following transfer to post-anesthesia care unit.

Results: Patients receiving SLN block had significantly lower incidence of perioperative cough (20% in group L vs 90% in group C; *p* value - 0.0001) as well as sore throat (5% in group L vs 95% in group C; *p* value - 0.0001). In these patients, severity of hoarseness of voice was greater in the early postoperative period (100% in group L vs 70% in group C; *p* value - 0.027), while it decreased significantly at 24 h postoperatively(0.0% in group L vs 30% in group C; *p* value - 0.027).

Conclusion: USG guided SLN block as an adjuvant to GA resulted in better recovery profile of the patients with significant reduction in postoperative cough, sore throat and hoarseness of voice.

1. Introduction

Direct rigid endoscopic laryngosurgery is a very common procedure performed to investigate and/or treat lesions in the larynx, with or without using operating microscope. During endoscopy, as movement of vocal cords, coughing or bucking may result in injurious consequences, this procedure is usually performed under general anesthesia (GA), in which adequate muscle relaxation and immobile vocal cords are crucial surgical needs [1]. Another additional challenge is the relatively short operating time that necessitates rapid awakening as well as rapid return of muscle power and laryngeal reflexes [1].

As is well known, larynx is a highly reflexogenic region, eliciting variable degree of reflexes in response to mechanical stimulation [2]. The larynx is always severely stressed when it is exposed with the operating laryngoscope and placed on the suspension device. Stretching of laryngeal structures produces maximum stimulation of the deep sensory receptors of the larynx, resulting in severe sympathetic stimulation causing tachycardia, hypertension and even arrhythmias, that maybe especially dangerous in already compromised elderly patients with co-existing diseases [2]. Further, endoscopic laryngosurgeries often result in cough, sore throat and hoarseness of voice in the postoperative period.

In the past, a number of techniques have been used to decrease the perioperative stress response of endoscopic laryngosurgeries [2–4]. These include topical local anesthetic (LA) application to the laryngeal mucosa, administration of intravenous (IV) LA, short acting opioids or beta adrenergic antagonists. In order to decrease postoperative cough, sore throat and hoarseness of voice, techniques used in the past include administration of lidocaine into the endotracheal tube cuff and use of anti-inflammatory agents like steroids [5,6]. However, all of these methods have variable outcomes and are not very reliable. Bilateral superior laryngeal nerve (SLN) blocks have also been increasingly

* Corresponding author.
E-mail address: drsumanarora@hotmail.com (S. Arora).
[1] Present address: Department of Anesthesia, Critical Care and Pain Medicine, All India Institute of Medical Sciences (AIIMS), Ansari Nagar (India).

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performed during these procedures [7–9]. As innervation of the larynx is provided by the internal branch of SLN, blocking of this nerve bilaterally is known to successfully attenuate hemodynamic responses to sympathetic stimulation during endoscopic procedures [10].

Though previously a number of authors have given bilateral SLN blocks using the conventional, blind technique, however, there are only a few case reports on the use of ultrasound (USG) for administering this block [11]. As is well known, USG-guided blocks are more likely to be successful, need less time to perform, have a faster onset, longer duration of action and fewer complications.

We thus conducted this prospective, randomized, double-blind study with the aim of evaluating the efficacy of ultrasound guided bilateral (B/L) block of the internal branch of superior laryngeal nerve (SLN) as an adjuvant to general anesthesia during endoscopic laryngeal surgery. Our primary objective was to assess the incidence and severity of postoperative cough. Our secondary objectives included hemodynamic response to surgical manipulation, incidence and severity of postoperative sore throat and hoarseness of voice, and incidence of any other perioperative complications like laryngospasm. We hypothesized that administration of USG guided B/L block of the SLN, in addition to GA, would decrease the incidence and severity of postoperative cough, sore throat and hoarseness of voice as well as blunt the hemodynamic response to surgical manipulation.

2. Material and methods

After institutional ethics committee approval and obtaining written informed consent from the patients, this prospective, randomized, double blind study was conducted on forty, ASA-I/II patients in the age group of 18–65 years of age scheduled to undergo direct rigid endoscopic laryngosurgery for vocal cord polyp, nodule, cyst or leukoplakia under general anesthesia (GA). We excluded patients with stridor, cardiovascular or respiratory disease, coagulation disorder, patients on analgesics or beta-blockers, patients with hypersensitivity to the study drug, Mallampati classification III and IV and patients requiring more than one attempt for endotracheal intubation. Patients were randomized into two groups of 20 patients each using a computer-generated table of random numbers. Patients in group C received GA, whereas those in group L received USG-guided SLN block bilaterally with 2.5 ml of 2% lignocaine on either side along with GA to undergo laryngosurgery. All the patients (in both the groups) received local 10% lignocaine spray at the end of procedure. Group assignments were sealed in sequentially numbered, opaque envelopes that were opened just before the procedure. Patients as well as investigators observing the patient in the postoperative period and analyzing the data were blinded to group allocation.

All patients presented to operation theatre on the day of surgery after overnight fasting of 8 h. Preoperatively, patients were administered intravenous (i/v) midazolam 0.02 mg/kg for anxiolysis, i/v dexamethasone 0.2 mg/kg for edema prophylaxis and i/v metoclopramide 10 mg with i/v ranitidine 50 mg for aspiration prophylaxis. In the operating room patients were monitored for heart rate (HR), non-invasive blood pressure (NIBP), electrocardiogram (ECG), oxygen saturation (SpO2), and temperature using multichannel monitors (Datex-Ohmeda S/5 Avance). GA was induced using i/v fentanyl 2 μg/kg, propofol 2 mg/kg and atracurium 0.5 mg/kg. Following intubation with size 6.0 mm internal diameter (ID) endotracheal tube(ETT) for females and 6.5 mm ID ETT for males, USG guided bilateral SLN block with 2% lignocaine, 2.0 ml on each side was given to all the patients belonging to group L. Anesthesia was maintained with 60% nitrous oxide in oxygen and isoflurane with a target MAC of 1–1.3. All the patients received injection ondansetron 0.1 mg/kg IV before completion of surgery. On completion of the surgical procedure and prior to extubation, patients in both the groups received oral 10% lignocaine spray. At the end of surgery, residual neuromuscular blockade was reversed with i/v neostigmine 50 μg/kg and i/v glycopyrrolate 10 μg/kg. Cough was assessed during emergence before extubation (bucking on the ETT) and at 1 min, 5 min and 10 min after extubation using a 4 grade scale (Table 1).Any other perioperative complications like laryngospasm were also recorded.

Table 1
Grading system for severity of cough, sore throat and hoarseness of voice.

Grading	Severity of cough	Severity of sore throat	Severity of voice hoarseness
Grade 0	No cough	No sore throat	None
Grade 1	Light or single cough	Mild sore throat (complains of sore throat only upon inquiry)	Noted by the patient
Grade 2	More than one episode of unsustained (65 s) coughing	Moderate sore throat (complains of sore throat on his/her own)	Obvious to the observer
Grade 3	Sustained (65 s) and repetitive cough with head lift	Severe sore throat (severe pain associated with marked change in voice)	Aphonia

After 10 min of extubation, patients were transferred to the post-anesthesia care unit (PACU) and were monitored for NIBP, HR, SpO2, and ECG. O2 supplementation (5 l/min) was provided via face mask. Postoperative cough, sore throat and hoarseness of voice were measured using a 4 grade scale (Table 1) at 30 min, 2 h, 4 h and 24 h following transfer to PACU.

2.1. Technique of USG-guided SLN block

For performing the block, all patients were positioned supine, with the neck extended. After taking all aseptic precautions, a high-frequency (5–10 MHz) hockey stick ultrasound probe (Sonosite, Inc. Bothell. WA 98021 USA) was placed over the submandibular area with a longitudinal orientation. We identified the greater horn of the hyoid bone and thyroid cartilage, which are hyperechoic signals on sonography. The thyrohyoid muscle and thyrohyoid membrane are between these two structures. The block was performed using 24gauge 1 in. needle attached to three ways with extension with 5 ml syringe that was filled with lidocaine 2%. An out-of-plane method was used to inject 2.5 mL of 2% lignocaine between the greater horn of the hyoid bone and the thyroid cartilage, just above the thyrohyoid membrane.

2.2. Statistical analysis

According to Ahmed et al. [11], the incidence of post operative cough in patients undergoing laryngeal surgery is 86%. In order to reduce this incidence by 50% following SLN block, our sample size came out to be 20 patients in each group with 80% power and 95% confidence interval. Continuous quantitative normally distributed data were expressed as means and standard deviations (SD). Quantitative discrete data were expressed as median and range. Qualitative nominal data e.g. incidence of complications were expressed as frequency or percentage. Normally distributed data were analyzed using Student's *t*-test and two-way ANOVA with repeated measures. Mann–Whitney *U* test was used for non-parametric data. Chi square or Fisher's exact tests were used as appropriate to compare qualitative data. A p-value < 0.05 was considered statistically significant.

3. Results

A flow chart of participant flow through the study is shown in Fig. 1. Demographic characteristics of patients in both the groups were comparable (Table 2). The most common indications for which the patients underwent endoscopic laryngeal surgeries were carcinoma larynx and vocal cord polyps, with the most commonly performed procedures being endoscopic assessment with biopsy and microscopic laryngeal surgery (Table 3). Patients receiving SLN block had significantly lower

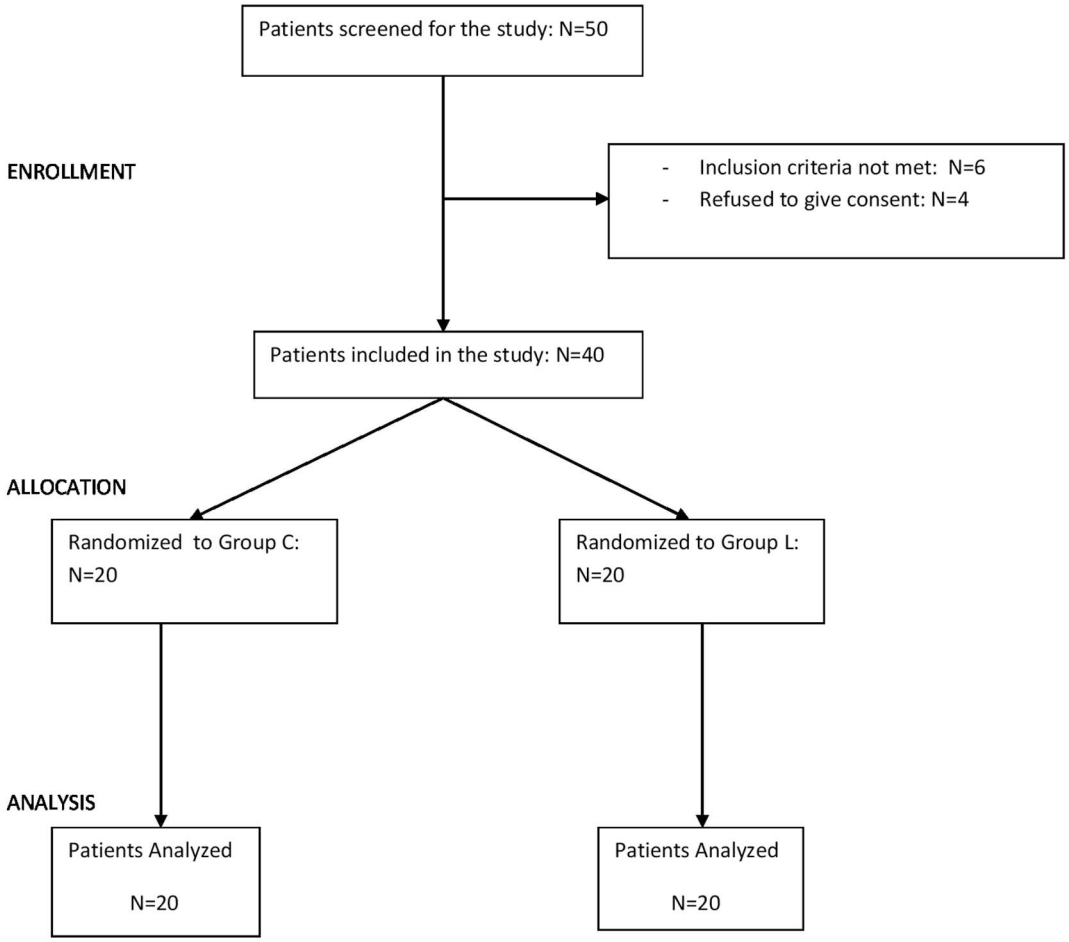

Fig. 1. Flow of participants through the study.

Table 2
Demographic characteristics of the study population.

	Group C (n = 20)	Group L (n = 20)	*p*-Value
Age (years)	49.90 ± 12.98	52.50 ± 13.54	0.539
Sex (M/F)	19/1	17/3	0.368
Weight (kg.)	69.75 ± 13.01	66.25 ± 11.24	0.227
Height (cm.)	165.52 ± 6.56	156.17 ± 33.41	0.598
ASA status (I/II)	11/9	16/4	0.091

Table 3
Types of surgeries performed.

Type of surgery and pathology	Group-C (n = 20)	Group-L(n = 20)
Endoscopic assessment & biopsy for carcinoma larynx	11 (55%)	9 (45%)
Microscopic laryngeal surgery for vocal cord polyps	9 (45%)	11 (55%)

Data expressed as number (percentage).

incidence of cough as well as sore throat in the perioperative period. The severity of cough and sore throat was also less in majority of these patients (Tables 4 and 5). In patients receiving SLN block, the severity of hoarseness of voice was greater in the early postoperative period. However at 24 h postoperatively, the severity of hoarseness of voice decreased significantly in these patients (Table 6). The two groups were comparable with regards to the hemodynamic response to surgical manipulation (Figs. 2, 3).

4. Discussion

Direct rigid endoscopic laryngosurgery is a very common procedure performed to treat or to investigate lesions in the larynx. This procedure is challenging for the anesthesiologists in many ways [1,2]. Firstly adequate muscle relaxation and immobile vocal cords are crucial surgical needs for this procedure, so as to avoid coughing and bucking during the procedure. Secondly, endoscopic laryngeal surgery is often associated with severe sympathetic stimulation, which can prove to be extremely hazardous in elderly patients. Thirdly, this procedure has a relatively short operative time necessitating rapid awakening with rapid return of laryngeal reflexes and muscle power. Fourthly, postoperative laryngospasm and edema are frequently encountered complications in these patients. Lastly, patients frequently complain of cough, sore throat and hoarseness of voice in the postoperative period.

As is well known, the sensory innervations of the larynx, a potent reflexogenic region [12], is provided by internal branch of superior laryngeal nerve (SLN). Bilateral block of this nerve is commonly performed as a part of upper airway preparation for awake fiberoptic bronchoscopy. We felt that blocking this nerve would also help in attenuating the hemodynamic response associated with endoscopic laryngosurgery as well as decrease the incidence and severity of postoperative cough, sore throat and hoarseness of voice. We performed bilateral SLN block under ultrasound guidance, so as to increase the success rate of the block. Majority of the patients in our study were males (Table 2). This could be due to the fact that all of our patients had either carcinoma larynx or vocal cord polyp (Table 3). Both of these pathologies are more commonly reported in males with smoking and alcohol intake being the risk factors for the same [13,14].

Table 4
Incidence and severity of postoperative cough.

		Group-C (n = 20)		Group-L (n = 20)		Total		*p*-Value
Post- operative	Mild	4	20.0%	14	70.0%	18	45.0%	0.001**
	Severe	16	80.0%	6	30.0%	22	55.0%	
Post- extubation	Mild	1	5.0%	16	80.0%	17	42.5%	0.0001**
	Severe	19	95.0%	4	20.0%	23	57.5%	
1 min	Mild	2	10.0%	16	80.0%	18	45.0%	0.0001**
	Severe	18	90.0%	4	20.0%	22	55.0%	
5 min	Mild	5	25.0%	19	95.0%	24	60.0%	0.0001**
	Severe	15	75.0%	1	5.0%	16	40.0%	
10 min	Mild	5	25.0%	20	100.0%	25	62.5%	0.0001**
	Severe	15	75.0%	0	0.0%	15	37.5%	
h	Mild	11	55.0%	20	100.0%	31	77.5%	0.002**
	Severe	9	45.0%	0	0.0%	9	22.5%	
4 h	Mild	16	80.0%	20	100.0%	36	90.0%	0.114
	Severe	4	20.0%	0	0.0%	4	10.0%	
	Total	20	100.0%	20	100.0%	40	100.0%	

Mild cough: Grade I; Severe cough: Grade II, III.
Data expressed as number (percentage).

Table 5
Incidence and severity of postoperative sore-throat.

		Group-C (n = 20)		Group-L (n = 20)		Total		*p*-Value
Postoperative sore throat grading 30 min	Mild	1	5.0%	19	95.0%	20	50.0%	0.0001**
	Severe	19	95.0%	1	5.0%	20	50.0%	
2 h	Mild	5	25.0%	20	100.0%	25	62.5%	0.0001**
	Severe	15	75.0%	0	0.0%	15	37.5%	
4 h	Mild	12	60.0%	20	100.0%	32	80.0%	0.006**
	Severe	8	40.0%	0	0.0%	8	20.0%	
24 h	Mild	15	75.0%	20	100.0%	35	87.5%	0.056
	Severe	5	25.0%	0	0.0%	5	12.5%	
	Total	20	100.0%	20	100.0%	40	100.0%	

Data expressed as number(percentage).

Table 6
Incidence and severity of postoperative hoarseness of voice.

		Group-C (n = 20)		Group-L (n = 20)		Total		*p*-Value
30 min	Grade-II	6	30.0%	0	0.0%	6	15.0%	0.027*
	Grade-III	14	70.0%	20	100.0%	34	85.0%	
2 h	Grade-II	9	45.0%	0	0.0%	9	22.5%	0.002**
	Grade-III	11	55.0%	20	100.0%	31	77.5%	
4 h	Grade-II	11	55.0%	10	50.0%	21	52.5%	1.000
	Grade-III	9	45.0%	10	50.0%	19	47.5%	
24 h	Grade-II	14	70.0%	20	100.0%	34	85.0%	0.027*
	Grade-III	6	30.0%	0	0.0%	6	15.0%	
Total		20	100.0%	20	100.0%	40	100.0%	

Data expressed as number (percentage).

In our study we found a statistically significant difference in the incidence as well as severity of cough during extubation and in the immediate postoperative period between the two groups, with the incidence and severity being greater in the control group than in the patients who had received bilateral superior laryngeal nerve block. The incidence of postoperative sore throat and hoarseness of voice was also significantly greater in the control group.

Postoperative cough and sore throat is precipitated by irritation of the laryngotracheal mucosa. This irritation can be caused by intubation maneuver, coughing/bucking on the tube, surgical manipulation of the larynx/the vocal cords. Several methods have been used to decrease this irritation, including topical anesthesia of the laryngotracheal mucosa using lidocaine either as a spray or gel and even inflation of the endotracheal tube cuff with lidocaine [4–6]. However, these techniques are known to have inconsistent effects. SLN blocks on the other hand produce better results without many complications. Blocking of the SLN bilaterally has been frequently used during awake intubation, during laryngoscopic examination as well as an adjuvant to general anesthesia to facilitate intubation without using muscle relaxant [7,9,10]. However, this was the first prospective randomized trial where ultrasound was used to administer SLN block during *endo*-laryngeal surgeries. Use of ultrasound to block the SLN results in better localization of the nerve, with the drug being deposited under vision resulting in a better and definitive response.

The incidence of postoperative sore throat, cough & hoarseness after tracheal intubation for general anesthesia can vary between 6.6 and 90% [15,16]. In our study, the incidence of postoperative cough (grade II & III) immediately following extubation was significantly higher in the control group (95%) as compared to those who had received bilateral SLN block (20%). Even in the postoperative period, following extubation, incidence of cough was significantly higher in patient who had not received bilateral SLN block, and varied from 20% (at 4 h post-extubation) to 75% (at 10 min post-extubation). Blocking of the SLN anesthetizes the laryngeal mucosa, resulting in decreased mucosal

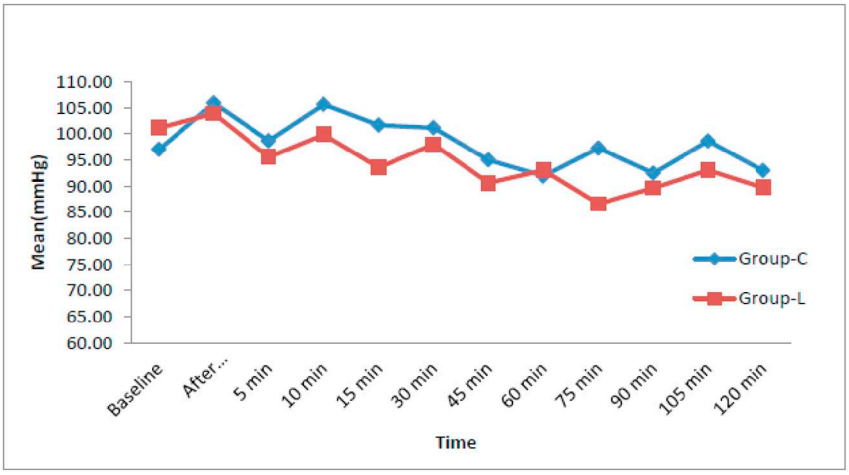

Fig. 2. Perioperative mean blood pressure.

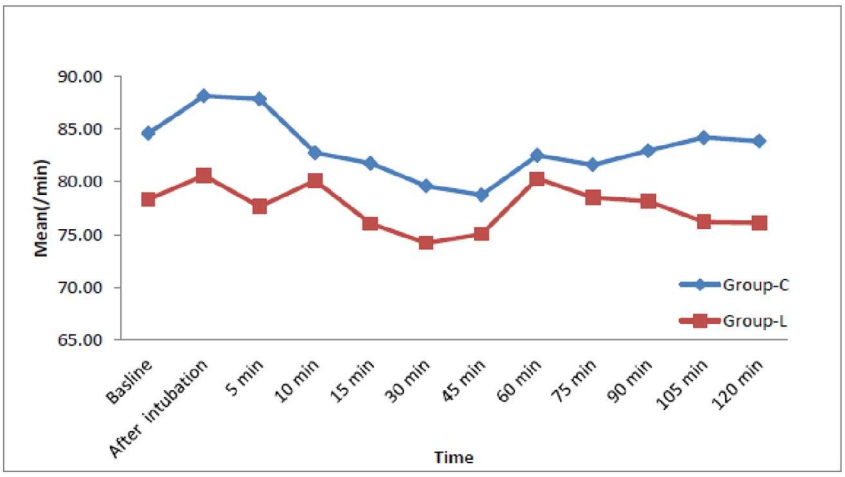

Fig. 3. Perioperative heart rate.

irritation. The lower incidence and severity of postoperative cough and sore throat found in our study group could be attributed to the increased tolerance of laryngeal mucosa to the tracheal tube as well as decreased surgical irritation of the mucosa, due to the anesthetized laryngeal mucosa.

In agreement with our findings, Trivedi et al. [17] compared upper airway nerve block with general anesthesia in patients undergoing laryngeal biopsies. The authors found that nerve block resulted in better postoperative analgesia as well as reduced cough and sore throat. Addington WR et al. [18] studied the effect of bilateral SLN block on cough reflex after inhalation of a chemo- irritant substance & found that the bilateral SLN block abolishes the laryngeal reflex.

Majority of the patients coming for endoscopic laryngeal surgeries are day care patients. Thus in these cases an ideal anesthetic technique, in addition to providing immobile vocal cords and clear field during surgery, should also ensure rapid recovery of vocal cord mobility and airway reflexes. One of the main concerns in patients with blocked SLN is the increased risk of aspiration in the postoperative period. However none of our patients had any of these problems. We also ensured adequate preoperative fasting and took all anti-aspiration prophylactic measures preoperatively.

One of the main limitations of our study was that we performed the block after inducing and intubating the patient, so we were unable to access the effect of the block on intubation response. Secondly, we could not identify the SLN on ultrasound examination. So, local anesthetic was deposited just above the thyrohyoid membrane. Thirdly, we feel that our sample size was too small to draw clinically relevant definite conclusions. Further, prospective, randomized trials with larger sample sizes are needed before any recommendations can be made.

5. Conclusion

To conclude, USG guided SLN block as an adjuvant to general anesthesia resulted in better recovery profile of the patients with significant reduction in postoperative cough, sore throat and hoarseness of voice with no increase in adverse events.

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Competing interests

None.

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