Effect of dexmedetomidine infusion on hemodynamic responses in microsurgery of larynx

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Abstract

Background and Aims: Microlaryngeal surgery is a frequently performed ear, nose, and throat procedure used to diagnose and treat laryngeal disorders. Suspension laryngoscopy causes prolonged stimulation of the deep pressure receptors of the larynx leading to adverse circulatory responses and consequently cardiac complications. In this study, dexmedetomidine infusion was used to assess its effectiveness for attenuation of this hemodynamic stress response.

Material and Methods: Sixty patients undergoing elective microlaryngeal surgery randomly received either dexmedetomidine 1 µg/kg over 10 min followed by continuous infusion of 0.5 µg/kg (Group D) or normal saline infusion at the same rate (Group P) till the end of surgery. Anesthesia in all patients was induced with propofol, succinylcholine to facilitate endotracheal intubation after premedication with fentanyl 2 µg/kg and glycopyrrolate. Intraoperative, vital parameters were maintained within 20% of baseline with rescue analgesic fentanyl 1 µg/kg and subsequently with propofol boluses up to 1 mg/kg. The percentage of patients and the total amount of intraoperative fentanyl and propofol required in each group were recorded. Sedation score at 10 minutes postextubation was assessed by Ramsay sedation score.

Results: Intraoperative heart rate and mean arterial pressure in Group D were lower than the baseline values and the corresponding values in Group P (P < 0.05). The percentage of patients requiring rescue fentanyl and propofol was higher in Group P than Group D (36.6% and 30% vs. 6.6% and 3.3% P = 0.01). Recovery scores were better in dexmedetomidine group.

Conclusion: Dexmedetomidine infusion attenuates the hemodynamic stress response during laryngoscopy, intubation, and microlaryngeal surgery and is associated better recovery profile.

Keywords: Anesthesia, dexmedetomidine, hemodynamic response, intubation, microlaryngoscopy, suspension laryngoscopy

Introduction

Manipulation of larynx during laryngoscopy and tracheal intubation leads to hemodynamic and cardiovascular responses secondary to release of catecholamines. Similar responses, more intense and prolonged than laryngoscopy and endotracheal intubation are encountered during microlaryngoscopic procedures due to a longer duration of suspension laryngoscopy (20–30 min as against 15–30 s) and surgical manipulation. The adverse circulatory changes occurring throughout the procedure can be of sufficient magnitude to induce myocardial ischemia, cardiac dysrhythmias, and cerebrovascular accidents in elderly patients with poor cardiopulmonary reserve. Mitigating the perioperative stress response with a drug that effectively suppresses these obnoxious stress stimuli while handling the laryngeal aperture and vocal cords along with maintenance of adequate depth of anesthesia without compromising oxygenation and ventilation and with a rapid recovery profile is required.
Dexmedetomidine, a highly selective, specific, and potent α2 adrenergic receptor agonist, owing to its central sympatholytic, anxiolytic properties are known to be effective in suppressing stress response to intubation. Hence, we hypothesized and investigated the effects of dexmedetomidine infusion on hemodynamic response in patients undergoing microlaryngoscopy (MLScopy) under general anesthesia. The primary aim was to maintain hemodynamics within 20% of baseline values during critical incidences such as laryngoscopy, endotracheal intubation, and MLScopy. The intraoperative requirement of fentanyl as rescue analgesic and propofol as an anesthetic to maintain the hemodynamics within the range of 20% baseline values was the secondary endpoint.

Material and Methods

This prospective, randomized, placebo-controlled, double-blind study was undertaken after institutional ethics committee approval. Sixty patients of either sex, having the American Society of Anesthesiologists (ASA) Grade I to III, aged between 18 and 60 years, undergoing elective microlaryngeal surgery under general anesthesia were included and written informed consent was obtained from all the participants. Hemodynamically unstable patients, patients with Ischemic heart disease, and those having left bundle-branch block or atrioventricular block more than first degree were excluded from the study. A computer-generated randomization table was used to assign each patient to either Group “P” or Group “D.” Randomly allocated coded syringes containing either normal saline or dexmedetomidine 4 µg/ml (200 µg diluted in 50 ml normal saline) were prepared by an anesthesiologist not involved in conducting the case, data recording or for monitoring during intra- and post-operative periods. After confirming adequate nil per oral status, patients were wheeled in the operation theater, and baseline heart rate (HR), electrocardiogram (ECG), arterial blood pressure (BP), oxygen saturation were recorded.

An intravenous access was secured with 20-gauge cannula for infusion of intravenous fluid, and Ringer lactate solution was infused at 2–3 ml/kg/h. An additional intravenous access was secured for infusion of study drug after premedication with glycopyrrolate 0.004 mg/kg and fentanyl 2 µg/kg. Group D received intravenous dexmedetomidine 1 µg/kg over 10 min followed by continuous infusion of 0.5 µg/kg/h. Group P received normal saline infusion at the same rate. All the patients received oxygen through nasal prongs at 2 l/min.

Fifteen minutes later, induction of anesthesia was carried out using propofol (2–2.5 mg/kg) till loss of eyelash reflex. Endotracheal intubation was facilitated by muscle relaxant succinylcholine (1.5 mg/kg). Under direct laryngoscopic vision, tracheal intubation was done with MLScopy tube of appropriate size 5 and 5.5. Anesthesia was maintained with 50% nitrous oxide in oxygen, and 2.0% end-tidal sevoflurane on close circuit with attached capnometer and ventilation was adjusted to maintain end-tidal CO₂ at 34–45 mmHg. Loading (0.5 mg/kg) and supplemental doses of atracurium 0.1 mg/kg were administered to provide immobile vocal cords. Suspension laryngoscope was fixed when HR and mean BP (MBP) returned to baseline values. Hemodynamic parameters, i.e., MBP, HR was recorded at specific time points, i.e., premedication, later every 2 min during loading dose infusion of study drugs and then at induction, laryngoscopy and intubation and thereafter at regular interval of 5 min throughout the surgical procedure. HR and MBP were maintained within 20% of baseline values. Fentanyl 1 µg/kg and later bolus doses of propofol up to 1 mg/kg were used to maintain the hemodynamics. Number of patients requiring fentanyl as rescue analgesic and anesthetic propofol and their total dose required in each group was recorded. Hypotension (fall in systolic BP >20%) was treated with fluids and ephedrine hydrochloride if required. Bradycardia, i.e., HR <45 on two consecutive readings was treated with atropine sulfate. The infusion of study drugs and sevoflurane were continued till the removal of suspension laryngoscope. All patients received dexamethasone 0.1 mg/kg and ondansetron 4 mg. On completion of surgery, residual neuromuscular blockade was reversed using glycopyrrolate 0.008 mg/kg and neostigmine, 0.06 mg/kg. Tracheal extubation was performed after application of 4% lignocaine spray and excluding cord edema when patients were able to respond to simple verbal commands. Sedation score was assessed 10 min’ postextubation and was shifted to the postanesthesia care unit (PACU) after complete clinical recovery where they received nasal O₂ supplementation, and were monitored for hemodynamic parameters, adverse events if any every 30 min for 2 h’ till transferred to the surgical ward.

Statistical analysis

Data analysis was done with the help of SPSS version 15 (SPSS Inc., Chicago, USA). Demographic data were compared with the help of unpaired t-test and Fisher’s exact test. Hemodynamic variables and various time intervals were analyzed using a unpaired t-test for intergroup analysis and paired t-test for intragroup analysis. Mann–Whitney U-test was used for data which were not distributed evenly. P < 0.05 was considered statistically significant.

The sample size calculation was done using the method described by Dupont and Plummer (1990) for continuous response measures in two independent groups according to the previous study. Twenty-nine experimental and 29 control
During loading dose infusion, a rise in MBP was found at 2 min \((P = 0.018)\) in Group D which was followed by a fall in MBP till induction. At intubation, both the groups showed a rise in MBP from baseline. However, on analyzing the magnitude of increase, patients in Group P exhibited a greater rise 16.7\% in comparison to 5.2\% rise in Group D \((P = 0.021)\). Similarly, a greater rise in MBP from baseline was observed in placebo group throughout the procedure at all time points. At 10 min of MLscopy, the rise was 13.4\% rise in placebo group against 0.1\% rise index \((P = 0.002)\). At the time of extubation also, MBP in Group D was found to be significantly lower than MBP in Group P [Table 3 and Figure 3].

Twelve patients (40\%) in dexmedetomidine group and seven patients (23.3\%) in placebo group were above the age of 50 with mean age of 54.875 in Group D, and 53.25 in Group P [Tables 4 and 5]. Three patients in Group P showed nonsignificant ECG changes which resolved spontaneously. No patient in Group D developed any ST-T changes. Bradycardia was observed in one patient in Group D. The HR dropped to 45/min, which responded to injection atropine 0.6 mg intravenously. Hypotension was not observed in any of the patients.

### Results

Statistically, no difference in the patient characteristics and surgical data were detected between the groups [Table 1]. Laser excision of laryngeal mass was performed in 25\% patients whereas 75\% of patients underwent diagnostic scopy [Figure 1].

Baseline hemodynamic parameters were comparable in both groups. Group D had a reduction in HR from baseline starting from 2 min of loading dose infusion, and this decline persisted throughout the procedure. The reduction in the HR ranged from 5.3\% at intubation and 8.8\% at 10 min of MLscopy \((P = 0.001)\), while placebo group showed significant rise in the HR from baseline and was found to be 21.3\% at intubation to 18.2\% at 10 min of MLscopy and remained elevated throughout the procedure and in the PACU [Table 2 and Figure 2].

### Table 1: Patient demographic and operative data

| Variable                        | Mean±SD  | Test applied        | \(P\)  |
|---------------------------------|----------|---------------------|--------|
|                                 | Dexmedetomidine | Placebo          |        |
| Age (years)                     | 43.7±13.0  | 37.7±13.8          | 0.089  |
| Weight (kg)                     | 54.6±10.2  | 57.4±10.1          | 0.285  |
| ASA status                      | 1.7±0.4   | 1.5±0.5            | 0.111  |
| Sex distribution                |           |                     |        |
| Male                            | 15       | 16                  | 1      |
| Female                          | 15       | 14                  |        |
| Duration of microaryngoscopy    | 14.7±5.4  | 15.6±8.5           | 0.613  |

Expressed as mean±SD or absolute number. ASA=American Society of Anesthesiologists, SD=Standard deviation

### Table 2: Variation in heart rate

| HR (/min)                      | Dexmed group | Placebo group | Test applied | \(P\) |
|--------------------------------|--------------|---------------|--------------|------|
|                                | Mean±SD      | Mean±SD       |              |      |
|                                 | Dexmed group | Placebo group | Test applied | \(P\) |
| Loading dose                   |              |               |              |      |
| 0 min                          | 90.9±14.0    | 84.3±18.0     | Unpaired t-test | 0.12 |
| 2 min                          | 88.9±16.7    | 82.3±14.9     | Unpaired t-test | 0.114|
| 10 min                         | 80.4±16.3    | 81.9±14.0     | Unpaired t-test | 0.716|
| At induction                   | 79.2±13.5    | 81.0±15.0     | Unpaired t-test | 0.626|
| At intubation                  | 85.6±14.0    | 100.3±16.9    | Unpaired t-test | 0.01 |
| Postintubation                 | 80.4±12.5    | 92.8±14.7     | Unpaired t-test | 0.001|
| 5 min                          | 83.2±14.5    | 95.0±14.6     | Unpaired t-test | 0.003|
| 10 min                         | 81.4±13.6    | 97.2±15.3     | Unpaired t-test | 0.01 |
| 15 min                         | 81.1±9.0     | 95.7±11.7     | Unpaired t-test | 0.004|
| End of infusion                | 76.2±12.7    | 90.3±14.6     | Unpaired t-test | 0.01 |
| Extubation                     | 77.0±12.3    | 88.1±12.5     | Unpaired t-test | 0.001|
| Recovery                       | 77.5±10.0    | 87.1±11.8     | Unpaired t-test | 0.003|

Data expressed as mean±SD and \(P\) value. SD=Standard deviation, HR=Heart rate
Fentanyl and propofol requirements to maintain hemodynamics within 20% of baseline values was found to be significantly reduced with dexmedetomidine. Only 2 (6.6%) patients in Group D against 11 (36.6%) patients in placebo group required fentanyl as rescue analgesic \[Figure 4\]. Meanwhile, propofol was required in only 1 (3.3%) patient in Group D and 9 (30%) patients in Group P. Total dose of fentanyl required was 52.5 ± 3.5 µg in Group D, whereas it was 70.9 ± 34.6 µg in Group P \[Figure 5\]. Total dose of propofol required was also found to be less (50 ± 0 mg) in dexmedetomidine group against (78.2 ± 29.5 mg) in control group.

The postoperative sedation scores 10 min’ postextubation was comparable in both groups. Maximum patients in Group D were tranquil and responding to verbal commands (Ramssay sedation score [RSS] of 2 or 3) while in Group P 9 patients were agitated (RSS 1), and 2 patients showed RSS of 4. None of the patients experienced unpleasant memories or discomfort during anesthesia \[Table 6\].

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### Table 3: Changes in mean blood pressure in both groups

| MBP (mmHg)                  | Dexmed group | Placebo group | Test applied | P  |
|-----------------------------|--------------|---------------|--------------|----|
| Loading dose                |              |               |              |    |
| 0 min                       | 30           | 30            | Unpaired t-test | 0.106 |
| 2 min                       | 30           | 30            | Unpaired t-test | 0.018 |
| 10 min                      | 30           | 30            | Unpaired t-test | 0.572 |
| During microlaryngoscopy    |              |               |              |    |
| At induction                | 30           | 30            | Unpaired t-test | 0.082 |
| At intubation               | 30           | 30            | Unpaired t-test | 0.021 |
| Postintubation              | 30           | 30            | Unpaired t-test | 0.124 |
| Before microlaryngoscopy    | 30           | 30            | Unpaired t-test | 0.002 |
| 5 min                       | 30           | 30            | Unpaired t-test | 0.142 |
| 10 min                      | 30           | 30            | Unpaired t-test | 0.008 |
| 15 min                      | 12           | 12            | Unpaired t-test | 0.751 |
| End of infusion             | 30           | 30            | Unpaired t-test | 0.008 |
| Extubation                  | 30           | 30            | Unpaired t-test | 0.407 |
| Recovery                    | 30           | 30            | Unpaired t-test | 0.321 |

Data expressed as mean±SD and P value. MBP=Mean blood pressure, SD=Standard deviation

### Table 4: Variation in heart rate (above 50 years)

| HR (/min)                  | Dexmed group | Placebo group | Test applied | P  |
|----------------------------|--------------|---------------|--------------|----|
| Loading dose               |              |               |              |    |
| 0 min                      | 12           | 8             | Unpaired t-test | 0.29 |
| 10 min                     | 12           | 8             | Unpaired t-test | 0.20 |
| During microlaryngoscopy   |              |               |              |    |
| At intubation              | 12           | 8             | Unpaired t-test | 0.18 |
| 5 min                      | 12           | 8             | Unpaired t-test | 0.06 |
| 10 min                     | 12           | 8             | Unpaired t-test | 0.20 |
| After microlaryngoscopy    | 12           | 8             | Unpaired t-test | 0.19 |
| Extubation                 | 12           | 8             | Unpaired t-test | 0.20 |
| Recovery                   | 12           | 8             | Unpaired t-test | 0.321 |

Data expressed as mean±SD and P value. SD=Standard deviation, HR=Heart rate

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Figure 1: Type of surgery

Figure 2: Perioperative changes in heart rate
MLScopy involves a series of stress-filled continuous suspension laryngoscopies leading to stimulation of deep pressure receptors of the larynx separated by varying periods of surgical stimulation. Although patient population presenting for MLScopy are elderly, having a long history of heavy tobacco, alcohol use, and associated comorbidities that predispose them to respiratory and cardiovascular diseases. Uncontrolled hemodynamics in these patients can lead to fatal arrhythmias and myocardial ischemia. Nevertheless, intraoperative procedure-related hypoxia, due to sharing of the common airway by surgeons and anesthetist may further accentuate the imbalance between myocardial oxygen supply and demand further aggravating arrhythmia, ischemia, and infarcts even in younger patients undergoing microlaryngeal surgery. Strong et al. reported a tenfold higher incidence of cardiac complications such as myocardial infarction, transient ischemia, and significant arrhythmias after microsurgery of larynx. Hence, a thoughtful consideration should be given by anesthesiologist to control perioperative cardiovascular stress responses to suspension laryngoscopy.

Various drugs such as propofol, sevoflurane, oral clonidine, lignocaine spray, β-blockers, and oral gabapentin have been used in various combinations and doses to ameliorate this hyperdynamic response to MLScopy.

However, a delayed postoperative awakening with propofol, delayed onset of action with oral clonidine and gabapentin and an increased incidence of complications secondary to myocardial depression with β-blockers were faced.

Intravenous dexmedetomidine, by causing 90% reduction in serum catecholamine levels, attenuates sympathoadrenal responses to intraoperative stress and intubation. It has been effectively used for suppression of stress response during laryngoscopy and intubation. Its anesthesia sparing, opioid sparing action, and blunting of exaggerated hemodynamic responses during surgery have also been documented.

Our search did not find any study evaluating the efficacy of dexmedetomidine infusion on the suppression of hemodynamic responses to MLScopy. In the present study, we chose a loading dose of 1 µg/kg based on the literature, followed by a continuous infusion to maintain constant plasma levels due to short distribution half-life (6 min) of dexmedetomidine. Literature suggests that lower infusions of dexmedetomidine are associated with recall and recognition whereas higher doses cause bradycardia, hypertension, increased systemic, and pulmonary

### Table 5: Changes in mean blood pressure in both groups (above 50 years)

| MBP (mm Hg) | Dexmed group | Placebo group | Test applied | P |
|-------------|--------------|---------------|--------------|---|
| Loading dose |              |               |              |   |
| 0 min       | 12           | 89±9.8        | 8            | 87.0±7.0 | Unpaired t-test | 0.74 |
| 10 min      | 12           | 83±9.2        | 8            | 84.4±7.2 | Unpaired t-test | 0.02 |
| During microlaryngoscopy |          |               |              |   |
| At intubation | 12          | 94±11.2       | 8            | 101.1±12.4 | Unpaired t-test | 0.02 |
| Postintubation | 12           | 86±11.0       | 8            | 90.9±8.7 | Unpaired t-test | 0.04 |
| 5 min       | 12           | 88±10.0       | 8            | 94.3±10.5 | Unpaired t-test | 0.02 |
| 10 min      | 12           | 89±10.2       | 8            | 97.0±12.7 | Unpaired t-test | 0.13 |
| End of infusion | 12          | 82±12.9       | 8            | 92.8±6.4 | Unpaired t-test | 0.02 |
| Extubation  | 12           | 84±14.4       | 8            | 89.7±7.4 | Unpaired t-test | 0.02 |
| Recovery    | 12           | 81±10.3       | 8            | 89.3±6.7 | Unpaired t-test | 0.02 |

*Data expressed as mean±SD and P value. MBP=Mean blood pressure, SD=Standard deviation*

### Table 6: Sedation score 10 min postextubation in both groups

| Ramsay sedation score | Response | Dexmed | Placebo |
|-----------------------|----------|--------|---------|
| 1                     | Anxious or restless or both | 0       | 9       |
| 2                     | Cooperative, oriented and tranquil | 25      | 15      |
| 3                     | Responding to verbal commands  | 5       | 4       |
| 4                     | Brisk response to stimulus    | 0       | 2       |
| 5                     | Sluggish response to stimulus | 0       | 0       |
| 6                     | No response to stimulus       | 0       | 0       |

*Data expressed as number*

### Discussion

However, a delayed postoperative awakening with propofol, delayed onset of action with oral clonidine and gabapentin and an increased incidence of complications secondary to myocardial depression with β-blockers were faced.

Intravenous dexmedetomidine, by causing 90% reduction in serum catecholamine levels, attenuates sympathoadrenal responses to intraoperative stress and intubation. It has been effectively used for suppression of stress response during laryngoscopy and intubation. Its anesthesia sparing, opioid sparing action, and blunting of exaggerated hemodynamic responses during surgery have also been documented.
vascular resistance and a reduction in cardiac output.\textsuperscript{[14,21]} Hence, a maintenance dose of 0.5 µg/kg/h which provides a linear kinetics was selected based on previous studies.\textsuperscript{[22,23]}

Data of our study revealed that HR and MBP in Group D remained lower throughout the surgery than Group P. These hemodynamic effects can be attributed to the central sympatholytic action of dexmedetomidine.\textsuperscript{[13,14]} It confirms the fact that critical incidences such as laryngoscopy and intubation, suspension laryngoscopy significantly accelerate the MBP and HR as seen in Group P and dexmedetomidine infusion attenuated the said exaggerated response. A transient increase in MBP was observed at 2 min of administration of dexmedetomidine infusion, which was followed by a fall probably due to the vasoconstriction effect of dexmedetomidine mediated by α2B receptors appearing before the central sympatholytic action.\textsuperscript{[13,14,20,21]}

Perioperative stress during MLScopy can result in undesirable myocardial events. Dexmedetomidine modifies the stress response by reducing the release of stress hormones (norepinephrine, cortisol). Jianjun Ren \textit{et al.} have evaluated this property of dexmedetomidine in patients of coronary artery disease undergoing off-pump coronary artery bypass (OPCAB). They witnessed a reduction in the levels of cardiac troponin I, creatine kinase-MB, norepinephrine, cortisol, BP, HR, myocardial ischemia, and postoperative arrhythmia with 0.2–0.5 µg/kg/h dexmedetomidine.\textsuperscript{[24]} In the present study, none of the patients in Group D developed ST-T changes. The lower HR and BP in Group D could probably have resulted in reducing the myocardial oxygen demand and thus facilitating the maintenance of the myocardial oxygen supply and demand balance.

Intraoperatively, hemodynamics in Group D were well maintained and lesser mean dose and fewer number 2 (6.6%) of patients required fentanyl as rescue analgesic in contrast to 11 (36.6%) patients in Group P. Similar findings have been described by Bajwa \textit{et al.}\textsuperscript{[16]} where patients in dexmedetomidine required lesser doses of fentanyl to maintain intraoperative hemodynamics. This could be due to the documented analgesic properties of dexmedetomidine.\textsuperscript{[18]}

In the present study, end tidal concentration of sevoflurane was maintained at 2% throughout the procedure. Exaggerated hemodynamic response was attributed to inadequate depth of anesthesia due to unavailability of bispectral analysis (BIS)/entropy and was treated with a slow bolus of up to 1 mg/kg propofol. Propofol requirement to maintain hemodynamics was significantly reduced with dexmedetomidine exploring the anesthesia sparing properties of the drug. Bakhamees \textit{et al.} also found a reduction in propofol requirement with dexmedetomidine in morbidly obese patients when propofol was used for maintenance of anesthesia using bispectral analysis (electroencephalogram) as the depth of anesthesia monitor.\textsuperscript{[17]}

The study of time taken for extubation and quality of extubation was not a part of our study as laryngeal microscopic surgery leads to irritable airway due to mechanical trauma to laryngeal tissues, and hence extubation is sometimes delayed due to laryngeal edema. Ten percent lignocaine spray was found to be effective in suppression of cough response during extubation by Lee \textit{et al.}\textsuperscript{[2]} In the present study, lignocaine spray was used in all the patients to reduce airway irritation.

Smooth emergence and recovery from anesthesia is the goal for successful management of MLScopy.\textsuperscript{[25]} Postoperative recovery of the patients was found to be better in Group D, could be due to anxiolytic, analgesic and anesthetic sparing properties of dexmedetomidine leading to improved recovery profile. Sedation produced by dexmedetomidine is like normal
sleep where patients are easily arousable and responding to verbal commands and then return to sleep like state when not stimulated. In the placebo group, however, 9 (30%) patients were agitated whereas 2 patients had RSS of 4. This deeper level of sedation could be due to the excessive perioperative requirement of higher doses of other anesthetic drugs such as fentanyl and propofol.

The sympatholysis caused by dexmedetomidine has potential to increase the incidence of bradycardia and hypotension. Only one patient in the present study developed bradycardia in contrast to 3 patients in clonidine group as reported by Sunitha J Zachariah in their study of comparison of clonidine versus metoprolol for suppression of hemodynamic response to MLScopy.[11]

Conclusion

Dexmedetomidine, a novel α₂ agonist, is an excellent drug for attenuation of pressor response during intubation, during continuous airway manipulation as in microlaryngeal surgery. It has anesthetic and opioid sparing properties (lesser intraoperative propofol and fentanyl requirement) without causing delayed postoperative recovery.

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Conflicts of interest

There are no conflicts of interest.

References

1. Henderson J. Airway management in the adult. In: Miller RD, editor. Miller's Anesthesia. 7th ed. USA: Elsevier; 2010. p. 2560-618.
2. Lee DH, Park SJ. Effects of 10% lidocaine spray on arterial pressure without causing delayed postoperative recovery.
3. Grewal A. Dexmedetomidine: New avenues. Indian J Anaesth 2011;55:422-7.
4. Grewal A. Dexmedetomidine: New avenues. Indian J Anaesth 2011;27:297-302.
5. Chouhan Y, Parikh H. Effects of dexmedetomidine on hemodynamics in patients undergoing laparoscopic surgeries under general anesthesia – A comparative study. Indian J Appl Res 2014;46:70-2.
6. Flory S, Appadurai IR. Special considerations in anesthesia for laryngeal cancer surgery. Otalaryngol Clin Int J 2010;2:185-90.
7. Michiels C. Physiological and pathological responses to hypoxia. Am J Pathol 2004;164:1875-82.
8. Strong MS, Vaughan CW, Mahler DL, Jaffe DR, Sullivan RC. Cardiac complications of microsurgery of the larynx: Etiology, incidence and prevention. Laryngoscope 1974;84:908-20.