Original Research Article

To compare the effects of intravenous dexmedetomidine and lignocaine on hemodynamic responses and airway reflexes during tracheal extubation in patients undergoing laparoscopic surgeries

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Abstract

Introduction : Emergence from anaesthesia and tracheal extubation can be associated with hemodynamic responses and sympatho-adrenal response results in increased cardiac workload leading to rise in myocardial oxygen demand and may be detrimental subsequently. Many techniques and drugs have been proposed to attenuate airway and cardiovascular responses. **Aims:** This study intends to compare the effect of Dexmedetomidine and Lignocaine on haemodynamic responses and airway reflexes during tracheal extubation. **Materials and Methods:** A double-blind, randomized study was conducted in the Department of Anaesthesiology 100 adult patients of age group 18 to 60 years of ASA Grade I and Grade II scheduled for laparoscopic surgery were studied in randomized manner. Group D received Dexmedetomidine 0.5mcg/kg and Group L received Lidocaine 1.5 mg/kg, both drugs diluted to 10ml and administered intravenously as bolus over 60 seconds prior to extubation. **Results** : Increase in heart rate was observed in both groups and it was significantly higher in Lignocaine group than Dexmedetomidine group, during extubation as well as after extubation (P-value of 0.001). We observed that the mean arterial blood pressure varied significantly between Dexmedetomidine group and Lignocaine group starting from 1 min after extubation up to 15 mins after extubation. Mean arterial blood pressure rise was more with Lignocaine group as compared to Dexmedetomidine group (P-value < 0.005). The quality of extubation (measured by cough score) was significantly better in Dexmedetomidine group compared to Lignocaine group (P-value <0.005). **Conclusion :** The attenuation of sympathetic response (HR, SBP) was better with Dexmedetomidine 0.5 mcg/kg than Lignocaine 1.5 mg/kg at the time of extubation and in the period following extubation. The airway response was better controlled with the use of Dexmedetomidine allowing a smooth tracheal extubation, thereby providing a more uneventful recovery and calm patients in post-operative recovery unit.

Keywords: Extubation, Dexmedetomidine, lidocaine.

Introduction

Endotracheal extubation is the process of removal of endotracheal tube in order to liberate the patient from mechanical ventilation. It is one of the most turbulent phases during the course of general anaesthesia and usually associated with haemodynamic changes and airway reactivity [1] Extubation during lighter planes of anaesthesia can stimulate sympathetic reflexes leading to haemodynamic changes [2,3]. These haemodynamic changes are reflected as rise in heart rate and arterial blood pressure and are usually variable, transitory and unpredictable. It is more dangerous in patients who have systemic hypertension, heart disease, intracranial aneurysms and Cerebro-vascular disease. Even the transient changes in arterial blood pressure and heart rate can result in potentially deleterious effects like cerebral haemorrhage, arrhythmia, myocardial ischemia, left ventricular failure, pulmonary oedema and rupture of intracranial aneurysm. Airway reactivity during extubation may lead to bronchospasm, laryngospasm and cough which are more detrimental in patients having comorbidities like bronchial asthma and Chronic Obstructive pulmonary disease. Various drugs and techniques have been tried from time and again to attenuate the airway and stress responses during tracheal extubation [4]. Attempts have been made to attenuate the pressor response by the use of drugs such as Fentanyl, Lignocaine, Propofol, magnesium sulphate, nitro-glycerine, clonidine, esmolol, labetalol, metoprolol etc. either as a sole agent or in combination with each other [5,6].To attenuate airway and pressor response during tracheal extubation, Dexmedetomidine, a highly selective alpha-2 adrenoceptor agonist has been studied as single dose at the time of extubation. It has a sympatholytic effect through which it decreases the concentration of Norepinephrine. This, in turn, decreases the blood pressure (BP) and the heart rate (HR). Dexmedetomidine, therefore, is theoretically appropriate for reducing airway and circulatory reflexes during emergence from anaesthesia. Lignocaine, an amide local anaesthetic, injected intravenously or applied topically to larynx and trachea, is variably effective at blunting the haemodynamic and airway response to tracheal stimulation. It decreases intracellular calcium concentration

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in airway smooth muscle which decreases myofilament calcium sensitivity and has been shown to suppress coughing and prevent reflex broncho-constriction. With this background, this study was conceptualized to analyse the effect of Dexmedetomidine and Lignocaine on the haemodynamic outcomes and recovery profiles during and after tracheal extubation.

Aim of The Study

1. To study the haemodynamic effects of Dexmedetomidine and Lignocaine during extubation.
2. To compare the quality of extubation provided by Dexmedetomidine with that of Lignocaine

Materials and methods

A double-blind, randomized study was conducted in the Department of Anaesthesiology, Kalinga Institute of Medical Sciences and Pradyumna Bal Memorial Hospital, Bhubaneswar after obtaining clearance from hospital ethical committee.

After approval, the study was registered in **Clinical Trials Registry of India (CTRI/2019/04/018528)**. Recruitment and data collection was started on April 2019 and ended by August 2020. 100 adult patients of age group 18 to 60 years of ASA Grade I and Grade II scheduled for laparoscopic surgery were studied in randomized manner.

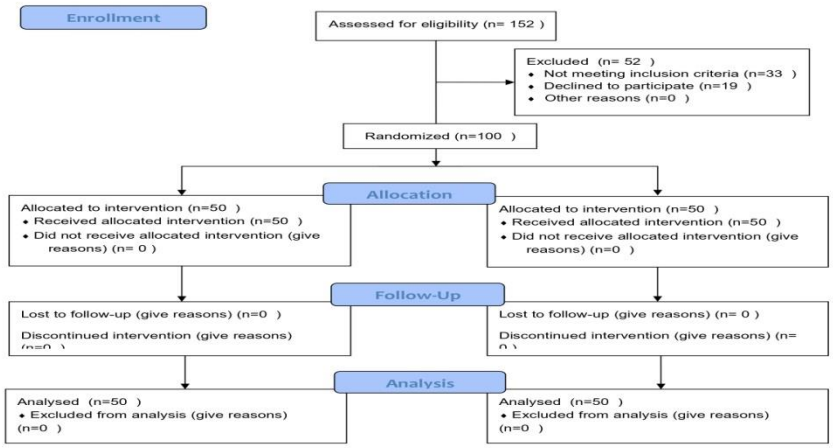

Fig 1: Depiction of flow manner

N master/ STATA 15.1 was used to calculate the sample size based on the study done by **Girija Prasad Rath et al .** Reported Mean and S.D. of SBP, DBP and HR measured at different occasion between two groups were adopted for this. A maximum sample size was observed by adopting mean and standard deviation of DBP in GROUP D (73 ± 4.4) and GROUP L (75 ± 4.8) at 5% **level of significance** with 90% of minimum study power for two sided alternative hypothesis. Each group required sample size of 48; therefore, the total sample size came to 96**.** So, we took a **total sample size of 100.**

Group D: Patients received single dose of intravenous Dexmedetomidine 0.5 mcg/kg administered as bolus over 60 seconds prior to extubation. (n=50)

Group L: Patients received single dose intravenous Lignocaine 1.5 mg/kg as bolus over 60 seconds prior to extubation. (n=50)

Patients with uncontrolled systemic disorder like diabetes, hypertension, hepatic or renal impairment, severe airway disorder, seizure disorder, ischemic and/or congestive cardiac diseases, coronary artery disease or recent MI, Patients taking medications that affect the BP & HR were excluded from the study.

Thorough pre-anaesthetic check-up was done. Patients were premedicated with tablet alprazolam 0.5mg in the night before surgery and in the morning on the day of surgery. After obtaining informed consent, the patients were taken into the operation theatre and all standard ASA monitors like electrocardiography (ECG), oxygen saturation (SpO_2), non-invasive blood pressure (NIBP) and end-tidal carbon-dioxide ($EtCO_2$) were attached to the patient. An intravenous catheter (18G) was inserted in a peripheral vein and intravenous fluid started. The patients were Pre-medicated with intravenous Inj. Glycopyrrolate 5 mcg/kg, Inj. Midazolam 0.025mg/kg and Inj. Nalbuphine 0.1mg/kg. After adequate preoxygenation, they were induced with Inj. Propofol 2mg/kg and intubation facilitated with Inj. Vecuronium 0.1mg/kg given intravenously. ETT of size 7.0 for females and size 8.0 for male were used. ETT cuff pressure was kept between 20 to 30 cm of water. Anaesthesia was maintained with 66% nitrous oxide, 33% oxygen, Isoflurane 1%-2% and intermittent Inj. Vecuronium. Adequate fluids were used for replacement and maintenance. Normothermia was ensured throughout the intra-op period. At the last skin suture, volatile agent was cut off and patients in each group received the specified drug i.e., Dexmedetomidine or

Lignocaine in the above mentioned dose intravenously over 1min. Nitrous oxide was discontinued at the end of infusion. For residual Neuromuscular blockade Inj. Neostigmine 0.05mg/kg and Inj. Glycopyrrolate 0.01mg/kg were given intravenously when spontaneous respiratory efforts were observed.

Patients were extubated when the following extubation criteria were fulfilled.

1) Sustained head lift for 5 seconds.
2) Sustained hand grip for 5 seconds.
3) Adequate level of consciousness.
4) Maximum inspiratory pressure- 20 cm H_2O or greater.
5) Clear oro/hypopharynx.

The heart rates (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), oxygen saturation (SpO2) were noted:

·At the time of administration of the drug
·At 1 min, 3 mins and 5 mins after administering the drug
·At extubation
·Post extubation at 1 min, 3 mins, 5 mins, 10 mins, 15 mins and 20 mins. Extubation quality was rated using Ishak 4-point cough scale. Any incidence of cough, laryngo spasm, breaths holding more than 20 secs, hypotension, broncho-spasm or desaturation were observed for a period of 30 mins post extubation.

Statstical Analysis: The data on categorical variables were shown as n (% of cases) and the data on continuous variables were presented as mean and standard deviation (SD) across two study groups. The inter-group statistical comparison of distribution of categorical variables were tested using Chi-Square test or Fisher's exact probability test for 2 x 2 contingency table if cell frequencies are less than 5. The inter-group statistical comparison of means of continuous variables were done using independent sample t test. All results are shown in tabular as well as graphical format to visualize the statistically significant difference more clearly. In the entire study, the p-values less than 0.05 were considered to be statistically significant. All the hypotheses were formulated using two tailed alternatives against each null hypothesis (hypothesis of no difference). The entire data was statistically analyzed using Statistical Package for Social Sciences (SPSS ver 22.0, IBM Corporation, USA) for MS Windows.

Results

Baseline patient characteristics like age, sex and initial oxygen saturation were comparable in all the groups.

Table 1:Inter-group comparison of mean heart rate

Heart rate (per min)	Group A [LIGNOCAINE] (n=50)		Group B [DEXMED] (n=50)		P-value
	Mean	SD	Mean	SD	
Base	87.62	11.90	82.80	9.95	0.030*
At drug	82.44	14.37	75.86	10.27	0.010**
1-Min	80.88	14.68	75.96	12.05	0.070NS
3-Min	86.48	16.58	80.64	13.01	0.053NS
5-Min	91.14	15.78	83.04	10.43	0.003**
At Extubation	103.68	12.70	91.94	11.81	0.001***
1-Min	98.06	13.20	84.62	11.48	0.001***
5-Min	91.10	12.09	79.32	10.91	0.001***
10-Min	86.12	11.38	74.54	8.66	0.001***
15-Min	79.74	8.31	71.92	8.48	0.001***

Values are mean and SD, P-value by independent sample t test. P-value<0.05 is considered to be statistically significant. *P-value<0.5, **P-value<0.01, ***P-value<0.001, NS-Statistically non-significant.

Distribution of mean heart rate at base, at the time of drug administration, 5-min after intubation, at extubation, at 1-min post extubation, 5-min, post extubation, 10-min post extubation and 15-min post extubation of cases studied was significantly higher in Group A [LIGNOCAINE] compared to Group B [DEXMED] (P-value<0.05 for all).

Table 2: Inter-group comparison of mean systolic BP

Systolic BP (mmHg)	Group A [LIGNOCAINE] (n=50)		Group B [DEXMED] (n=50)		P-value
	Mean	SD	Mean	SD	
Base	133.94	11.85	131.82	11.96	0.376NS
At drug	128.94	11.16	132.92	12.76	0.100NS
1-Min	129.26	12.32	135.54	12.93	0.015*
3-Min	130.96	12.85	133.66	17.47	0.381NS
5-Min	136.16	12.13	133.34	16.93	0.341NS
At Extubation	143.54	10.12	139.88	13.98	0.137NS
1-Min	137.32	11.97	131.96	13.44	0.038*
5-Min	132.24	10.77	123.84	15.56	0.002**
10-Min	130.74	11.26	118.82	13.91	0.001***
15-Min	128.12	10.29	116.74	12.87	0.001***

Values are mean and SD, P-value by independent sample t test. P-value<0.05 is considered to be statistically significant. *P-value<0.5, **P-value<0.01, ***P-value<0.001, NS-Statistically non significant.

Distribution of mean systolic BP at base, at the time of drug administration, 3-min and 5 min after intubation and at extubation did not differ significantly between two study groups (P value>0.05 for all). Distribution of mean systolic BP at 1-min after the drug administration of cases studied was significantly higher in Group B [DEXMED] compared to Group A [LIGNOCAINE] (P value<0.05). Distribution of mean systolic

BP at 1-min, 5-min, 10-min and 15-min post extubation of cases studied was significantly higher in Group A [LIGNOCAINE] compared to Group B [DEXMED] (P-value<0.05 for all).

Table 3: Inter-group comparison of mean diastolic BP

Diastolic BP (mmHg)	Group A [LIGNOCAINE] (n=50)		Group B [DEXMED] (n=50)		P-value
	Mean	SD	Mean	SD	
Base	84.54	10.34	86.06	7.47	0.402^{NS}
At drug	85.08	9.73	85.26	9.57	0.926^{NS}
1-Min	84.50	10.72	88.72	9.64	0.041*
3-Min	86.90	10.08	85.68	10.53	0.555^{NS}
5-Min	87.72	9.38	85.04	11.62	0.208^{NS}
At Extubation	91.86	7.04	87.90	9.47	0.020*
1-Min	86.14	9.47	83.90	10.39	0.263^{NS}
5-Min	83.56	9.90	79.68	9.59	0.049*
10-Min	83.78	7.93	76.54	9.82	0.001***
15-Min	83.58	6.49	75.02	10.24	0.001***

Values are mean and SD, P-value by independent sample t test. P-value<0.05 is considered to be statistically significant. *P value<0.5, **P-value<0.01, ***P-value<0.001, NS-Statistically non-significant.

Distribution of mean diastolic BP at base, at the time of drug administration, 3-min and 5- min after intubation and at 1-min post extubation did not differ significantly between two study groups (P-value>0.05 for all).

Distribution of mean diastolic BP at 1-min after the drug administration of cases studied was significantly higher in Group B [DEXMED] compared to Group A [LIGNOCAINE] (P value<0.05).

Table 4: Inter-group comparison of mean of mean arterial pressure (MAP)

MAP (mmHg)	Group A [LIGNOCAINE] (n=50)		Group B [DEXMED] (n=50)		P-value
	Mean	SD	Mean	SD	
Base	99.78	8.43	101.44	8.78	0.337^{NS}
At drug	97.54	10.52	100.02	11.17	0.256^{NS}
1-Min	97.96	10.37	103.82	9.72	0.004**
3-Min	102.70	13.67	101.76	12.84	0.724^{NS}
5-Min	100.34	10.08	99.14	13.61	0.618^{NS}
At Extubation	107.62	8.96	103.86	10.99	0.064^{NS}
1-Min	104.86	9.81	98.90	12.15	0.008**
5-Min	100.56	9.25	94.32	12.95	0.007**
10-Min	100.86	11.52	91.46	11.91	0.001***
15-Min	98.78	7.05	89.16	11.40	0.001***

Values are mean and SD, P-value by independent sample t test. P-value<0.05 is considered to be statistically significant. *P-value<0.5, **P-value<0.01, ***P-value<0.001, NS-Statistically non-significant.

Distribution of mean MAP at base, at the time of drug administration, 3-min and 5-min after intubation and at extubation did not differ significantly between two study groups (P value>0.05 for all).

Distribution of mean MAP at 1-min after the drug administration of cases studied was significantly higher in Group B [DEXMED] compared to Group A [LIGNOCAINE] (P value<0.05).Distribution of mean MAP at 1-min, 5-min, 10-min, and 15-min post extubation of cases studied was significantly higher in Group A [LIGNOCAINE] compared to Group B [DEXMED] (P-value<0.05 for all).

Table 5: Inter-group distribution of quality of extubation among the cases studied

Quality of extubation	Group A [LIGNOCAINE] (n=50)		Group B [DEXMED] (n=50)		P-value
	n	%	n	%	
No cough	36	72.0	45	90.0	0.022*
Mild cough	14	28.0	5	10.0	
Moderate cough	0	0.0	0	0.0	
Marked cough	0	0.0	0	0.0	

Total	**50**	**100.0**	**50**	**100.0**	
Values are n (% of cases), P-value by Chi-Square test. P-value<0.05 is considered to be statistically significant. *P value<0.05.					

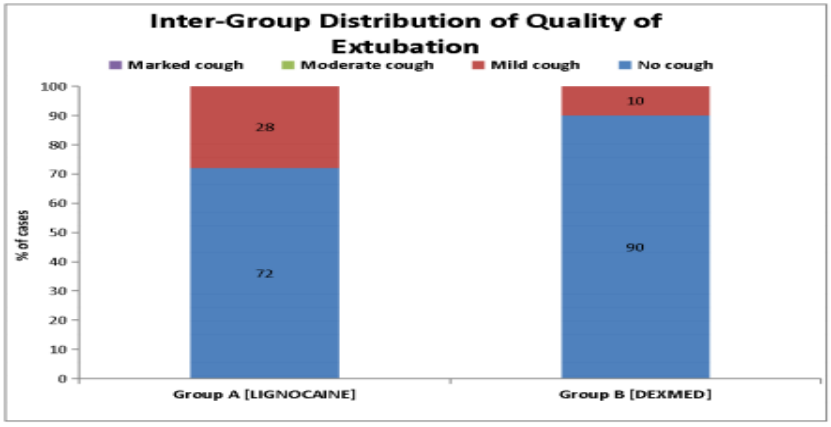

Fig. 1: Inter-group distribution of quality of extubation among the case studied

Of 50 cases studied in Group A [LIGNOCAINE], 36 (72.0%) had no cough and 14 (28.0%) had mild cough. Of 50 cases studied in Group B [DEXMED], 45 (90.0%) had no cough and 5 (10.0%) had mild cough.

The distribution of quality of extubation among the cases studied was significantly better in Group B [DEXMED] compared to Group A [LIGNOCAINE] (P-value<0.05).

Discussion

Emergence from general anaesthesia and tracheal extubation is often accompanied with tachycardia and hypertension. These responses may produce myocardial ischemia or infarction in susceptible patients. The effect of the changes in circulatory and airway response during intubation has been discussed at length as compared to extubation in the literature. Many possible factors such as surge in circulatory catecholamine, airway irritation due to suction, intense pain from surgical wounds and emergence have been put forward to explain the sudden increase in HR, BP, rise in ICP and IOP during extubation [7].This could prove deleterious in patients undergoing cardiac, neurosurgical or ophthalmic procedures. To attenuate the haemodynamic responses during laparoscopic surgeries, a wide variety of agents are being used both as premedication and induction. α2 adrenoceptor agonists are being increasingly used in anesthetic practice as they not only decrease sympathetic tone and attenuate the stress response to anaesthesia and surgery, but also have sedative, analgesic and anxiolytic properties. Recently there has been much interest in the use of newer α2 agonist Dexmedetomidine in anaesthesia. There are several studies where the effect of Dexmedetomidine, given as a bolus and/or infusion on haemodynamic response to anesthetic and surgical stress, especially in laparoscopy has been investigated[8].

Dexmedetomidine offers a unique pharmacological profile with properties like sedation, sympatholysis, analgesia, cardiovascular stability and added advantage of not causing respiratory depression.

Main findings of our study were:

1) HR increase was significantly higher in lignocaine group then dexmedotomidine group during extubation as well as after extubation (p value 0.001).
2) Quality of extubation was significantly better in Dexmedetomidine group. (p <0.005)
3) MAP rise was more with lignocaine as compared to dexmedetomidine group (p <0.005).

In our study, we used a dose of 0.5mcg/kg of Dexmedetomidine and compared it with Lignocaine 1.5mg/kg on the lines of the study conducted by **Girija Prasad et al[9]**. Our study was in accordance with the study conducted by **Girija Prasad et al** on all the parameters except that we had recruited a larger sample size in our study. Our study findings were similar to that of **Gosai et al [10]** with regards to increase in MAP and HR. In our study, patients of both groups showed a significant rise in HR and BP during and after extubation possibly because of lighter planes of anaesthesia subsequent to discontinuation of volatile agents and N_2O just before extubation. Similar findings were also documented by **Kothari et al[11]** in a study involving 50 neurosurgical patients.

We found a cough score of 0 in 90% of patients and a score of 1 in 10% of patients in Dexmedetomidine group, whereas in Lignocaine group 72% of patients had a score 0 and 28% had a score 1. These observations were similar to the studies of **Sharma et a**l[12] **and Kothari et al.**

Airway complications such as breath holding, laryngospasm and desaturation during and after extubation were not observed with Dexmedetomidine in our study which

Were in accordance with the findings noted in studies conducted by **Bindu et al [13]**, **Aksu et al[14] and Dutta et al[15].**

There was one limitation in our study. We studied single doses of Lignocaine and Dexmedetomidine for attenuation of haemodynamic and airway reflexes. A dose-response study might have been useful in determining the appropriate dose of the study drugs.

Conclusion

We conducted this prospective, randomized, double-blind study to compare the effects of Dexmedetomidine and Lignocaine on the attenuation of haemodynamic and airway responses during tracheal extubation. The attenuation of sympathetic response (HR, SBP) was better with Dexmedetomidine 0.5 mcg/kg than Lignocaine 1.5 mg/kg at the time of extubation and in the period following extubation. The airway response was better controlled with the use of Dexmedetomidine allowing a smooth tracheal extubation, thereby providing a more comfortable recovery and calm patients in post-operative recovery unit.

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