Original Article

Comparison of hemodynamics and LMA insertion conditions using combination of Ketamine-Propofol, Fentanyl-Propofol or Saline-Propofol

Koirala M, Acharya SP, [1]Pradhan B, Marhatta MN, Bhattarai AS, Parajuli BD

Department of Anesthesiology, Maharajgunj Medical Campus, Tribhuvan University Teaching Hospital, [1]Professor and Head, Department of Anesthesiology, MMCVTC, Maharajgunj

Correspondence aurthor: Dr. Megha Koirala

Email: megha_koirala@hotmail.com

Abstract

Introduction: Laryngeal Mask Airway(LMA) insertion requires a certain depth of anaesthesia to blunt the airway reflexes. Propofol alone causes undesirable hemodynamics effects and suboptimal LMA insertion condition. So this study was designed to compare the hemodynamics and insertion conditions when Ketamine or Fentanyl was combined with Propofol for induction.

Methods: In this study, sixty ASA PSI(American Society of Anesthesiologists Physical Status) patients undergoing various surgical procedures under LMA were assigned to three groups; Group K, Group F and Group S who received 0.5 mg/kg of Ketamine, 1 µg/kg Fentanyl and Normal saline respectively before receiving Propofol 2.5 mg/kg after which LMA insertion was done. Arterial blood pressure and heart rate were measured at various intervals. LMA insertion conditions were graded under different parameters to calculate LMA insertion summation score.

Result: Significant difference in systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean blood pressure (MAP) was seen between Gr K and Gr S after successful LMA insertion and after 2 mins of insertion. Significant difference in SBP was seen in between Group K and Group F (p=0.01) after successful LMA insertion. The median summed score describing the LMA insertion condition was significantly better in Ketamine [7.0 (6.0-7.5)] and Fentanyl [7.0 (6.0-7.0)] in comparison to Saline [8.5 (8.0-11.0)]

Conclusion: During LMA insertion, adding Ketamine to Propofol provides stable hemodynamics in comparison to using Propofol. Addition of either Ketamine or Fentanyl to Propofol provides equally good conditions during LMA insertion than using Propofol alone.

Key words: Fentanyl, Ketamine, LMA, Propofol

Introduction

The Laryngeal Mask Airway is a supraglottic airway device invented by Dr. Archie Brain[1] in 1981 for quickly securing the airway provided that the depth of anaesthesia is sufficient to ensure adequate mouth opening and depression of airway reflexes. Inadequate depth of anaesthesia leads to coughing, bucking, swallowing, gagging and laryngospasm making the LMA insertion difficult. Various drugs have been used to facilitate insertion of an LMA, with Propofol 2.5 to 3.5 mg/kg being the most appropriate induction agent.[2,3] But when used alone, it can still lead to hypotension and does not completely blunt the airway reflexes.[4,5,6] In order to improve insertion conditions, drugs such as Lignocaine[7], Midazolam[8], Fentanyl[9,10,11,12], Alfentanil[13,14], Remifentanyl[15], Suxamethonium[16], Mivacurium[17,18] are injected along with Propofol during induction. Unfortunately these medications increase the incidence and duration of apnoea.

The combination of Ketamine and Propofol is found to have superior analgesia with less respiratory depression.[19,20] When used with Propofol for induction, the cardio stimulant effects of Ketamine balances the cardio depressant effects of Propofol, thus preserving hemodynamic stability as compared to using Propofol alone.[21,22]

We compared the hemodynamic profile during LMA insertion using the combination of Ketamine with Propofol versus Fentanyl with Propofol versus Saline with Propofol. Also, we compared whether the administration of Ketamine or Fentanyl before induction with Propofol improves LMA insertion conditions than when Propofol was used alone. The incidence of apnoea was also compared among the groups.

Methodology

After getting ethical approval from Institution Review Board (IRB), Research Department, Institute of Medicine (IOM), 60 ASA physical status I patients, aged 15 to 60 years, undergoing various orthopedic, plastic, urological surgical procedures, in whom anaesthesia could be maintained in spontaneously breathing condition with an LMA were randomly allocated into one of the three groups using sealed envelope technique. Ketamine group (Group K) received Ketamine 0.5 mg/kg, Fentanyl group (Group F)received Fentanyl 1 µg/kg and Saline group (Group S) received 0.9% normal saline, all prepared in 5 ml solution by an anaesthesia assistant not involved in the study. Patients at risk of aspiration, allergic to Propofol, Ketamine or Fentanyl, anticipated difficult airway, hypertension, coronary artery disease, psychiatric illness, pregnant, weighing>100 kgs, raised ICP were excluded from the study. Preoperative evaluation was done a day prior to surgery. Patients were kept nil per oral for 6 hrs before the operation. Oral midazolam 7.5 mg was administered 2 hrs before the surgery. On the day of surgery in the pre anaesthetic preparation room, baseline measurements of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) were recorded. In the O.T, preoxygenation was done via face mask with O_2 at 5lts/min for three minutes. Patients were given their assigned study drugs (5 ml) intravenously over 10 secs which was followed immediately by Propofol 2.5 mg/kg intravenously over 15 secs. Insertion of the LMA (size 3 for females and size 4 for males) was performed 60 secs later after checking for fixed pupillary reflex which if present was taken as the end point of induction. If the SPO_2 decreased to <90% during this period, bagging was done. If required, Propofol 0.5 mg/kg was given after every 30 secs until the patient was considered to be induced after which LMA insertions were carried out and correct positioning confirmed. LMA insertion conditions was graded in the following parameter[22]: mouth opening (1=full, 2=partial, 3=nil); coughing (1=nil, 2=slight, 3=gross); swallowing(1=nil, 2=slight, 3=gross); movement (1=nil, 2=slight, 3=gross); laryngospasm (1=nil, 2=partial, 3=complete); ease of LMA insertion (1=easy, 2=difficult, 3=impossible). The six scores were then summed to give an overall insertion condition score. Following LMA insertion, absence of respiration for more than 30 secs was defined as apnea. If the patient remained apneic for more than 30 secs after LMA insertion, the lungs was manually ventilated via the LMA. If SPO_2 dropped below 90% within 30 secs of LMA insertion then bagging was done and patients were excluded from the study. If first attempt at LMA insertion was unsuccessful or resulted in malposition, the patient received a subsequent bolus dose of Propofol 0.5 mg/kg and insertion was attempted again to a maximum of three attempts. The total number of attempts at LMA insertion was recorded. However, the conditions during LMA insertion were only graded at the first attempt. After successful LMA insertion, anaesthesia was maintained with Halothane 1- 1.5%. If the third attempt was unsuccessful, then it was considered as a failure and patients were excluded from the study. During intraoperative period, all patients were monitored. MAP, SBP, DBP and heart rate were recorded immediately after induction of anaesthesia (AI), immediately after successful LMA insertion (ASLI 0 mins) and then every two minutes thereafter for up to four minutes. If the SBP decreased to less 30% of baseline values, then, inj Mephentermine 6 mg i.v.was administered and if the HR decreased to less than 45 beats per minute, inj. Atropine 0.6 mg i.v. was administered. After 4 mins of recording the vitals, Group F received Fentanyl 1 µg/kg whereas Group K and Group N received Fentanyl 2 µg/kg, all diluted in 5 ml 0.9% NS. After giving the analgesia, surgery was allowed to start.

Analysis were performed using SPSS version 13 using Analysis of Variance (ANOVA), Post hoc, Chi square, Mann Whitney U, Kruskal Wallis and Wilcoxon tests. Values are presented as mean (SD or range) or number (%) or median (interquartile range)

Result

The three groups were well matched for age, sex and weight (Table 1).Statistically significant difference in SBP, DBP and MAP was recorded in between Group K and Group S after successful LMA insertion and after 2 mins of insertion (Table 2).Heart rate was higher in group K than compared to other groups but it was not statistically significant at any observational time (Figure 1).

Table 1: Patients distribution among three groups based on demography

Variables	F	K	S	P value
Age (yrs) (Mean ± SD)	35.80±11.04	36.65±11.75	37.40±11.27	0.906
Weight (kgs) (Mean ± SD)	58.00±8.03	58.30±9.71	57.20±9.86	0.927
Sex				0.903
Male	11	11	10	
Female	9	9	10	

Values are mean (SD or range) or number (%)

Table 2: Hemodynamic Changes among three groups at different time interval

Variables	SBP (Mean ± SD in mm of Hg)				DBP (Mean ± SD in mm of Hg)				MAP (Mean ± SD in mm of Hg)			
	Gr. F	Gr. K	Gr. S	P value	Gr. F	Gr. K	Gr. S	P value	Gr.F	Gr.K	Gr S	P value
Baseline	131.55 ±10.22	124.55 ± 11.15	129.85 ± 10.49	0.103	82.7 ±8.79	79.1 ±11.47	79.3 ±10.71	0.473	98.95 ±8.59	94.3 ±10.26	96.05 ±9.94	0.311
AI	111.55 ±8.15	115.75 ± 9.12	105.30 ± 8.47	0.001 (K v/s S)	71.6 ±9.43	71.9 ±10.52	67.85 ± 10.85	0.388	84.95 ±8.44	86.5 ±9.22	80.25 ±9.57	0.86
ASLI	108.5 ±9.12	116.75 ± 7.55	102.55 ± 9.37	<0.001 (K v/s S), 0.01 (F v/s K)	69.85 ±10.52	74.3 ±11.22	63.55 ±9.15	0.005 (K v/s S)	82.7 ±9.65	88.45 ±8.92	76.55 ±8.88	<0.001(K v/s S)
ASLI 2min	98.45 ±10.11	106 ± 9.35	93.45 ± 10.08	0.001 (K v/s S)	60.9 ±10.94	64.05 ±10.33	54.75 ±9.3	0.01 (K v/s S)	73.35 ±10.33	78.89 ±7.89	67.65 ±8.96	0.001(K v/s S)
ASLI 4min	96.7 ±6.54	99.25 ± 9.14	94.55 ± 4.16	0.125	60.3 ±7.33	59 ±8.33	54.35 ±7	0.04 (F v/s S)	72.4 ±6.17	72.68 ±7.76	67.75 ±5.43	0.034 (not significant in post hoc)

(AI: After Induction; ASLI: After successful LMA Insertion)

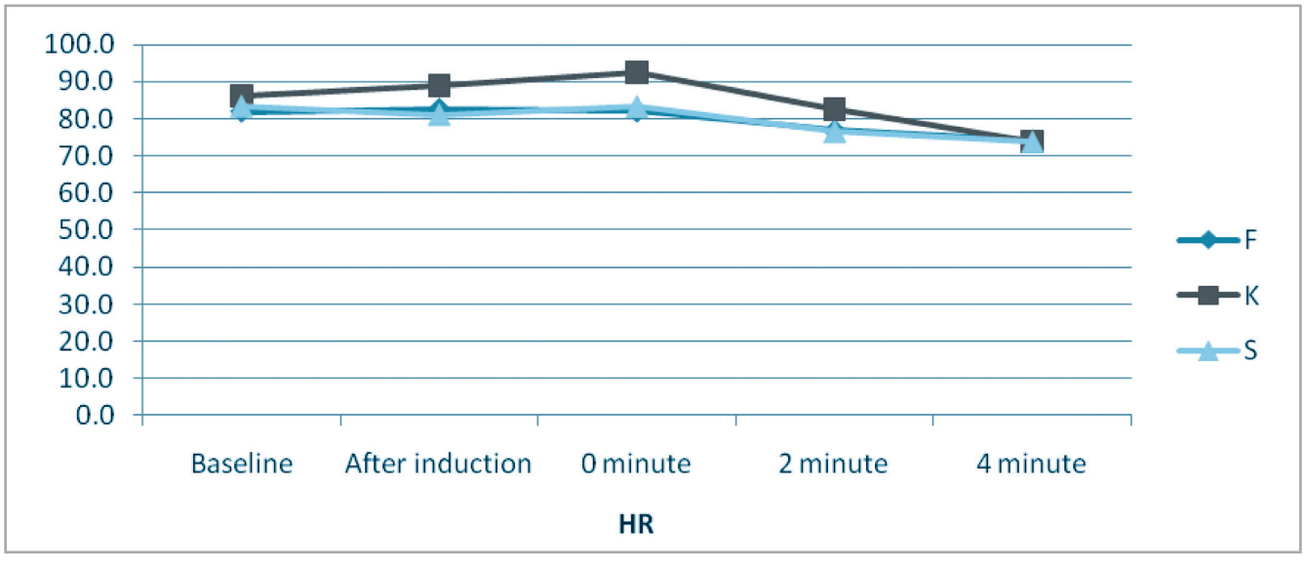

Figure 1: The changes in heart rate among three groups at different intervals

The median summation score describing the LMA insertion condition was significantly better in Ketamine [7.0(6.0-7.5)] and Fentanyl [7.0(6.0-7.0)] in comparison to Saline [8.5(8.0-11.0)](Table 3).Fourteen of the patients (70%) in group S required Mephentermine, whereas 9 patients (45%) in group F and 1 patient (5%) in group K required mephentermine. This data was statistically significant. Most of the patients required it after 2 or 4 mins of successful LMA insertion when their SBP decreased to 30% of the baseline (Table 3).

LMA was inserted successfully in the first attempt in group F and group K, whereas in group S, the first attempt was successful only in 75% (15 patients) of cases (Table 3).

Table 3: Comparison of LMA Insertion conditions scores, no. of attempts, apnoea and mephentermine requirement among three groups

Score	Gr. F	Gr. K	Gr. S	P value
Mouth opening				
1 (Full)	16	16	6	
2 (Partial)	4	4	14	
3 (Nil)	0	0	0	
Coughing				
1 (Nil)	20	19	15	
2 (Mild)	0	1	4	
3 (Severe)	0	0	1	
Swallowing				
1 (Nil)	20	20	18	
2 (Mild)	0	0	2	
3 (Severe)	0	0	0	
Movement				
1 (Nil)	11	10	0	
2 (Mild)	7	9	12	
3 (Severe)	2	1	8	
Laryngospasm				
1 (Nil)	20	20	20	
2 (Mild)	0	0	0	
3 (Severe)	0	0	0	
Ease of insertion				
1 (Easy)	18	19	10	
2 (Difficult)	2	1	5	
3 (Impossible)	0	0	5	
LMA insertion summation score				
6	7	9	0	
7	11	6	4	
8	0	4	6	
9	2	1	1	
10	0	0	3	
11	0	0	3	
12	0	0	2	
13	0	0	1	
LMA Insertion summed score	7.00(6.00-7.00)	7.00(6.00-7.75)	8.5(8.00-11.0)	<0.001(K v/s S), (F v/s S)
No of attempt				
1st	20(100)	20(100)	15(75)	0.004
2nd	0	0	5	
Apnoea	18(90)	0(0)	2(10)	<0.001
Meph required	9(45)	1(5)	14(70)	<0.001

Ninety percent of the patients (18 patients) had apnoea in group F whereas 10% (2 patients) in group S had apnoea. None patients in the group K had apnoea. This result was statistically significant (Table 3). But none of the patient desaturated to <90% during the apnoeic period.

Discussion

LMA insertion after induction with Propofol alone does not guarantee success.[3,4,5] Many studies have been conducted to find the best combination with Propofol that obtund airway reflexes to ease the insertion.[7,8,9,15,16,17]Preadministration of Fentanyl facilitates insertion of a laryngeal mask.[9,10]In a study done by Goh PK et al.[22] they concluded that the addition of Ketamine 0.5 mg/kg improved hemodynamics when compared to Fentanyl 1µg/kg, with less apnoea, and was associated with equally good LMA insertion conditions. So we have used Ketamine 0.5 mg/kg with Propofol for induction during insertion of LMA.

We used 1 µg/kg Fentanyl before Propofol as recommended by Tan ASB and colleagues[11]as the most optimal dose of Fentanyl to be used with Propofol 2.5 mg/kg for the insertion of LMA. Hui TW et al.[21] studied the effects of Ketamine and Propofol on arterial pressure and heart rate which was opposite in nature, resulting in improved cardiovascular stability as compared to giving either agent individually.

In our study, there was a trend towards higher heart rate in Ketamine group probably because of its sympathomimetic action. After induction of anaesthesia with Propofol, SBP and DBP decreased throughout the 5 mins observation period in all groups as compared to the preinduction values. This was probably because of the combined effect of our induction agent, Propofol along with the inhalational agent, Halothane which was turned on after successful LMA insertion along with the absence of any surgical stimuli till the study duration. In our study we demonstrated consistently higher arterial pressure throughout the study period in Ketamine group in comparison to the other two groups. Statistically significant decrease in SBP, DBP and MAP was seen in Saline group in comparison to Ketamine group at after successful LMA insertion and after 2 mins of successful LMA insertion. Propofol decreases arterial pressure by decreasing peripheral vascular resistance and cardiac contractility whereas Ketamine increases heart rate and blood pressure because of its sympathomimetic action.[21] When these two drugs are combined, the two opposite effects tend to balance which may have led to a statistically significant higher blood pressure in Ketamine group. More decrease was seen in Saline group probably because additional bolus doses of Propofol had to be injected for induction and successful LMA insertion. When the systolic pressure decreased to below 30% of the baseline, inj. Mephentermine was given which was more common in Saline group(14 patients) than in Ketamine group (1 patient)

During insertion, the most frequently observed action in our study was movement. All the patients in group Saline showed some kind of movement during insertion suggesting that Propofol alone does not provide the most optimal condition for LMA insertion.Adding Fentanyl or Ketamine could prevent the movement in almost 50% of the patients. In our study, the total time between Fentanyl injection and LMA insertion was 75 secs. According to a previous study by Ko SH et al.[23], the optimal injection time of Fentanyl for tracheal intubation is 5 mins before intubation. So it is uncertain whether 75 secs was sufficient time period to allow the brain and arterial drug concentrations to equilibrate. So probably, if we had increased the time duration between the Fentanyl injection and LMA insertion, we would have been able to decrease the patient's response during LMA insertion. Severe movements required us to add bolus doses of Profofol during insertion.

None of the patients in any group had laryngospasm in our study. Mouth opening was graded as full in 80% of cases in Fentanyl and Ketamine group and in 30% of the patients of Saline group which is similar to the study done by Tan ASB and group.[11] LMA insertion was graded easy in 18 and 19 patients of group Fentanyl and Ketamine respectively whereas for Saline group it was only for 10 patients.In our study optimal score of full 6 was obtained by only 35% in Fentanyl group, 45% in Ketamine group and 0% in Saline group. In the study done by Wong TH et al.[9], combining Fentanyl with Propofol provided optimal condition in 65% of patients which is greater than our study and is probably due to increased time interval between injection of Fentanyl and insertion of LMA. The median (interquartile range) summed score describing the overall insertion condition were similar in Ketamine [median 7.0, interquartile range (6.0-7.5)] and Fentanyl group [median 7.0, interquartile range (6.0-7.0)]. Both appeared significantly better than Saline. [median 8.5, interquartile range (8.0-11.0)] This finding indicates that the optimal condition for

inserting an LMA were similar in between the Fentanyl and Ketamine groups and definitely better than Saline group.

In our study, 90% of the patients (18 patients) had apnoea in group Fentanyl whereas 10% in group Saline (2 patients) had apnoea. None of the patients in the group K had apnoea. Two patients in Saline group had apnoea in our study which is probably due to requirement of additional bolus doses of propofol. This result was statistically significant. In our study, a higher percentage of patients in fentanyl group had respiratory depression than in the previous studies which was probably due to a shorter cut off time of 30 secs for apnoea.LMA was inserted successfully in the first attempt in all patients of group F and K, whereas in group S, the first attempt was successful only in 75% of cases. The LMA insertion condition were comparable between Ketamine and Fentanyl, both providing good LMA insertion condition, resulting in 100% successful first attempt insertion.

Conclusion

During insertion of an LMA, adding Ketamine to Propofol provides stable hemodynamics in comparison to using Propofol alone. Also, addition of either Ketamine or Fentanyl to Propofol produces equally good LMA insertion condition in comparison to using Propofol alone leading to 100% success during insertion in first attempt. Addition of Fentanyl causes prolonged respiratory depression.

Conflict of interest: None declared.

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