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Attenuation of hemodynamic response to laryngoscopy and endotracheal intubation with dexmedetomidine: a randomized controlled trial

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Abstract

Background: Laryngoscopy and endotracheal intubation causes marked increase in heart rate and blood pressure. Even though various agent tried to blunt the hemodynamic response but none of them proved to be an ideal. The aim of the study was to compare dexmedetomidine and placebo in blunting the hemodynamic response to laryngoscopy and endotracheal intubation.

Methods: A randomized placebo controlled study with total of 90 patients were included in the study of which 30 patients received dexmedetomidine (Group D) 10 minutes prior to endotracheal intubation and 30 patients received 3 ml Normal Saline (Group C) 10 minutes prior to endotracheal intubation. They were evaluated with change in heart rate and mean arterial pressure at 1, 3 and 5 minutes post laryngoscopy and endotracheal intubation. Any adverse effect of the drug was noted.

Results: Age, gender, physical status and weight were comparable between the groups. Heart rate and mean arterial pressure attenuated significantly in dexmedetomidine group ($p<0.001$ in 1, 3 and 5 minute intervals respectively), whereas placebo failed to attenuate hemodynamic response after laryngoscopy and intubation in any measured interval. No complications were noted.

Conclusions: Dexmedetomidine 1 mcg/kg given 10 min prior to endotracheal intubation significantly attenuates heart rate and mean arterial pressure at 1, 3 and 5 minutes compared to placebo.

Keywords: Dexmedetomidine; endotracheal intubation; hemodynamic response; laryngoscopy.

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Introduction

The hemodynamic response during laryngoscopy and endotracheal intubation is expected and might be terrible. Both laryngoscopy and endotracheal intubation induce a sympathetic response resulting in a rise in serum catecholamines. The rise in serum concentrations of norepinephrine might be upto 147% and that of epinephrine level upto 60% during laryngoscopy and endotracheal intubation.[1] It leads to an increase heart rate (HR) and Mean arterial pressure (MAP).[2] In Nepal, the first endotracheal intubation was reported by Bhawani Bhakta singh in 1955 in Bir hospital.[3]

The change in hemodynamic response is usually transient, variable and unpredictable. This is well tolerated by healthy individuals but may be life-threatening in susceptible individuals.[4] Hemodynamic changes can be attenuated by either pharmacological methods or non pharmacological methods. None of the avilable agent has proved to be ideal.[4] Hence, the search for an ideal agent to attenuate the hemodynamic responses is continuing and recently dexmedetomidine has gained interest among researchers for blunting hemodynamic response during laryngoscopy and endotracheal intubation. The alfa-2(α_2)-adrenergic agonist dexmedetomidine is being investigated as a potent agent for the attenuation of hemodynamic response. Preoperative single dose (1 µg/kg) over 10 min results in progressive increases in sedation and seems to blunt hemodynamic responses during laryngoscopy.

Purpose of this study was to study the attenuating effects in terms of HR and MAP by dexmedetomidine in Nepalese population and help clinicians find the gold standard agent to blunt hemodynamic response during laryngoscopy and endotracheal intubation as well as to record the adverse effect of the drug if any.

Methods

This was a prospective, randomized study conducted in two tertiary care centres in Kathmandu. The sample size calculation was based on the study done by Sajith Sulaiman et al.[5] Standard deviation was taken from the mean of the heart rate at 1 minute of post endotracheal intubation from the study and power analysis at 5% level of significance and 80% power of study; the sample size was 30 in each group.

The ASA I and II with both gender of aged 15-45 years posted for elective surgery requiring general anaesthesia and endotracheal intubation were included in study. Patients with pre-existing hypertension, asthma, chronic obstructive pulmonary disease (COPD), patients with sinus bradycardia, heart block, on anti hypertensive drugs; pregnant patients; patient with anticipated difficult intubation, encountered difficult ventilation and/ or difficult intubation after induction were excluded from the study.

The study was conducted after approval from the Institutional Review Board. Informed written consent for participation in the study was obtained during the preoperative visits from each patient. The patients were premedicated with diazepam 10 mg orally. Patients were kept nil per oral at least for 6 hours.

Inside the operation theatre, standard monitors were attached. Intravenous line was opened by 18 G cannula. A base line value of mean arterial pressure and heart rate was recorded. Patient was randomized into two group using sealed envelope technique. Group D (n=30) received intravenous dexmedetomidine 1 µg/kg diluted to 3 ml over 10 minutes prior to intubation, and Group C (n=30) received placebo (normal saline 3 ml) over 10 minutes prior to intubation.

Preoxygenation started with 100% oxygen and premedication done with i.v. pethidine 0.7 mg/kg and i.v. midazolam 0.04 mg/kg, 4 minutes prior to intubation. Induction of anesthesia was done with propofol in titrating dose till the loss of verbal response. After induction heart rate and mean arterial pressure was noted. Intubation was facilitated with 0.1 mg/kg of vecuronium 3 minutes prior to intubation. Laryngoscopy was performed using a standard Macintosh laryngoscope blade, 3 minutes after administering vecuronium (0.1 mg/kg) and trachea was intubated.

Hemodynamic variables i.e. heart rate and mean arterial blood pressure was recorded immediately after endotracheal intubation and after 1, 3 and 5 minutes of tracheal endotracheal intubation. During these 5 minutes all surgical stimulation was avoided. After 5 minutes of endotracheal intubation, the stress of induction considered being over and surgery was started and further management was done based on institutional protocal.

Collected data was analysed by means of various statistical tests. Independent t test was used for comparison between two groups for continuous variables like age, heart rate and mean arterial pressure. Chi square test is applied for comparison of sex ratio and ASA physical status.

Results

The age, gender weight and ASA physical status were comparable between the groups.

Table 1: Demographic data of the patient

Variables	Group D(n=30)	Group C(n=30)	p value
Age in years (Mean±SD)	35.40±9.04	34.43±9.21	0.560
Gender(Male/ Female)	13/17	12/18	0.392
Weight in Kilograms (Mean±SD)	55.83±9.85	55.87±9.67	0.921
ASA physical status I/II	21/9	20/10	0.709

Heart rate and mean arterial pressure were comparable at baseline. The heart rate was significantly reduced after induction in dexmedetomidine group. Mean arterial pressure response after induction was comparable between the groups. The HR and MAP was significantly attenuated in all measured interval that is after laryngoscopy and intubation, 1 minutes, 3 minutes and 5 minutes after intubation.

Table 2: HR response in dexmedetomidine and lidocaine

HR	Group D	Group C	p-value
Baseline	85.50±12.96	90.27±15.53	0.680
After induction	76.77±14.46	88.43±14.59	0.014
After laryngoscopy and endotracheal intubation	81.57±14.47	105±16.84	<0.001
1 min	81.43±16.32	106.03±11.90	<0.001
3 min	76.83±11.20	99.87±13.38	<0.001
5 min	73.97±10.45	92.13±13.65	0.001

Table 3: MAP response in dexmedetomidine and lidocaine

MAP	Group D	Group C	p-value
Baseline	92.20±11.73	92.97±12.85	1.00
After induction	80.26±11.30	84.70±11.17	0.656
After laryngoscopy and endotracheal intubation	85.83±11.54	105.77±10.04	<0.001
1 min	82.87±12.03	107.67±14.16	<0.001
3 min	79.90±10.85	103.63±13.02	<0.001
5 min	76.63±9.45	97.60±11.79	<0.001

No complications were observed in both the groups.

Discussion

Direct laryngoscopy and endotracheal intubation is associated with a variety of adverse responses. Although, this reflex response is usually short and transient, its effects cannot be underestimated especially in high risk susceptible individuals. These responses to endotracheal intubation can be life threatening to the patient and clinically challenging to the anaesthesiologists. These changes in heart rate and blood pressure are maximum at 1 minute after endotracheal intubation and last for 5-10 min.

The main finding of the study was dexmedetomidine in a dose of 1 μg/kg over 10 minutes before induction effectively attenuated the hemodynamic response to laryngoscopy and endotracheal intubation as compared with placebo without major adverse effects. The mechanism behind the attenuation is inhibition of central sympathetic outflow as well as stimulation of presynaptic α-2 receptor, which causes decrease in norepinephrine release, causing a fall in blood in blood pressure and heart rate.[6]

Shribman et al demonstrated an increase in serum catecholamine levels during laryngoscopy, with and without concomitant endotracheal intubation, which could be the probable cause of these hemodynamic changes.[7] In this study we did not encounter any difficult endotracheal intubation case and all case those who were randomized for study was evaluated for the results. Laha et al[8] also found intravenous dose of dexmedetomidine 1 μg/kg significantly blunted the heart rate and blood pressure response at 1 min, 2 min and 5 min after laryngoscopy and endotracheal intubation when comparing with control group which was similar to our study, though the analgesic agents used in both study were different.

A similar result was found by R. Saraf et al[9] and Sajith Sulaiman et al[5] with low dose (0.6 μg/kg and 0.5 μg/kg respectively) dexmedetomidine. Even though the dose was low but the study population was on beta-blocker therapy. Another study done by Ferdi Menda et al[10] also found that dexmedetomidine infusion (1 μg/kg) before the anaesthesia induction blunted the HR and MAP response during laryngoscopy and endotracheal intubation. However, the anesthetic induction agent etomidate was used in that study.

Other multiple studies also found similar result to ours that dexmedetomidine with the dose of 1 μg/kg a was effective in attenuation of increase in heart rate and blood pressure during laryngoscopy and endotracheal intubation.[11,12,13] Recent studies however, questioned dexmedetomidine adverse effect like hypotension, bradycardia and non-fatal myocardial infarction in Biccard BM et al[14] randomized meta-analysis controlled trials, another study done by Volkan Hanci[15] also recommended that there is risk of bradycardia while using dexmedetomidine infusion. But, there were no adverse effects noted in our study. Slow dexmedetomidine infusion over 10 minutes might have prevented the bradycardia and hypotension.

The hemodynamic response during laryngoscopy and endotracheal intubation may last upto 10 minutes. But surgical incision was made after 5 minutes and the measurement time interval was limited to 5 minutes post laryngoscopy and endotracheal intubation. This might be the limitation of the study.

Conclusion

This study concludes that dexmedetomidine in a dose of 1 μg/kg over 10 minutes before laryngoscopy and endotracheal intubation effectively attenuates the hemodynamic response as compared to placebo without major adverse effect in ASA physical status I and II of aged 15-45 years Nepalese patient undergoing general anesthesia and endotracheal intubation for different elective surgical procedures.

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