ORIGINAL ARTICLE

# Comparison of the effect of intravenous dexmedetomidine and lignocaine spray instilled into the endotracheal tube on extubation response in patients undergoing spine surgery

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## Abstract

**Background:** In spine surgery rapid emergence and extubation with haemodynamic stability is crucial for early neurological examination. Here, we have studied the effect of α2 agonist – dexmedetomidine intravenous (IV) and lignocaine spray instilled into the endotracheal tube at the end of the procedure to attenuate the extubation responses. **Methods:** A total of 45 patients undergoing spine surgery were randomly allocated in three groups. After the return of spontaneous respiration, Group-D: Dexmedetomidine 0.3 mcg/kg IV, Group-L: 10% lignocaine spray 1.5 mg/kg through endotracheal route and Group-P: Normal saline IV given over 60 s. Haemodynamic responses (systolic blood pressure, diastolic blood pressure, mean arterial pressure [MAP], heart rate [HR] and $SpO_2$) were recorded before and after administration of drugs and also duration of emergence, extubation, quality of extubation and post-operative sedation level were evaluated. **Results:** The increase in MAP and HR during extubation was significantly less in Group-D than Group-L and Group-P, 2 min after administration of the respective drugs ($P < 0.05$). There were no significant differences in the grade of a cough after extubation and post-operative sedation level. **Conclusion:** Dexmedetomidine (0.3 mcg/kg) attenuates haemodynamic response better than lignocaine spray (1.5 mg/kg) during emergence and extubation. It also provides smooth extubation and easy recovery without any post-operative sedative effect.

**Key words:** Airway response, dexmedetomidine, haemodynamic response, lignocaine spray, tracheal extubation

## INTRODUCTION

Tracheal extubation is as challenging as intubation in anaesthesia practice.[1] It is prudent to have rapid emergence and extubation without any adverse haemodynamic and airway changes in spine surgery where the early neurological examination is commonly needed.[2]

Dexmedetomidine reduces arterial pressure and heart rate (HR)[3-5] and may also have a role in the prevention of airway reflexes during extubation.[6] Lignocaine also has been used to attenuate these reflexes during extubation.[7,8]

Hence, we compared the efficacy of dexmedetomidine (0.3 μg/kg intravenous [IV]) and 10% lignocaine spray (1.5 mg/kg) endotracheally to attenuate the

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haemodynamic and airway reflexes and also the quality of extubation.

## SUBJECTS AND METHODS

After obtaining the approval from the Institutional Ethics Committee and Review Board, this randomised, double blinded and placebo-controlled study was conducted on 45 patients, aged between 18 and 70 years with American Society of Anesthesiologists (ASA) grade I and II, undergoing elective spine surgery in our institution. All the patients with active upper respiratory tract infection, obstructive and restrictive respiratory disease and cardiac, renal, hepatic dysfunctions and h/o allergy to the study drug were excluded from the study. Furthermore, the patients who were being treated with β-blockers, α2-agonist and who might require post-operative mechanical ventilation were excluded from the study.

After obtaining the written informed consents, all the patients were randomly allocated in three groups of 15 patients each by using 'Chit in Box Method'. The patients in Group-D received 0.3 μg/kg dexmedetomidine (diluted to 10 ml with normal saline) intravenously + normal saline spray in endotracheal route, Group-L received 1.5 mg/kg 10% lignocaine spray through endotracheal route + 10 ml normal saline intravenously and Group-P received 10 ml normal saline intravenously + normal saline spray in endotracheal route. A sealed envelope method was used to hide patient's allocation. All the study drugs were prepared in identical volumes and syringes and the company labels of the containers of lignocaine spray and normal saline spray were removed and labelled them according to the groups by an anaesthesiologist who was not involved in the anaesthetic management of the patients. The anaesthesiologist who was administering the study drugs and the anaesthesiologist who was recording the data were also blinded to the study drugs.

In the operating room, IV access was established with 18G-IV cannula and monitors for electrocardiography, HR, pulse oxymetry and non-invasive blood pressure were attached and pre-operative vital parameters were recorded.

For premedication, ranitidine 50 mg, metoclopramide 10 mg, glycopyrrolate 0.2 mg, midazolam 0.02 mg/Kg and fentanyl 2 mcg/Kg were administered. After preoxygenation for 3 min, general anaesthesia was induced with propofol (2 mg/kg) intravenously. Then endotracheal intubation was done using rocuronium (0.9 mg/kg) IV and anaesthesia was maintained with nitrous oxide and oxygen (50:50) with sevoflurane of 1MAC and for the maintenance of muscle relaxation atracurium (0.1 mg/kg) was given IV in every 15–20 min. All the patients were ventilated to maintain $EtCO_2$ between 35 and 40 mmHg. The left radial artery was cannulated with 20G-cannula for invasive arterial blood pressure monitoring. If there is a rise in mean arterial pressure (MAP) and HR >20% from the pre-operative values, fentanyl (0.5–1 μg/kg) IV given and the rate of sevoflurane was adjusted according to the level of MAP.

The values of MAP, systolic and diastolic blood pressure and HR were measured just before the administration of the study drug and these values were considered as the baseline value. At the start of the skin closure sevoflurane was stopped and after the last skin suture, the study drug was given intravenously (over 60 s) and endotracheally.

On the return of spontaneous effort reversal of neuromuscular blockade was done with neostigmine (0.05 mg/kg) + glycopyrrolate (0.01 mg/kg) IV. Then tracheal extubation was done when the patient started following verbal commands with spontaneous respiration and sustained head lift for 5 s. Haemodynamic parameters MAP, HR and $SpO_2$ were recorded before and 1 min, 2 min, 3 min, 5 min, 10 min and 15 min after the administration of study drug. The emergence time, extubation time, grade of a cough after extubation, post-operative sedation level and any adverse effects were noted.

Emergence time was defined as the time interval between cessation of anaesthetics and obeying of a verbal command. The extubation time is the time required for extubation after the cessation of anaesthetics.

The quality of extubation was measured by the grade of a cough after extubation. It is a four point scale - Grade 0 - No cough, easy breathing; Grade 1 - Slight cough (one or twice); Grade 2 - Moderate cough (3–4 times) and Grade 3 - Severe cough (5 or more times).

The level of post-operative sedation was measured by using 'Four point sedation score' - Grade 1 - Eyes open spontaneously; Grade 2 - Eyes open to speech; Grade 3 - Eyes open on shaking and Grade 4 - unarousable.

Any complication such as laryngospasm, bradycardia, hypotension, breath holding, nausea and vomiting, etc., was noted. All the patients were shifted to the neurosurgical Intensive Care Unit for post-operative care.

### Statistical analysis

All statistical analysis and calculations were done with the statistical programming software - SPSS (Statistical Package for the Social Science) version 20.0.0 (SPSS Inc., Chicago, Illinois, USA). The sample size was calculated to be 15 subjects in each group at power of 80% and alpha error of 0.05 assuming standard deviation of residual of 8.4, for minimum detectable difference of means of

10 in MAP 2 min after the administration of respective drugs based on a pilot study with 5 subjects in each group. The data of continuous variables (quantitative data) such as age, weight, blood pressure, HR and time were presented in terms of mean and standard deviation and the categorical variables (qualitative data) such as ASA grade, sex, grade of cough and sedation level were expressed in frequency and percentage. The quantitative data were analysed by applying one-way ANOVA and *post-hoc* test – Tukey for the intergroup comparison. Chi-square test or Kruskal–Wallis test was used for the analysis of qualitative data. A $P < 0.05$ was considered as statistically significant.

## RESULTS

There was no significant difference between the patients of these three groups with respect to their demographic variables such as age, sex, ASA grade and body weight ($P > 0.05$) [Table 1].

### Circulatory parameters

After administration of drugs, MAP was decreased than the baseline in Group-D and Group-L but it kept rising in Group-P. The reduction in MAP was persistent in Group-D but in Group-L, MAP initially decreased (at 1 min) but later it kept rising till the extubation and then it came below the baseline level [Figure 1]. We found statistically significant difference among these three groups in MAP from 2 min after the administration of the drug till the end of the study ($P < 0.05$) [Table 2]. The inter-group analysis has shown significant differences between Group-D, Group-P and Group-L and Group-P from 2 min to 3 min after drug administration, respectively, but it failed to show any significant difference between Group-D and Group-L with respect to changes in MAP after drug administration.

HR was increased in all the three groups. There was significant difference among these three groups from 2 min after administration of drug till the end of the study ($P < 0.05$) and it remains higher than the baseline in all the three groups [Table 3]. In Group-D, HR initially decreases below the baseline (1 min after administration of the drug) but then it rises above the baseline and remained throughout the study period [Figure 2].

### Extubation and emergence time

Regarding the time of emergence and extubation time, we did not observe any significant difference between these three groups [Table 4].

### Airway response

Though there were no significant differences in post-extubation grade of a cough [Table 5] among the three groups, number of patients with cough grade zero was more in Group-D (86.67%) than Group-L (60%) and Group-P (53.34%). In Group-P, 6.67% patients had cough grade of 2 but there was no incidence of laryngospasm and undue sedation after the extubation in these three groups.

### Sedation

No statistically significant difference ($P > 0.05$) was observed regarding the post-operative sedation level among these three groups [Table 6].

**Table 1: Demographic data (mean±SD or *n*)**

| Variables | Group-D | Group-L | Group-P | *P* |
|---|---|---|---|---|
| Age (years) | 44.2±13.2 | 47.33±10.6 | 46.133±10.45 | 0.754 |
| Sex | | | | |
| Male | 5 | 9 | 5 | 0.233 |
| Female | 10 | 6 | 10 | |
| ASA | | | | |
| I | 11 | 10 | 10 | 0.902 |
| II | 4 | 5 | 5 | |
| Weight (kg) | 61±7.12 | 60±7.35 | 62.6±6.67 | 0.599 |

SD = Standard deviation, ASA = American Society of Anesthesiologists

**Table 2: Changes in MAP (mean±SD)**

| Group | D | L | P | *P* |
|---|---|---|---|---|
| Pre-operative | 100.73±13.05 | 96.06±12.0 | 92.33±13.02 | 0.205 |
| Baseline | 111.06±9.75 | 107.53±5.56 | 103.3±11.81 | 0.091 |
| 1 min | 109.13±9.32 (−1.74) | 106.53±7.17 (−0.92) | 105.6±9.82 (+2.19) | 0.531 |
| 2 min | 106.66±8.27 (−3.96) | 108.53±9.0 (+0.92) | 116.46±12.25 (+12.71) | 0.024 |
| 3 min | 104.8±7.16 (−5.64) | 109.93±12.61 (+2.23) | 123.6±9.21 (+19.61) | 0 |
| 5 min | 103.4±11.85 (−6.9) | 111.26±18.24 (+3.47) | 131.2±10.52 (+26.97) | 0 |
| 10 min | 97.46±6.3 (−12.244) | 105.53±11.84 (−1.859) | 121.93±13.74 (+18) | 0 |
| 15 min | 96.93±9.67 (−12.72) | 101.6±11.62 (−5.517) | 114.6±10.28 (+10.9) | 0 |

Brackets are mean percentage changes from baseline values (+)=Increase, (−)=Decrease, SD = Standard deviation, MAP = Mean arterial pressure

## DISCUSSION

The haemodynamic and airway responses during tracheal intubation have been widely discussed in our literature as compared to tracheal extubation. Different theories such as reduced tolerance to endotracheal tube, rapid surge of catecholamine,[9] pain from surgical wound,[10] airway irritation due to suction and change of position from prone to supine,[11] have been proposed to explain these airway and circulatory changes. These changes are of greater concerned to the patients opted for the neurosurgical procedure and with other co-morbidities. We designed this study with the aimed to compare and evaluate the attenuating effects of single dose dexmedetomidine given intravenously and 10% lignocaine spray given endotracheally on haemodynamic and the airway responses during extubation in patients undergoing spine surgery.

In the present study, we found that dexmedetomidine (0.3 μg/kg) and 10% lignocaine spray (1.5 mg/kg) both were effective in attenuating the haemodynamic responses during extubation than the control. In Group-D, MAP remained below the baseline value throughout the study period but in Group-L, it raised before the extubation and also the rise of HR was less in Group-D than Group-L. Dexmedetomidine mainly exerts its action by reducing central sympathetic tone by activating α2 adrenoceptors and or imidazoline preferring receptors in the ventrolateral medulla.[6] Turan *et al*.[12] and Guler *et al*.[13] used dexmedetomidine 0.5 μg/kg over 60 s 5 min before the end of the surgery to attenuate the haemodynamic and airway reflexes during extubation and they found MAP and HR were significantly higher in placebo group ($P < 0.05$) than the dexmedetomidine group and these results were in accordance with the result of our study. Dexmedetomidine induced the reduction of blood pressure and HR during extubation is mainly dose dependent, that is, higher doses are more effective than the lower doses.[14] Bindu *et al*. studied the effect of dexmedetomidine in a dose of 0.75 μg/kg over 15 min before the anticipated time of end of surgery and they observed that dexmedetomidine had reduced the haemodynamic responses and provided smooth extubation with increased incidence of bradycardia, hypotension and higher level of post-operative sedation score.[6] In our study, dexmedetomidine (0.3 μg/kg) was satisfactory enough to reduce blood pressure and HR during extubation without any incidence of bradycardia, hypotension and undue post-operative sedation.

α2 agonistic agents had shown their smooth muscle relaxant effect *in vitro*,[6] therefore, dexmedetomidine may also have this property. This had been supported

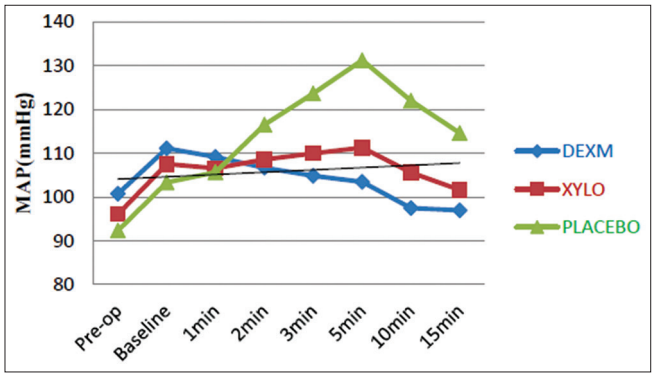


**Figure 1:** Changes in mean arterial pressure

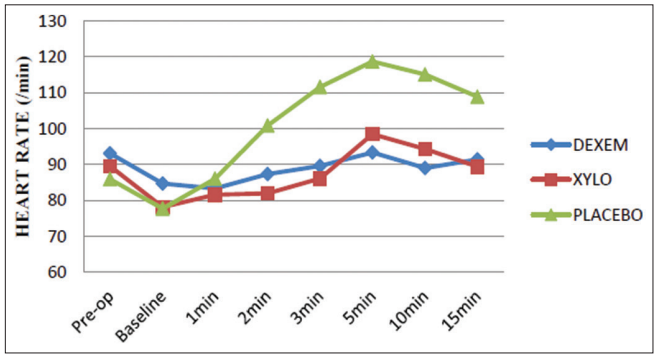


**Figure 2:** Changes in heart rate

**Table 3: Changes in heart rate (mean±SD)**

| Group | D | L | P | *P* |
|---|---|---|---|---|
| Preoperative | 93.06±16.73 | 89.53±14.94 | 85.86±13.59 | |
| Baseline | 84.66±16.88 | 78.13±11.17 | 77.66±8.225 | 0.248 |
| 1 min | 83.26±14.31 (−1.7) | 81.53±8.83 (+4.35) | 86±11.03 (+10.73) | 0.573 |
| 2 min | 87.33±13.3 (+3.15) | 81.93±8.99 (+4.86) | 100.86±11.62 (+29.87) | 0 |
| 3 min | 89.6±13.51 (+5.82) | 86.06±9.79 (+10.15) | 111.6±11.82 (+43.69) | 0 |
| 5 min | 93.33±19.53 (+10.23) | 98.46±22.84 (+26.02) | 118.73±13.44 (+52.87) | 0.002 |
| 10 min | 89±17.83 (+5.11) | 94.33±21.14 (+20.73) | 115.06±10.32 (+48.15) | 0 |
| 15 min | 91.4±17.4 (+7.95) | 89.4±16.81 (+14.42) | 108.86±7.4 (+40.17) | 0.001 |

Values in the brackets are mean percentage changes from baseline values (+)=Increase, (−)=Decrease, SD = Standard deviation

**Table 4: Emergence and extubation time (min) (mean±SD)**

| Group | D | L | P | *P* |
|---|---|---|---|---|
| Emergence | 4.78±1.0 | 4.83±0.58 | 4.78±0.85 | 0.984 |
| Extubation | 7.3±1.7 | 7.2±1.37 | 7.78±1.96 | 0.604 |

SD = Standard deviation

**Table 5: Grade of cough *n* (%)**

| Group | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| D | 13 (86.67) | 2 (13.34) | - | - |
| L | 9 (60) | 4 (26.67) | 2 (13.34) | - |
| P | 8 (53.34) | 3 (20) | 3 (20) | 1 (6.67) |

*P*=0.087, *H*=4.879 with 2 degrees of freedom

**Table 6: Sedation level *n* (%)**

| Group | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| D | 14 (93.33) | 1 (6.67) | - | - | - |
| L | 15 (100) | - | - | - | - |
| P | 15 (100) | - | - | - | - |

*P*=0.368, *H*=2.000 with 2 degrees of freedom

by several studies where dexmedetomidine reduced the incidence of a post-operative cough or any other airway complications.[6,12-14] We also found a larger number of patients with post-operative cough grade zero (86.67%) in dexmedetomidine group than lignocaine group and control.

Stimulation of the slowly adapting proprioceptors of the upper airway may have a role in the haemodynamic and airway reflexes during tracheal intubation as well as extubation,[15,16] and therefore, lignocaine given endotracheally may blunt these reflexes by its local anaesthetic effect. There are two opinions regarding the mechanism of action of lignocaine sprayed endotracheally – first, it can get absorbed from the airway mucosa to attain adequate plasma concentration or second, it can exert it's effect solely by its local anaesthetic effects on the airway mucosa. Earlier studies had shown that the required plasma concentration of lignocaine to attenuate haemodynamic and airway reflexes was more than equals to 3 μg/ml when used intravenously,[17] but it also had showed it's efficacy in blunting these reflexes when used as an endotracheal spray at much lower plasma concentration.[18] Hence, the local anaesthetic action of lignocaine is the main mechanism behind these functions when used as an endotracheal spray. In the present study, we found that instillation of 10% lignocaine spray (1.5 mg/kg) endotracheally before extubation was associated with less rise of blood pressure (MAP), HR and airway responses during extubation than control ($P < 0.05$). Other studies where lignocaine was used endotracheally had also shown the similar results. Takita *et al*., used tracheal lignocaine (4%, 4 ml) before intubation, and they observed that tracheal lignocaine was very effective to reduce cardiovascular responses during intubation.[19] Jee and Park had compared the effect of 2% lignocaine in a dose of 1 mg/kg given endotracheally and intravenously 5 min and 3 min before extubation, respectively. In the results, lignocaine given endotracheally was better than the IV lignocaine in attenuating airway-circulatory reflexes during extubation.[7] Lee and Park, had evaluated the effect of 10% lignocaine spray in a dose of 1.5 mg/kg to the larynx and trachea before suspended laryngoscopy and they observed that lignocaine spray (10%) was effective in attenuation of rise of arterial pressure during suspended laryngoscopy and suppression of a cough during extubation.[20]

Earlier studies have established the superiority of IV dexmedetomidine (0.5 mg/kg) over IV lignocaine (1.5 mg/kg) to attenuate the extubation responses,[21] till now no study has compared the effect of IV dexmedetomidine (0.3 μg/kg) and 10% lignocaine spray given prior to the extubation. We had also found that the MAP remained above the baseline up to the extubation in lignocaine spray group, whereas in dexmedetomidine group it remained below the baseline till the end of the study. The number of patients having smooth extubation (60%) was also lesser than the dexmedetomidine group (86.67%).

## Limitation

We had to take the weight of the patients as multiplication of 10 to ease the calculation and administration of the required dosage of lignocaine by using 10% lignocaine spray. Second, we administered dexmedetomidine as a single IV bolus dose rather than an infusion. Hence, the result could have been different as dexmedetomidine bolus dose itself can rise the blood pressure, HR temporarily because of its peripheral sympathomimetic action.[22] Third, the plasma nor-epinephrine, which precisely correlate with the sympatholytic effect of dexmedetomidine had not been measured.

## CONCLUSION

In our study, dexmedetomidine (0.3 μg/kg) as a single bolus IV dose and 10% lignocaine spray (1.5 mg/kg) given tracheally, both were effective in maintaining haemodynamic stability during extubation with respect to control. However, dexmedetomidine provided better attenuation of haemodynamic and airway responses than lignocaine, with smooth extubation and early neurological examination without any undue sedation and other side effects.

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## Conflicts of interest
There are no conflicts of interest.

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