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LARYNGOLOGY

Comparing the effect of dexmedetomidine and labetalol on hemodynamic variables in patients undergoing microlaryngoscopy

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Abstract

Introduction This study was conducted to compare the effect of dexmedetomidine and labetalol on hemodynamic variables in patients undergoing microlaryngoscopy.

Material and methods In this randomized clinical trial study 70 patients undergoing microlaryngoscopy were involved. The patients were randomly assigned into two groups. Patients in dexmedetomidine group received 0.5 µg/kg of dexmedetomidine diluted in 100 ml of saline solution and the patients in the second group received 0.25 mg/kg of labetalol before anesthesia induction. At the beginning of the surgery, dexmedetomidine was infused at the dose of 0.4 µg/kg/h in the dexmedetomidine group, and labetalol at the dose of 1.8 mg/kg/h in the labetalol group. Patients' systolic blood pressure, diastolic blood pressure, mean arterial blood pressure and heart rate at different times and anesthesia and surgery duration, recovery time and dose of prescribed propofol were recorded and compared between two groups.

Results There was a significant difference in mean systolic blood pressure, mean diastolic blood pressure, mean arterial blood pressure and mean heart rate between two groups at different times (p value < 0.05).

Conclusion The results of this study indicated that dexmedetomidine had higher efficacy, compared to labetalol, in reducing diastolic blood pressure, systolic blood pressure, heart rate, and mean arterial blood pressure following microlaryngoscopy.

Keywords Microlaryngoscopy · Dexmedetomidine · Labetalol · Hemodynamic variables

Introduction

Laryngoscopy is one of the most painful stimuli during anesthesia and surgery. Laryngoscopy and tracheal intubation are associated with hemodynamic changes such as hypertension, tachycardia, dysrhythmia and myocardial ischemia, intracerebral hemorrhage, and increased intraocular pressure along with increased circulation of catecholamines. The laryngoscope is located in the patient's mouth for a longer time in microlaryngoscopy than in laryngoscopy for tracheal intubation. As a result, this intense and prolonged stimulation caused by microlaryngoscopy can greatly affect the patient's hemodynamic parameters [1]. To decrease the severity of laryngoscopy-induced stimulation during tracheal intubation, various practices have been investigated and applied such as increase of anesthesia depth, administration of intravenous lidocaine, administration of adequate opioids, the use of items such as vasodilators, namely nitroglycerin, clonidine, beta-blocker, calcium-blocker, etc. Dexmedetomidine is known as a highly selective α2 adrenoceptor agonist [2]. Dexmedetomidine, as an adjuvant during general anesthesia, contributes to the patient's hemodynamic stability through its central sympathetic effect; in addition, it has a powerful sedative and analgesic effect [3–5], decreasing the need for opioids administration and consequently their complications, reducing the stress response, and improving the quality of recovery [6, 7]. Labetalol is a medication used to treat hypertension, and it is a combination of alpha–beta-adrenergic antagonists [8]. The main physiological action of labetalol is to compete for blocking adrenergic stimulation of β-receptors within the myocardium and vascular smooth muscle, decreasing the pressure of systemic arterial and the resistance of the systemic vascular without a notable reduction in resting heart rate, cardiac output, or stroke volume.

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This action, therefore, leads to a decrease in blood pressure and does not have much effect on heart rate reduction [1, 9–14]. In previous studies, moderate bolus doses or high doses of labetalol have been used to reduce cardiovascular response to laryngoscopy and tracheal intubation [11–14]. The aim of this study was to compare the effect of dexmedetomidine and labetalol infusion on hemodynamic variables in patients undergoing microlaryngoscopy.

Material and methods

After approval by local ethics committee and obtaining written informed consent, in this randomized clinical trial study, 70 patients aged 30–60 years with ASA class I–II undergoing microlaryngoscopy were involved. Patients with history of airway problems, bradycardia, heart disease, hypertension, diabetes mellitus, thyroid diseases, and history of allergy excluded from the study. Using random number table, patients were assigned to dexmedetomidine and labetalol groups ($n=35$ in each group). Patients were evaluated with fiberoptic bronchoscope to ensure lack of difficulty in airway intubation. Patients' heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial blood pressure were measured on entering the operating room. All patients were continuously monitored by non-invasive blood pressure, pulse oximetry, and electrocardiography. Patients in dexmedetomidine group received 0.5 µg/kg of dexmedetomidine (Made by Hospira, INC USA) diluted in 100 ml of saline solution over 10 min before anesthesia induction. 20 min before anesthesia induction, the patients in the second group received 0.25 mg/kg of labetalol (Made by KERN Pharma, Spain) over 2 min. Fentanyl (2 µg/kg) and midazolam (0.02 mg/kg) were administered as premedication. Next, anesthesia induction was performed using 2 mg/kg propofol and 0.5 mg/kg atracurium. After 3 min of ventilation, an anesthetist resided performed tracheal intubation using 5.5–6 cuffed endotracheal tube. The surgeon then fixed the surgical laryngoscope in the pharynx and started the surgery. With the onset of the surgery, dexmedetomidine was infused at the dose of 0.4 µg/kg/h in the dexmedetomidine group, and labetalol at the dose of 1.8 mg/kg/h in the labetalol group. Anesthesia was maintained with infusion of propofol, 50% O_2, and 50% N_2O. The infusion rate of propofol was adjusted to maintain patients' BIS (Bispectral index) at 50 (The BIS of all patients was measured by Hersteller anesthesia depth monitor, made in Denmark). Patients' systolic blood pressure, diastolic blood pressure, mean arterial pressure, and heart rate were measured and recorded at the following times: on patient's arrival in the operating room, before induction of anesthesia, after induction of anesthesia, 1 and 3 min after tracheal intubation, 1 and 5 min after fixation of the surgical laryngoscope, every 10 min until the end of the surgery, before removing the surgical laryngoscope, 1 min after surgical laryngoscope removal, upon patient's admission at the recovery room, and at patient's discharge from the recovery room. After return of neuromuscular relaxation using neostigmine 0.04 mg/kg and atropine 0.02 mg/kg, patient's spontaneous respiratory, and confirmation of the air leak test around the trachea, the tracheal tube was removed.

Duration of anesthesia: From initiation of anesthesia induction until complete awakening and extubation of the tracheal tube.
Surgical time: From laryngoscope fixation until laryngoscope removal.
Recovery duration: From recovery admission until complete awakening and having criteria for discharging from the recovery room.

The total amount of infused propofol during the operation was recorded, and then, based on the patient's weight and duration of anesthesia, was calculated as µg/kg/min. Prescribing the medications and data recording was done by a person who was blinded about the medications. The data were analyzed by SPSS (version 24). The significance level was considered as $P<0.05$.

Results

This double-blind clinical trial study was conducted to compare the effect of dexmedetomidine and labetalol on hemodynamic variables in 70 patients undergoing microlaryngoscopy. There were 35 patients in each group. The mean age of patients was 50.4 ± 7.49 years old and 52.3 ± 5.7 years old in dexmedetomidine group and labetalol group, respectively (P value $=0.237$). There were 30 males and 5 females in the labetalol group and 28 males and 7 females in the dexmedetomidine group ($P=0.520$). The mean systolic blood pressure, was not significantly different at entering the operating room (P value $=0.114$), before the induction (P value $=0.260$) and 1 (P value $=0.210$), 5 (P value $=0.763$) minutes after the intubation but there was a significant different in mean systolic blood pressure over other different times between two groups (P value <0.05) (Table 1). The mean diastolic blood pressure was significantly different at different times between two groups (P value <0.05) (Table 2). The mean arterial blood pressure, was not significantly different at entering the operating room (P value $=0.499$) and before the induction (P value $=0.292$) but there was a significant difference in mean arterial blood pressure between two groups over other different times (P value <0.05) (Table 3). The mean heart rate was not significantly different at entering the operating room (P

Table 1 Mean systolic blood pressure between two groups at different times

Time	Dexmedetomidine	Labetalol	*P* value
Entering the operating room	131.5 ± 8.7	126.1±18.0	0.114
Before induction	129.9 ± 9.1	126.0±18.2	0.260
After induction	126.7 ± 8.6	99.9±12.4	0.001
1 min after intubation	121.4 ± 9.5	126.1±19.8	0.210
3 min after intubation	121.4 ± 9.3	122.4±17.2	0.763
1 min after laryngoscope fixation	119.1 ± 9.4	131.7±17.5	0.001
5 min after laryngoscope fixation	116.8 ± 8.6	131.4±15.1	0.001
15 min after laryngoscope fixation	112.8 ± 9.1	127.7±15.3	0.001
25 min after laryngoscope fixation	111.3 ± 9.3	125.8±13.3	0.001
Before laryngoscope removal	109.5 ± 9.6	126.6±14.8	0.001
1 min after laryngoscope removal	111.5 ± 9.0	121.8±14.6	0.001
Recovery	113.1 ± 8.3	122.0±14.5	0.002

Table 2 Mean diastolic blood pressure between two groups at different times

Time	Dexmedetomidine	Labetalol	*P* value
Entering the operating room	78.1 ± 5.4	83.7 ± 12.5	0.018
Before induction	77.3 ± 5.1	84.6 ± 12.0	0.001
After induction	73.9 ± 6.5	65.8 ± 11.8	0.001
1 min after intubation	72.5 ± 6.0	81.8 ± 12.7	0.001
3 min after intubation	71.0 ± 5.7	80.7 ± 10.8	0.001
1 min after laryngoscope fixation	69.7 ± 5.5	85.5 ± 10.9	0.001
5 min after laryngoscope fixation	68.5 ± 5.7	85.2 ± 8.7	0.001
15 min after laryngoscope fixation	67.4 ± 5.7	83.1 ± 9.1	0.001
25 min after laryngoscope fixation	7.1 ± 5.4	82.4 ± 8.7	0.001
Before laryngoscope removal	66.9 ± 5.7	83.6 ± 9.8	0.001
1 min after laryngoscope removal	67.9 ± 5.3	80.7 ± 9.7	0.001
Recovery	6.69 ± 3.5	8.9 ± 2.81	0.001

Table 3 Mean arterial blood pressure between two groups at different times

Time	Dexmedetomidine	Labetalol	*P* value
Entering the operating room	96.4 ± 5.9	98.1 ± 13.6	0.499
Before induction	95.4 ± 6.6	98.1 ± 13.5	0.292
After induction	91.6 ± 5.8	76.6 ± 11.7	0.001
1 min after intubation	89.5 ± 6.1	95.7 ± 13.5	0.016
3 min after intubation	88.3 ± 5.7	94.1 ± 12.6	0.016
1 min after laryngoscope fixation	86.1 ± 5.4	100.2 ± 13.1	0.001
5 min after laryngoscope fixation	84.5 ± 5.5	100.4 ± 10.2	0.001
15 min after laryngoscope fixation	82.5 ± 5.4	97.6 ± 10.7	0.001
25 min after laryngoscope fixation	82.4 ± 6.1	96.7 ± 9.7	0.001
Before laryngoscope removal	81.4 ± 5.6	97.3 ± 10.8	0.001
1 min after laryngoscope removal	82.5 ± 5.3	94.2 ± 10.4	0.001
Recovery	84.1 ± 4.9	94.9±11.6	0.001

value = 0.709), before (*P* value = 0.200) and after the induction (*P* value = 0.433) but there was a significant difference in mean heart rate between two groups over other different times (*P* value < 0.05) (Table 4). The mean of surgery duration was 30.3 ± 6.4 min in the dexmedetomidine group and 29.7 ± 6.2 min in the labetalol group (*P* value = 0.692). The mean of anesthesia duration was 44.6 ± 8.3 min in the dexmedetomidine group and 46.4 ± 7.7 min in the labetalol group (*P* value = 0.467). The mean of recovery time was 22.2 ± 2.5 min in the dexmedetomidine group and

Table 4 Mean heart rate between two groups at different times

Time	Dexmedetomidine	Labetalol	*P* value
Entering the operating room	80.2 ± 8.7	81.3 ± 15.5	0.709
Before induction	78.9 ± 7.4	82.5 ± 14.7	0.200
After induction	77.1 ± 7.5	75.2 ± 12.1	0.433
1 min after intubation	74.6 ± 7.1	86.4 ± 15.5	0.001
3 min after intubation	73.1 ± 7.2	83.5 ± 13.9	0.001
1 min after laryngoscope fixation	72.1 ± 6.8	87.9 ± 15.9	0.001
5 min after laryngoscope fixation	70.4 ± 6.3	83.5 ± 14.5	0.001
15 min after laryngoscope fixation	69.2 ± 6.1	82.1 ± 13.1	0.001
25 min after laryngoscope fixation	68.4 ± 5.0	82.7 ± 13.3	0.001
Before laryngoscope removal	68.7 ± 4.9	81.4 ± 14.9	0.001
1 min after laryngoscope removal	69.4 ± 5.1	79.8 ± 15.4	0.001
Recovery	69.7 ± 5.1	77.2 ± 15.1	0.007

19.6 ± 2.6 min in the labetalol group (*P* value = 0.0001). The dosage of propofol was 0.15 ± 0.01 µg/kg/min in dexmedetomidine group and 0.23 ± 0.02 µg/kg/min in labetalol group (*P* value = 0.0001); Finally, the results of the present study indicated no postoperative complications, namely nausea and vomiting, in either of two groups.

Discussion

In this study, the effect of dexmedetomidine and labetalol on hemodynamic variables in patients undergoing microlaryngoscopy was compared. Dexmedetomidine is known as a highly selective α2 adrenoceptor agonist [2] and contributes to the patient's hemodynamic stability through its central sympathetic effect; in addition, it has a powerful sedative and analgesic effect [3–5], reducing the stress response, and improving the quality of recovery [6, 7]. Labetalol is a combination of alpha–beta-adrenergic antagonists [8]. It decreases the systemic arterial pressure and the systemic vascular resistance without a notable reduction in resting heart rate, cardiac output, or stroke volume [1, 9–14]. The results of this study indicated that dexmedetomidine had higher efficacy, compared to labetalol, in reducing diastolic blood pressure, systolic blood pressure, heart rate, and mean arterial blood pressure following microlaryngoscopy. Tanskanen et al. [15] pointed out that infusion of dexmedetomidine (0.4 µg/kg) resulted in heart rate and blood pressure reduction compared to placebo infusion in 53 patients undergoing elective surgery of supratentorial brain tumor. Kumari et al., aimed to determine the efficacy of dexmedetomidine infusion 10 min before anesthesia induction in reducing hemodynamic responses following laryngoscopy and intubation. They indicated that dexmedetomidine could significantly prevent the increase of systolic blood pressure, diastolic blood pressure, and mean of heart rate up to 5 min after tracheal intubation. In addition, they reported that the dose of propofol required for anesthesia induction was reduced notably [16]. Ying et al. [17] also found that dexmedetomidine at the dose of 0.5 µg/kg was able to control and inhibit cardiovascular responses following intubation without leaving respiratory complications. All of the previously mentioned studies, similar to our study, demonstrated that dexmedetomidine could be effective in promoting hemodynamic stability during endotracheal intubation in patients undergoing surgery [18] In addition, in different studies researchers pointed out that dexmedetomidine could control hemodynamic responses better than Fentanyl [19, 20], Esmolol [21] and Clonidine [22]. On the other hand, researchers pointed that patients receiving labetalol had lower heart rate and systolic blood pressure than those that received remifentanil [23], lidocaine [14] and placebo during laryngoscopy but no study compared labetalol with dexmedetomidine.

Conclusion

The results of this study indicated that dexmedetomidine had higher efficacy, compared to labetalol, in reducing diastolic blood pressure, systolic blood pressure, heart rate, and mean arterial blood pressure following microlaryngoscopy.

Compliance with ethical standards

Conflict of interest Authors have no conflicts of interest.

Ethical approval Study protocol was in accordance with the latest Declaration of Helsinki for medical research involving human subjects and was approved by ethics committee of Shahid Sadoughi University of Medical Sciences.

Research involving animals This article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all participants of the study.

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