Original article

Comparison Study of Remifentanil and Lidocaine Effect on Hemodynamic Stability during Endotracheal Intubation in Karbala, Iraq.

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Abstract

Background: One of the important tasks of anesthetists is controlling the hemodynamic responses (the increase in blood pressure and heart rate) associated with direct laryngoscopy and endotracheal intubation. Many medications were tried for this purpose; among them were remifentanil and lidocaine are given intravenously after induction of general anesthesia.
Objectives: To compare the effect of remifentanil and lidocaine, determine which has a superior activity, on hemodynamic stability, during endotracheal intubation.
Patients and methods: This is a randomized controlled clinical trial study conducted on 60 clinically fit patients, planned for elective surgery under general anesthesia with endotracheal intubation. Patients were divided randomly into two groups according to the administration of the Remifentanil or Lidocaine drug. Baseline readings of systolic, diastolic blood pressure, and heart rate were recorded as time 1. General anesthesia was induced using intravenous propofol and rocuronium. The study drug was given, and the readings again were recorded after 90 seconds as time 2, followed by direct laryngoscopy and endotracheal intubation. The third and fourth readings (time 3 & 4) were recorded at one & three minutes postintubation, respectively.
Results: Mean systolic blood pressure and heart rate were significantly reduced at times 2 & 3, while mean diastolic blood pressure was significantly reduced at time 2 in the remifentanil group compared to the lidocaine group.
Conclusion: Remifentanil is more effective than lidocaine in attenuating the sympathoadrenal response of direct laryngoscopy and endotracheal intubation.
Keywords: Remifentanil, lidocaine, endotracheal intubation, hemodynamics.

Introduction

After induction of general anesthesia, endotracheal intubation is the most airway securing method used because it is the most reliable, with maximum safety, and gives the anesthetists the guarantee of the patent airway [(1)]. However, direct laryngoscopy and endotracheal intubation cause strong sympathoadrenal response caused by stimulation of oropharyngeal and laryngopharyngeal (supraglottic) areas that are innervated by trigeminal and glossopharyngeal nerves and glottic and subglottic areas innervated by branches of the vagus nerve [(2)]. This stimulation can cause serious hemodynamic changes, including hypertension, tachycardia, arrhythmias due to increased catecholamines. These changes may be detrimental to the myocardium, especially in patients with a history of chronic hypertension or ischemic heart disease because of increased oxygen demand on a given supply [(3)]. The cardiovascular responses may be variable and unpredictable, start within seconds of the conduct of direct laryngoscopy, peak in one to two minutes and return to the baseline of the parameters in about five minutes postintubation in patients with no coexisting diseases [(4)]. These events burden the anesthetist who manages the more susceptible patients, and many

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medications are given to attenuate these changes. Remifentanil, a potent opioid, and lidocaine, a local anesthetic, are among these used medications [5].

Remifentanil is a short-acting opioid analgesic with rapid onset and rapid recovery times [6]. Its pharmacokinetics allows for quicker postoperative recovery when compared with other opioids [7]. It is given in a bolus dose of 1 microgram /kg slow intravenous or a maintenance dose of 0.1-0.5 microgram /kg/min [8]. Its short context-sensitive half-life makes it a good choice in intense but short pain or strong irritant stimulations such as direct laryngoscopy and endotracheal intubation [9]. It is rapidly metabolized to an inactive form by hydrolysis of an ester linkage by nonspecific plasma and tissue esterase's [10]. Its onset of action is one minute and a context-sensitive half-life of 3-5 minutes and a terminal elimination half-life of 10 min [10].

Lidocaine is an amide local anesthetics' drug that alters the signal conduction in neurons by prolonging the inactivation of fast sodium channels in the cell membrane responsible for action potential propagation [11]. Besides its local anesthetic effect, it is given intravenously to decrease blood pressure, slow heart rate, and treat ventricular arrhythmias, getting the benefit of fast onset of action, which is about 1-1.5 min and a duration of 10-20 min [11].

There is limited data available to compare the effect of remifentanil and lidocaine among Iraqi patients. Therefore, the current study aims to demonstrate the clinical effects of their intravenous administration in attenuating the sympathoadrenal response associated with direct laryngoscopy and endotracheal intubation.

Patients and methods

A randomized controlled clinical trial study was carried out in Imam Al-Hussein Medical City Teaching Center/ Holly Karbala / Iraq from 15 October 2019 to 20 January 2020. Patients enrolled in the study were 60 adult patients aged between 20-60 years with the American Society of Anesthesiologists (ASA) classification I-II (clinically fit) [12], scheduled for elective surgery under general anesthesia with endotracheal intubation. An informed and explicit consent was taken from all participants after explaining the study's objectives. They were randomly divided into two groups R and L, who will take remifentanil and lidocaine, respectively (randomization of groups done after selecting clinically fit class I-II ASA with matching age, gender, height & weight). The patients were monitored by a pulse oximeter, Electrocardiogram (ECG), temperature & non-invasive blood pressure monitor. The baseline readings of the study variables, the systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR), are measured, recorded, and named as time 1 (T1). Pre-oxygenation was followed by induction of general anesthesia with intravenous propofol in an average dose of 2mg/kg, and rocuronium 0.6 mg/kg, the patients of group R, received 1 µ /kg remifentanil directly slow intravenous.

In contrast, the patients of group L received 1 mg/kg lidocaine directly slow intravenous. Manual ventilation using bag-mask was done, and the second reading was recorded as time 2 (T2) at 90 seconds after study drug administration, followed by direct laryngoscopy and endotracheal intubation with capnography monitoring. One minute after intubation, the third reading was recorded as time 3 (T3). Three minutes after intubation, the fourth reading was recorded as time 4 (T4). General anesthesia was maintained by 1 MAC (Minimum Alveolar Concentration) isoflurane with fentanyl 2 µ/kg as analgesia. Patients with suspected or unpredicted difficult airway were excluded from the study as well as those with ASA classification III and above, especially those with a history of cardiovascular diseases as chronic hypertension or ischemic heart diseases or chronic respiratory diseases.

Data of studied groups were analyzed using the statistical package for Social Sciences

(SPSS) version 22. Descriptive statistics were presented as mean, standard deviation (SD), frequencies (n), and percentages (%); independent Student's t-test was used to compare two means of a continuous normally distributed variable, a P-value of <0.05 was considered as statistically significant.

Results

The study groups were matched for age, gender, height & weight. Table 1 clarifies the mean distribution of age, gender, weight, and height for all the participants in both study groups.

The mean systolic blood pressure for the remifentanil group at times 2 & 3 was significantly lower than the lidocaine group with p-values= 0.002, < 0.001, respectively. In time 4 no significant difference between the two groups, although the mean of group R is still lower than group L as shown in Table 2.

Regarding diastolic blood pressure, at time 2, the mean was significantly lower in group R with p-value= 0.008; however, the means at times 3 & 4 have no statistical significance, although they were still lower than group L (Table3, Figure 2).

Finally, when comparing heart rates for the study groups, times 2 & 3 showed statistically significant lower means in group R with p-value < 0.001, 0.0094 respectively. In time 4, the mean was also lower in group R, although not statistically significant (Table 4).

Discussion

The hemodynamic response to direct laryngoscopy and endotracheal intubation is one of the major problems facing anesthetists. Several medications were used and studied to attenuate these responses, including deepening anesthesia with inhalational agents, administrating intravenous opioids, beta-blockers, lidocaine, or topical anesthesia to airways mucosa [5].

Table 1. Distribution of demographic characteristics of studied groups

Parameter		**Group R Mean ± SD (n=30)**	**Group L Mean ± SD (n=30)**
Age (years)		37.13 ± 12.23	37.00 ± 13.48
Weight (kg)		73.6 ± 11.47	72.20 ± 12.67
Height (cm)		167.06 ± 8.89	167.00 ± 10.49
Gender	**Male (n, %)**	16, 53.3%	16, 53.3%
	Female (n, %)	14, 46.7%	14, 46.7%

R: remifentanil, L: lidocaine, SD: standard deviation, n: number.

Table 2. Comparison of systolic blood pressure at study times in both groups

SBP (mm Hg) / parameter	**Group R Mean ± SD (n=30)**	**Group L Mean ± SD (n=30)**	**P-value**
Time 1	130.86 ± 6.41	129.06 ± 12.05	0.236
Time 2	116.40 ± 9.96	124.46 ± 10.92	**0.002***
Time 3	110.21 ± 6.48	118.46 ± 11.00	**< 0.001***
Time 4	109.40 ± 8.87	113.60 ± 11.54	0.059

Student T-test, significant P-value< 0.05, *: significant p-value, SBP: systolic blood pressure, R: remifentanil, L: lidocaine, SD: standard deviation, n: number

Table 3. Comparison of diastolic blood pressure at study times in both groups

DBP (mm Hg) / parameter	**Group R Mean ± SD (n=30)**	**Group L Mean ± SD (n=30)**	**P-value**
Time 1	84.80± 4.47	83.80 ± 5.64	0.225
Time 2	75.70 ± 5.44	79.46 ± 6.40	**0.008***
Time 3	73.36 ± 4.92	75.60± 6.81	0.075
Time 4	71.60 ± 3.27	72.20 ± 8.17	0.355

Student T-test, significant P-value< 0.05, *: significant p-value, DBP: diastolic blood pressure, R: remifentanil, L: lidocaine, SD: standard deviation, n: number

Table 4. Comparison of heart rate at study times in both groups

HR (beat/minute) / parameter	Group R Mean ± SD (n=30)	Group L Mean ± SD (n=30)	P-value
Time 1	89.00 ± 7.63	89.20 ± 4.71	0.295
Time 2	79.23± 5.82	83.93 ± 5.04	**<0.001***
Time 3	75.56 ± 5.41	78.93 ± 5.38	**0.009***
Time 4	74.26 ± 4.74	75.20 ± 6.48	0.094

Student T-test, significant P-value< 0.05, *: significant p-value, HR: heart rate, R: remifentanil, L: lidocaine, SD: standard deviation, n: number

The current study investigates the efficacy of the opioid remifentanil versus the local anesthetic lidocaine as intravenous boluses before laryngoscopy and intubation. Several factors may affect these responses, including the age of the patient, preoperative medical conditions as cardiovascular or respiratory diseases, preoperative surgical conditions that may affect fluid status (dehydration, fluid losses, shifts, bleeding, etc.), and the choice of anesthetic drug or muscle relaxant used [13].

Based on these data, selecting patients between 20-60 years of age may limit the age-related effects that may occur in extremes of age. On the other hand, selecting patients with a preoperative assessment of ASA class I-II will exclude patients with significant cardiovascular diseases as chronic hypertension, ischemic heart disease, or respiratory or neurological diseases that may alter respiratory gases, which virtually affect the results. Another important factor is excluding the emergency surgeries because of the possibility of the associated preoperative fluid or blood losses, affecting study results [13].

In addition, selecting the anesthetic drugs with little hemodynamic effects is important to eliminate medication's side effects on study variables. Propofol was used in the current study because of its availability and fewer effects on heart rate than thiopentone or ketamine, although a dose-related decrease in blood pressure is encountered [14]. Using rocuronium as a muscle relaxant was based on its availability and favorable pharmacodynamics regarding no histamine release and stable hemodynamics [15]. Finally, an important factor that affects the variables is the time required in the procedure of direct laryngoscopy and endotracheal intubation, and the minimal time is taken, the minimal sympathoadrenal response [16]. Considering the above concept, the patients with suspected or unsuspected difficult airway management were excluded from the study due to the prolonged stimulation period.

Present findings declared that systolic blood pressure and heart rate mean levels were significantly reduced in group R at T2 & T3, while diastolic blood pressure mean was reduced significantly in group R at T2. At T3 diastolic blood pressure mean was also reduced, although statistically non-significant.

Similar results were concluded by a Kim HJ *et al.* study that compared the effect of remifentanil versus lidocaine, nicardipine, and nitroglycerine and found that remifentanil was the most effective [16]. Similar data obtained by a previous study on emergency surgeries using rapid sequence induction comparing the same current study drugs [17].

Another study that used the opioid fentanyl (belonging to the same drug family as remifentanil) found it also more effective than lidocaine [13]. Finally, an Iraqi study done in Basrah used fentanyl and lidocaine and concluded that both were equally effective in controlling the hemodynamics of intubation [18].

In conclusion, remifentanil is more effective in controlling blood pressure and heart rate changes associated with direct laryngoscopy and endotracheal intubation than intravenous lidocaine.

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