Original Article

Comparison of landmark-guided and ultrasound-guided technique for superior laryngeal nerve block to aid fibreoptic intubation - An observational study

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Abstract

Background and Aims: Awake fibreoptic intubation (AFOI) is the gold standard in the management of the difficult airway. Several methods to achieve airway anesthesia to aid AFOI include superior laryngeal nerve block (SLNB). This study aimed to compare land-mark-guided and ultrasound-guided techniques for SLNB to aid AFOI.

Material and Methods: This was a prospective, observational study. Patients in both groups received 1 mg Midazolam and 50 µg of fentanyl for mild sedation before intubation, nasal passages were anaesthetized using lignocaine-coated nasopharyngeal airways, nebulization of 3 ml of 2% lignocaine, and intratracheal injection of 2 ml of 2% lignocaine given through cricothyroid membrane. Patients in Group L received SNLB, at the lateral end of the thyrohyoid membrane (2 ml of 1.5% lignocaine). Patients in Group U had their thyrohyoid membrane visualized using linear ultrasound probe (8 – 13 Hz) and the injection was placed just superficial to the membrane using out of plane method. The groups were compared with respect to quality of anesthesia (assessed on a 5-point scale), patient comfort during AFOI, time taken to intubation and Haemodynamics.

Results: A total of 25 patients were enrolled: 13 in Group L and 12 patients in Group U. The demographics were comparable. Quality of airway anesthesia, time taken to intubation, haemodynamics and patient comfort were comparable. All were intubated successfully and there were no complications.

Conclusion: USG-guided SLNB was comparable to landmark-based method with respect to quality of airway anesthesia and patient comfort. USG-guided block did not add any advantage over the landmark-based method.

Keywords: Airway anesthesia, awake fibreoptic intubation, landmark-guided, superior laryngeal nerve block, ultrasound-guided

Introduction

Patients undergoing surgery under general anesthesia often require endotracheal intubation for control of the airway. This is usually done after induction of anesthesia and achieving muscle relaxation. Occasionally, when it is assessed that endotracheal intubation after induction of anesthesia can be difficult, endotracheal intubation is done first after anaesthetizing the airway using topical anesthesia. After confirming its correct position, anesthesia is then induced.

The procedure of awake intubation can be quite uncomfortable to the patient and its success largely depends on the adequacy of topical anesthesia achieved. Good topical anesthesia together with mild sedation can even have the patients amnesic about the whole procedure postoperatively. With the availability of

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fibreoptic bronchoscope, awake fibreoptic intubation is the most common approach and this is best done through the nose.

There are many ways of achieving topical anesthesia. The nasopharynx can be anaesthetized using nasal pledgets soaked in local anesthetic solution. The oropharynx can be anaesthetized with local anesthetic gargle or sprays. Nebulized lignocaine also helps to achieve these. The laryngopharynx can be anaesthetized using superior laryngeal nerve block. The interior of the larynx and trachea can be anaesthetized by recurrent laryngeal nerve block. The superior laryngeal block is traditionally given using a landmark approach where the thyrohyoid membrane is identified and the nerve is blocked as it crosses this membrane. Recently, this block is described using ultrasound-guidance.

This study was undertaken to compare the patient comfort achieved when superior laryngeal nerve block is given using traditional approach and ultrasound-guided approach. The aim of the study was to compare ultrasound and landmark-guided block of superior laryngeal nerve during upper airway anesthesia to aid awake fibreoptic intubation. The primary objective was the quality of airway anesthesia. The secondary objectives included time to intubation, haemodynamics changes and patient's perception of discomfort.

Material and Methods

This prospective, observational, cohort study was done at a tertiary referral hospital with a reasonable load of oropharyngeal malignancies requiring extensive surgery. Institutional Research Ethics Committee approval was obtained and the study was registered with the CTRI (CTRI/2019/07/020379). The study was conducted during the period January 2019 to March 2020. Written informed consent was obtained from all the patients. Patients aged between 18 and 60 years, either gender, belonging to ASA I and II, with anticipated difficult airway (modified Mallampati class III–IV *or* interincisor distance <2.5 cm), and planned for awake fibreoptic intubation were included in the study. Noncooperative patients, those with local pathology of the neck precluding injections, bleeding diathesis, known allergy to local anesthetic agents and those unable to comprehend the procedure were excluded.

An intravenous line was secured and they were premedicated with intravenous glycopyrrolate 0.2 mg. All patients received nebulization with 3 mL 4% lignocaine over 10 min in the preoperative holding area. Thereafter, they were wheeled into the operating room. In the OR, monitoring of electrocardiogram, noninvasive blood pressure and pulse oximetry was commenced. Midazolam 1 mg was given intravenously to reduce their anxiety. Oxygen supplementation through nasal prongs was given throughout the procedure. Vasoconstrictor nasal drops (oxymetazoline) were instilled into both nostrils. The more patent nasal passage was anesthetized using serial insertion of nasopharyngeal airways (26 F, 28 F and 30 F) coated with lignocaine jelly. While this nostril would be used for endotracheal intubation, the other nostril would be used for insertion of a nasogastric tube after the induction of general anesthesia.

The patients received superior laryngeal nerve block by either anatomical landmark technique or guided by ultrasound as deemed suitable by the consultant anesthesiologist. Those who received landmark-based SLN block were designated Group L and those receiving ultrasound-guided SLN block were designed Group U. In Group L, the patient was placed in the supine position, with the head and neck extended. The hyoid bone, thyroid lamina, and the space in between (occupied by the thyrohyoid muscle and the ligament underneath) were palpated. After identifying the greater horn of the hyoid (GHH) bone, the SLN was blocked by injecting 2 mL of 1.5% lignocaine just anterior and below the GHH. The SLN of the opposite side was also blocked in a similar manner. The larynx and trachea were anesthetized using lignocaine 2%, 2 ml by transtracheal injection through the cricothyroid membrane. In Group U, the portable ultrasound device with the linear (6–13 MHz) transducer was used. The probe was placed in a vertical (in the midline, sagittal plane) direction over the trachea and moved cephalad to identify the cricoid cartilage and the thyroid cartilage. The probe was then moved laterally to identify the thyrohyoid membrane, thyrohyoid muscle and the hyoid bone. The hyoid bone and thyroid cartilage were seen as hyperechoic structures on USG. The superior laryngeal nerve (SLN) lies on the membrane beneath the muscle. This space, called the SLN space, has the thyroid cartilage caudally, thyrohyoid muscle anteriorly, hyoid bone cephalad and the thyrohyoid ligament posteriorly. The epiglottis can also be seen posterior to the thyrohyoid membrane [Figure 1]. Using an out-of-plane approach, 2 mL of 1.5% lignocaine was injected into this space on each side using a 23-gauge hypodermic needle. The cricothyroid membrane was identified using USG and marked. The larynx and trachea were anesthetized using transtracheal injection of lignocaine 2%, 2 ml, through that site.

After the blocks were given by Observer 1 using either of the two techniques, the anesthetist in-charge proceeded to perform a fibreoptic laryngoscopy followed by endotracheal intubation. Subsequent anesthesia was continued as deemed fit by the concerned anesthesia team.

The following observations were done by an Observer (a postgraduate in anesthesia) who was kept unaware of the type of SLN block given to eliminate bias.

1. Quality of airway anesthesia: Assessment of quality of airway anesthesia was done on a 5-point scale as described by Reasoner *et al*.[1] 0 = No coughing or gagging in response to intubation, 1 = Mild coughing and/or gagging that did not hinder intubation, 2 = Moderate coughing and/or gagging that interfered minimally with intubation, 3 = Severe coughing and/or gagging that made intubation difficult, 4 = Very severe coughing and/or gagging that required additional local anesthetic (LA) and/or change in technique to achieve successful intubation
2. *Time for intubation:* Defined as time between insertion of fiberscope through nostril to confirmation of the correct position of the endotracheal tube using capnography.
3. *Effect on haemodynamic variables:* Heart rate (HR), Mean arterial pressure (MAP) before intubation (baseline), 1 min after intubation and peak value within 10 min of intubation
4. *Oxygen saturation.*
5. *Patient perception of pain and discomfort during intubation:* This was assessed 24 h postoperatively using numerical rating scale (NRS), where 0 indicated no discomfort and 10 the worst discomfort.

Sample size

The sample size was derived from the results of an initial pilot study involving 10 patients based on quality of airway anesthesia achieved using the two methods of achieving superior laryngeal nerve block. Grades 0 and 1 were considered desirable, Grades 2, 3 and 4 were not desirable.

Fifteen patients were required in each group for an alpha error of 0.05 and beta error of 0.2 (80% power). We were able to recruit 13 and 12 patients in Group L and Group U respectively. Patient enrolment was affected by Covid-19. Even after elective surgeries were recommenced, only two patients could be recruited into the study. We did not enroll patients who were scheduled for head and neck surgery but were not considered difficult airways and therefore did not require awake fibreoptic intubation.

Figure 1: Ultrasound-guided superior laryngeal nerve block

Results

This was a prospective, observational study. A total of 25 patients were recruited, 13 in Group L and 12 in Group U.

Table 1 shows that the demographic data were comparable between the groups. The various surgeries that the patients underwent are given in Table 2. These were similar between the groups. Tables 3 and 4 show the quality of airway anesthesia in all patients. Quality of airway anesthesia was comparable between the groups. No patient had a Grade of 4. Grades of 0 and 1 were considered desirable and Grades 2, 3 and 4, undesirable. There was

Table 1: Demographic data

Sl No	Group L (n=13)	Group U (n=12)	*P*
Age* (years)	52.62±12.53	52.27±16.67	0.9547
Gender M/F#	10/3	10/2	1.000

**Students t test, #Chi-square test*

Table 2: The list of surgeries undergone by patients in both groups

Surgeries	Group L (n=13)	Group U (n=12)	*P*
WLE + Neck dissection	4	3	0.5279
WLE + PMMC flap/Forehead flap/Free flap	6	7	
Maxillofacial#	2	1	
ENT surgery MLS and excision/FESS + Septoplasty	1	1	

Chi square test

Table 3: Quality of airway anaesthesia

Grade	Group L (n=13)	Group U (n=12)	*P*
0	3	3	0.813
1	5	5	
2	1	2	
3	4	2	
4	0	0	

Chi Square test

Table 4: Number of patients in either group whose scores (quality of airway anaesthesia) were desirable and undesirable

Parameter	Group L (n=13)	Group U (n=12)	*P*
Desirable (Score 0, 1)	8	8	0.916
Undesirable (Score 2, 3, 4)	5	4	

Chi Square test

Table 5: Time (in seconds) taken for intubation and patient discomfort

Parameter	Group L (n=13)	Group U (n=12)	P
Time for intubation* (s) (Mean±SD)	234.43±112.14	192.7±94.48	0.349
Patient perception of discomfort (NRS)# [(Median (IQR)]	5 (4-8)	3 (2-6)	0.2713

*Students t-test, #Mann Whitney U test

Table 6: Heart rate changes during intubation

Parameter	Group L (n=13)	Group U (n=12)	P
Baseline	75.57±9.13	84±17.66	0.14
2 min after intubation	86.7±18.15	76.86±11	0.112
4 min after intubation	85.07±15.13	99.1±19.69	0.0608
6 min after intubation	81.79±13.52	89.9±17.54	0.2134
8 min after intubation	74.79±11.57	85.50±18.12	0.0904
10 min after intubation	75.07±13.14	76.50±14.75	0.8052

Paired t test

Table 7: Changes in mean blood pressure during intubation

Parameter	Group L (n=13)	Group U (n=12)	P
Baseline	92.71±24.62	98.40±10.39	0.5007
2 min after intubation	105.80±12.67	102.21±12.41	0.4975
4 min after intubation	110.57±12.71	106.8±16.2	0.5291
6 min after intubation	93.2±21.95	97.14±18.47	0.6382
8 min after intubation	79.86±14.43	82.5±13.91	0.6579
10 min after intubation	76.86±8.33	86.90±10.50	0.0159

Paired t test

no difference between the two groups. The time taken to intubation and patient's perception of discomfort are tabulated in Table 5.

Changes in heart rate and blood pressure during intubation were recorded at 2-minute intervals from baseline (just before commencement of intubation) up to 10 min after intubation. Tables 6 and 7 show the heart rate and blood pressure changes respectively in both the groups. There was no difference between the two groups with respect to heart rate and mean blood pressure changes, both intra- and intergroup comparisons.

Discussion

Optimal airway anesthesia is necessary in addition to a cooperative patient to provide smooth intubating conditions during AFOI. The tonicity of the airway muscles is maintained during AFOI, which provides a great degree of safety during the management of the difficult airway.[2] Various techniques have been used in different clinical settings to offer adequate airway anesthesia. A combination of topical airway anesthesia with bilateral SLNB has been reported to produce good haemodynamic stability and patient comfort.[3,4]

The anatomical landmark-based SLNB is easy to perform with variable success rates. Sometimes, the landmarks may be difficult to palpate, e.g., obese patients, and deep palpation can lead to patient's discomfort.[1] USG has gained popularity in providing nerve blocks for regional anesthesia. Likewise, USG can be useful to perform SLNB in patients with difficult neck anatomy during AFOI.[5,6] It can help in the correct deposition of LA with real-time visualization and avoid damage to the surrounding structures.

In this study, the thyroid cartilage, the hyoid bone and the SLN space lying between the thyrohyoid muscle and the membrane were identified using the linear transducer placed parasagittally. The local anesthetic was injected using an out of plane approach superficial to the thyrohyoid membrane. The feasibility of USG guided ibSLNB was reported in the cadaveric study as well as in clinical trial.[3,7] Kaur *et al.*,[8] in a volunteer and cadaveric simulation study, reported that the accurate identification of SLN is possible with USG. However, visualization of SLN may be unsuccessful as it needs experience and a high-resolution transducer to identify a small nerve.[9]

A 5-point scale was used to assess the quality of airway anesthesia.[1] The desirable quality (none or mild coughing/gagging that did not hinder intubation) of anesthesia was achieved in 8 patients each in group L and U. Severe coughing and/or gagging that made intubation difficult (Score 3) for 4 and 2 patients in group L and U, respectively. None of the study participants had very severe coughing and/or gagging (score 4). Hence, no additional LA and/or change in technique to achieve successful intubation was required.

Ambi *et al.*[3] compared anatomical landmark-based and USG guided technique for SLNB to aid AFOI in 40 patients. They observed a significantly better quality of anesthesia in patients who had received USG guided SLNB ($P < 0.001$). The overall quality of anesthesia scores between the two groups was similar in our study. This could be because the blocks were performed by an experienced anesthesiologist, and the smaller sample size in our study groups.

Sivakumar *et al.*[10] reported good quality of analgesia following landmark guided bilateral SLNB (success rate 82.5%) in 40 patients undergoing diagnostic direct laryngoscopy. Sawka *et al.*[11] in a case series of five patients demonstrated good quality of airway anesthesia for AFOI following USG guided SLNB. Krause *et al.*[12] performed USG guided SLNB along with translaryngeal block and achieved adequate anesthesia for AFOI in 4 patients with anticipated difficult airways.

The duration of tracheal intubation was shorter in Group U (192.7 ± 94.48 seconds) as compared to Group L (234.43 ± 112.14) in our study but it was statistically not significant. ($p = 0.349$). Ambi *et al.*[3] also observed longer duration of tracheal intubation in patients who received landmark-based SLNB (109.05 ± 30.09 seconds) as compared to USG guided SLNB group (71.05 ± 9.57 seconds) and the difference was statistically significant. The relatively shorter time for intubation in group U could be due to more accurate and precise deposition of LA under USG guidance. It might help to achieve early airway anesthesia for AFOI as compared to those who received landmark-based SLNB.

Discomfort associated with passing the tube through the nostrils could be due to expansion of nasal bones or inadequate airway anesthesia. This discomfort was probably significant once the lower part of the upper airway was anaesthetized by either landmark-guided or ultrasound-guided techniques. Landmark-guided SLNB was easy in all the patients because the patients in this study were not obese, the landmarks were easily felt and did not require deep palpation unlike the findings of Ambi *et al.*[3] Ultrasound-guidance did not offer any greater benefit in our patients.

In the study by Ambi *et al.*,[3] the patients who received superior laryngeal nerve block using landmark-guided technique had a higher pain score. They stated that the reason may have been because of the deep palpation and manipulation needed to identify the hyoid bone and the thyroid cartilage during landmark-based technique. Chatrath *et al.*[2] assessed the efficacy of landmark-based combined regional nerve blocks (bilateral glossopharyngeal nerve block, SLNB, and RLN block) and observed that 90% of patients were quite comfortable during and even after AFOI.

The hemodynamic stress responses during conventional laryngoscopy and intubation are well known. The magnitude of these changes during AFOI is less as compared to rigid laryngoscopy due to less stretching of tissues in the epipharynx and laryngopharynx in fibreoptic bronchoscopy.[13] The passage of the endotracheal tube through the glottic opening provides the maximum stimulus to haemodynamic changes.[14]

An awake patient is also likely to have some amount of awareness of the passage of the fiberscope and endotracheal tube. The use of bilateral SLNB as an adjuvant to GA is reported to attenuate hemodynamic responses to endotracheal intubation.[15] Trivedi and Sharma compared the effects of regional airway nerve blocks (bilateral SLNB, glossopharyngeal block and RLN block) versus GA in diagnostic laryngoscopy and biopsy for suspected laryngeal carcinoma.[16] They observed significant haemodynamic changes in patients who did not receive airway blocks during the perioperative period. In our study, the highest increase in HR and MAP in both groups was observed at four minutes after AFOI as compared to the baseline values. The differences between the groups were statistically insignificant. The increases could have been exaggerated because of the continued action of glycopyrrolate, the anticholinergic drug we used for reducing secretions during the study. Ambi *et al.*[3] observed a significant increase in HR and MAP values during and after intubation in patients who received landmark-based SLNB as compared USG guided SLNB group.

We did not observe any difference between the two groups with regard to the rate of successful intubation or adverse events. Although we were short of five patients (2 in one group and 3 in the other), we do not think there would have been any difference demonstrated between the two groups. This study demonstrates that it is feasible to give USG guided SLN block and it remains to be seen if this technique is of use when palpation of landmarks is difficult.

One limitation of the study is that the sample size was just short of the target because of restriction of patient enrolment as well as stoppage of elective surgeries due to COVID-19. The other limitation is that SLN block is but one aspect of airway anesthesia and other aspects of an awake intubation such as counselling, anesthesia of the airway above the larynx, a very good rapport with the patient are all important.

Conclusion

Comparison of landmark-guided and ultrasound-guided technique for superior laryngeal nerve block to aid awake fibreoptic intubation shows that there is no difference between the two techniques with respect to quality of anesthesia, time to intubation, haemodynamic changes and patient discomfort.

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Conflicts of interest
There are no conflicts of interest.

References

1. Reasoner DK, Warner DS, Todd MM, Hunt SW, Kirchner J. A comparison of anesthetic techniques for awake intubation in neurosurgical patients. J Neurosurg Anesthesiol 1995;7:94–9.
2. Chatrath V, Sharan R, Jain P, Bala A, Ranjana, Sudha. The efficacy of combined regional nerve blocks in awake orotracheal fiberoptic

intubation. Anesth Essays Res 2016;10:255-61.
3. Ambi US, Arjun BK, Masur S, Endigeri A, Hosalli V, Hulakund SY. Comparison of ultrasound and anatomical landmark-guided technique for superior laryngeal nerve block to aid awake fibre-optic intubation: A prospective randomized clinical study. Indian J Anaesth 2017;61:463-8.
4. Kundra P, Kutralam S, Ravishankar M. Local anaesthesia for awake fibreoptic nasotracheal intubation. Acta Anaesthesiol Scand 2000;44:511–6.
5. Manikandan S, Neema PK, Rathod RC. Ultrasound-guided bilateral superior laryngeal nerve block to aid awake endotracheal intubation in a patient with cervical spine disease for emergency surgery. Anaesth Intensive Care 2010;38:946–8.
6. Liao YC, Wu WC, Hsieh MH, Chang CC, Tsai HC. Ultrasound-guided superior laryngeal nerve block assists in anesthesia for bronchoscopic surgical procedure: A case report of anesthesia for rigid bronchoscopy. Medicine (Baltimore) 2020;99:e20916.
7. Lang CH, Cheng WC, Yang YL. A new method for ultrasound-guided superior laryngeal nerve block. Tzu Chi Med J 2013;25:161-3.
8. Kaur B, Tang R, Sawka A, Krebs C, Vaghadia H. A method for ultrasonographic visualization and injection of the superior laryngeal nerve: Volunteer study and cadaver simulation. Anesth Analg 2012;115:1242-5.
9. Vaghadia H, Lawson R, Tang R, Sawka A. Failure to visualize the superior laryngeal nerve using ultrasound imaging. Anaesth Intensive Care 2011;39:503.
10. Sivakumar RK, Rajasekar R, Sellappan P, Anandan H. Efficacy of bilateral superior laryngeal nerve block for diagnostic direct laryngoscopy. Int J Sci Stud 2017;4:133-5.
11. Sawka A, Tang R, Vaghadia H. Sonographically guided superior laryngeal nerve block during awake fiberoptic intubation. A Case Rep 2015;4:107-10.
12. Krause M, Khatibi B, Sztain JF, Rahman P, Shapiro AB, Sandhu NS. Ultrasound-guided airway blocks using a curvilinear probe. J Clin Anesth 2016;33:408-12.
13. Ovassapian A, Yelich SJ, Dykes MH, Brunner EE. Blood pressure and heart rate changes during awake fiberoptic nasotracheal intubation. Anesth Analg 1983;62:951-4.
14. İnangil G, Cansız KH, Gürbüz F, Bakal Ö, Gökben FM, Şen H. Comparison of hemodynamic responses to endotracheal intubation with the GlideScope video laryngoscope and Macintosh laryngoscope in patients undergoing cardiovascular surgery. Turk Gogus Kalp Damar Cerrahisi Derg 2018;26:386-93.
15. Ahmed A, Saad D, Youness AR. Superior laryngeal nerve block as an adjuvant to general anesthesia during endoscopic laryngeal surgeries: A randomized controlled trial. Egypt J Anesth 2015;31:167–74.
16. Trivedi V, Sharma G. Evaluation of airway blocks versus general anaesthesia for diagnostic direct laryngoscopy and biopsy for carcinoma larynx. J Indian Med Assoc 2012;110:78-83.