Section: Anesthesiology

Original Research Article

ATTENUATION OF HAEMODYNAMIC RESPONSES TO LARYNGOSCOPY AND ENDOTRACHEAL INTUBATION: COMPARATIVE ANALYSIS BETWEEN FENTANYL (2 MCG/KG) AND BUPRENORPHINE (5 MCG/KG)

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Abstract

Background: Laryngoscopy and endotracheal intubation can provoke significant haemodynamic responses, leading to potentially harmful consequences, especially in high-risk patients. This study aims to compare the efficacy of fentanyl and buprenorphine in attenuating these responses. **Material & Methods:** In this prospective, randomized, double-blind study, 60 patients scheduled for elective surgeries were allocated into two groups: Group B (Buprenorphine group, 5 mcg/kg) and Group F (Fentanyl group, 2 mcg/kg). The study assessed and compared the effects of these drugs on heart rate, blood pressure, and mean arterial pressure (MAP) during laryngoscopy and endotracheal intubation. **Results:** The demographic data (age, sex, and body weight) and types of surgical procedures were comparable between the groups. The mean duration of surgery was also similar. Heart rate measurements showed significant increases post-induction and post-intubation in Group B compared to Group F. Systolic and diastolic blood pressure readings revealed significant variations at various time points, particularly after induction and during post-intubation in both groups, with Group B generally exhibiting higher values. The mean arterial pressure followed a similar trend. The incidence of side effects like bradycardia and hypotension was not significantly different between the groups. **Conclusion:** Both fentanyl and buprenorphine effectively attenuate the haemodynamic responses to laryngoscopy and intubation, but their impacts on heart rate, blood pressure, and MAP vary. Fentanyl demonstrates a more stable haemodynamic profile compared to buprenorphine.

INTRODUCTION

Laryngoscopy and endotracheal intubation are critical components of general anesthesia, routinely performed in surgical settings. However, these procedures are known to elicit significant haemodynamic responses, characterized by increased heart rate, blood pressure, and mean arterial pressure.[1,2] These responses, while transient in healthy individuals, can pose serious risks in patients with cardiovascular comorbidities, potentially leading to myocardial ischemia, cerebrovascular accidents, or even cardiac arrhythmias.[3,4]

The attenuation of these haemodynamic responses has been a focus of research, with various pharmacological agents being explored for their efficacy and safety.[5] Among these, opioids such as fentanyl and buprenorphine have gained prominence due to their analgesic properties and effectiveness in blunting the sympathetic response elicited by laryngoscopy and intubation.[6]

Fentanyl, a potent, short-acting opioid, is widely used for its rapid onset and profound analgesic effects. Conversely, buprenorphine, a partial mu-opioid agonist, has a longer duration of action and a ceiling effect in terms of respiratory depression, making it a potentially safer alternative in certain patient populations.[7,8] Despite their widespread use, there is a lack of consensus on which of these agents better modulates the haemodynamic response during airway manipulation.

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This study aims to provide a comparative analysis of the effects of fentanyl and buprenorphine on the haemodynamic response to laryngoscopy and endotracheal intubation. By examining heart rate, blood pressure, and mean arterial pressure among patients undergoing elective surgeries, this study seeks to elucidate the differential impacts of these drugs, thereby guiding anesthesia practice towards optimized patient care.

MATERIALS AND METHODS

Study Design and Setting

This prospective, randomized, double-blind study was conducted at the Government Medical College/Government General Hospital, Ananthapuramu. The study spanned one year, from June 2018 to May 2019.

Participants

A total of 60 patients, aged between 20 to 50 years, scheduled for elective surgeries under general anesthesia, were enrolled in the study. Patients were randomly assigned to one of two groups: Group B (Buprenorphine group) and Group F (Fentanyl group), with 30 patients in each group. The study included both male and female patients, ensuring a balanced demographic representation.

Inclusion and Exclusion Criteria

Patients classified as ASA (American Society of Anesthesiologists) physical status I and II were included. Exclusion criteria encompassed patients with known allergies to study drugs, a history of chronic analgesic use, cardiovascular, hepatic, renal, or respiratory disorders, and those on medications affecting the cardiovascular system.

Intervention

Patients in Group B received 5 mcg/kg of buprenorphine, while those in Group F were administered 2 mcg/kg of fentanyl. The drugs were administered intravenously three minutes before the induction of anesthesia.

Anesthesia Protocol

Standard anesthesia induction was achieved using thiopentone sodium, and muscle relaxation was facilitated with vecuronium bromide. Maintenance of anesthesia was carried out using isoflurane in oxygen and nitrous oxide. Laryngoscopy and endotracheal intubation were performed three minutes after giving vecuronium bromide.

Data Collection

Haemodynamic parameters, including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure, were recorded at baseline, 2, 5, and 8 minutes after drug administration, before induction, immediately after induction, and at 1, 3, 5, and 10 minutes post-intubation. The duration of laryngoscopy and any side effects, such as bradycardia or hypotension, were also noted.

Statistical Analysis

Data were analyzed using Chi-square tests for categorical variables and unpaired t-tests for continuous variables. Repeated measures ANOVA was used for analyzing changes in haemodynamic parameters over time within each group. A P-value of less than 0.05 was considered statistically significant.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of the Government Medical College, Ananthapuramu. Informed consent was obtained from all participants after thoroughly explaining the nature and purpose of the study.

RESULTS

Demographics and Clinical Characteristics

Age Distribution

The study included 60 patients, with 30 in each of the Buprenorphine (Group B) and Fentanyl (Group F) groups. The age distribution was as follows: in the 20-30-year range, there were 18 patients (60%) in Group B and 16 (53.3%) in Group F; in the 31-40-year range, 9 patients (30%) in Group B and 12 (40%) in Group F; and in the 41-50-year range, 3 patients (10%) in Group B and 2 (6.7%) in Group F. The mean age was 29.40 years (SD = 8.82) in Group B and 30.27 years (SD = 10.01) in Group F, with an overall mean of 30.03 years (SD = 8.80). The age distribution difference between the groups was not statistically significant (P = 0.689).

Sex Distribution

Among the participants, 14 males (46.7%) and 16 females (53.3%) were in Group B, while Group F comprised 16 males (53.3%) and 14 females (46.7%). The overall distribution was 30 (50%) for each sex. The difference in sex distribution between the groups was not statistically significant (P = 0.606).

Body Weight Distribution

The body weight distribution was as follows: 0 patients (0%) in Group B and 1 (3.3%) in Group F weighed between 35-44 kg; 15 patients (50%) in each group weighed between 45-54 kg; and 15 (30%) in Group B and 12 (40%) in Group F weighed between 55-64 kg. No participants in Group B and 2 (6.7%) in Group F weighed ≥65 kg. The mean body weight was 54.70 kg (SD = 4.98) in Group B and 53.53 kg (SD = 6.33) in Group F, with an overall mean of 54.12 kg (SD = 5.68). The difference in body weight distribution was not statistically significant (P = 0.343).

Surgical Procedures

The types of surgical procedures the participants underwent were categorized as follows: General surgeries accounted for 24 cases (80%) in Group B and 18 (60%) in Group F; Orthopaedic surgeries comprised 3 cases (10%) in Group B and 8 (26.67%) in Group F; ENT surgeries were 1 case (3.33%) in Group B and 3 (10%) in Group F; and Miscellaneous surgeries were 2 cases (6.67%) in Group B and 1 (3.33%) in Group F. The difference

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in the type of surgical procedures between the groups was not statistically significant (P = 0.343).

Mean Duration of Surgery

The mean duration of surgery was 51.87 minutes (SD = 19.58) in Group B, with no significant difference from Group F (P = 0.502).

Haemodynamic Responses

Heart Rate Changes

At baseline, the mean heart rate was 85.07 bpm (SD = 7.02) in Group B and 85.60 bpm (SD = 4.75) in Group F (P = 0.732). Subsequent measurements at 2, 5, and 8 minutes after drug administration showed no significant differences between the groups (P = 0.539, 0.280, and 0.052, respectively). However, significant differences were observed before and after induction, and at 1, 3, 5, and 10 minutes after intubation, with Group B consistently showing higher heart rates.

Blood Pressure Changes

Systolic Blood Pressure (SBP): At baseline, the mean SBP was 125.57 mm Hg (SD = 6.51) in Group B and 125.77 mm Hg (SD = 5.82) in Group F (P = 0.901). Significant differences were noted at various time points after drug administration, particularly after induction and at all-time points post-intubation.

Diastolic Blood Pressure (DBP): Baseline DBP was 83.73 mm Hg (SD = 4.51) in Group B and 84.30 mm Hg (SD = 7.09) in Group F (P = 0.713). Similar to SBP, significant differences were observed at various time points, especially after induction and during post-intubation measurements.

Mean Arterial Pressure (MAP)

The MAP at baseline was 97.53 mm Hg (SD = 3.78) in Group B and 98.53 mm Hg (SD = 5.87) in Group F (P = 0.436). Significant differences were observed at multiple time points following drug administration and intubation.

Laryngoscopy Duration

The mean duration of laryngoscopy was 12.47 seconds (SD = 1.59) in Group B, with no significant difference from Group F (P = 0.788).

Side Effects

In Group B, 2 patients (6.7%) experienced bradycardia and 3 (10%) had hypotension, while none in Group F had these side effects. The difference in side effect incidence between the groups was not statistically significant (P = 0.065).

Table 1: Age distribution

Age in years	Group B No.(%)	Group F No.(%)	Total	P value (Chi-square test)
20-30	18 (60)	16 (53.3)	34 (56.7)	0.689
31-40	9 (30)	12 (40)	21 (35)	
41-50	3 (10)	2 (6.7)	5 (8.3)	
Total	30	30	60	
Mean (SD)	29.40 (8.82)	30.27 (10.01)	30.03 (8.80)	

Table 2: Sex distribution between the two groups

Sex	Group B No.(%)	Group F No. (%)	Total	P value (Chi-square test)
Male	14 (46.7)	16 (53.3)	30 (50)	0.606
Female	16 (53.3)	14 (46.7)	30 (50)	
Total	30	30	60	

Table 3: Body weight distribution

Body weight(Kgs)	Group B No.(%)	Group F No.(%)	Total	P value (Chi-square test)
35-44	0 (0)	1 (3.3)	1 (1.7)	0.343
45-54	15 (50)	15 (50)	30 (50)	
55-64	15 (30)	12 (40)	27 (45)	
≥65	0 (0)	2 (6.7)	2 (3.3)	
Total	30	30	60	
Mean (SD)	54.70 (4.98)	53.53 (6.33)	54.12 (5.68)	

Table 4: Type of surgical procedure

Type of Ssurgery	Group B No. (%)	Group F No. (%)	Total	P value (Chi-square test)
General surgeries	24 (80)	18 (60)	42 (70)	0.343
Orthopaedic Surgeries	3 (10)	8 (26.67)	11 (18.33)	
ENT Surgeries	1 (3.33)	3 (10)	4 (6.67)	
Miscellaneous Surgeries	2 (6.67)	1 (3.33)	3 (5)	
Total	30 (100)	30	60	

Table 5: Mean duration of surgery

Group	Mean (SD) duration of surgery (minutes)	P value (unpaired t test)
Group B	51.87 (19.58)	0.502

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Table 6: Intergroup comparison of mean heart rate (bpm) changes in response to laryngoscopy and intubation

Heart rate	Group B Mean (SD)	Group F Mean (SD)	P value (unpaired t test)
Baseline	85.07 (7.02)	85.60 (4.75)	0.732
AD-2min	85.97 (7.12)	84.97 (5.29)	0.539
AD-5min	86.57 (6.91)	84.83 (5.28)	0.280
AD-8min	87.30 (6.52)	84.20 (5.53)	0.052
Before induction	88.43 (5.93)	82.47 (5.51)	<0.001
After induction	104.47 (5.96)	87.87 (5.63)	<0.001
AI-1st min	105.00 (5.95)	99.83 (5.33)	0.001
AI-3 min	105.40 (6.08)	98.20 (4.63)	<0.001
AI-5min	105.77 (6.12)	93.03 (4.54)	<0.001
AI-10min	105.40 (5.73)	86.40 (14.05)	<0.001
P value (Repeated measures ANOVA)	<0.001	<0.001	

AD-After study drug administration, AI-After intubation

Table 7: Intergroup comparison of Systolic Blood Pressure (mm Hg) changes in response to laryngoscopy and intubation

SBP	Group B Mean (SD)	Group F Mean (SD)	P value (unpaired t test)
Baseline	125.57 (6.51)	125.77 (5.82)	0.901
AD-2min	126.63 (6.64)	124.20 (6.31)	0.151
AD-5min	124.97 (4.75)	119.40 (6.25)	<0.001
AD-8min	127.63 (5.36)	115.80 (6.03)	<0.001
Before induction	131.47 (4.87)	114.03 (5.62)	<0.001
After induction	130.07 (6.44)	108.93 (5.63)	<0.001
AI-1st min	155.27 (6.88)	127.67 (5.01)	<0.001
AI-3 min	139.23 (7.97)	123.03 (6.40)	<0.001
AI-5min	129.10 (7.05)	119.67 (6.81)	<0.001
AI-10min	127.27 (5.13)	119.20 (7.18)	<0.001
P value (Repeated measuresANOVA)	<0.001	<0.001	

AD-After study drug administration, AI-After intubation

Table 8: Intergroup comparison of Diastolic Blood Pressure (mm Hg) changes in response to laryngoscopy and intubation

DBP	Group B Mean (SD)	Group F Mean (SD)	P value (unpaired t test)
Baseline	83.73 (4.51)	84.30 (7.09)	0.713
AD-2min	82.70 (4.39)	83.50 (7.24)	0.607
AD-5min	82.17 (3.91)	81.63 (7.59)	0.733
AD-8min	81.77 (3.77)	75.63 (6.99)	<0.001
Before induction	80.73 (3.85)	72.73 (6.78)	<0.001
After induction	79.87 (3.87)	69.30 (7.16)	<0.001
AI-1st min	105.57 (3.88)	85.90 (7.37)	<0.001
AI-3 min	94.87 (7.61)	76.27 (7.77)	<0.001
AI-5min	91.83 (6.64)	73.43 (7.84)	<0.001
AI-10min	86.93 (8.34)	70.50 (7.63)	<0.001
P value (Repeated measures ANOVA)	<0.001	<0.001	

AD-After study drug administration, AI-After intubation

Table 9: Intergroup comparison of Mean Arterial Pressure (mm Hg) changes in response to laryngoscopy and intubation

MAP	Group B Mean (SD)	Group F Mean (SD)	P value (unpaired t test)
Baseline	97.53 (3.78)	98.53 (5.87)	0.436
AD-2min	97.17 (3.94)	97.03 (5.96)	0.919
AD-5min	96.50 (3.26)	94.03 (6.18)	0.058
AD-8min	97.10 (3.05)	89.10 (5.90)	<0.001
Before induction	97.67 (3.91)	86.47 (5.53)	<0.001
After induction	96.50 (3.31)	82.50 (5.63)	<0.001
AI-1st min	122.07 (3.28)	99.63 (5.17)	<0.001
AI-3 min	109.47 (5.99)	91.33 (5.97)	<0.001
AI-5min	104.10 (5.06)	88.83 (6.39)	<0.001
AI-10min	99.80 (5.98)	86.67 (6.08)	<0.001
P value (Repeated measures ANOVA)	<0.001	<0.001	

AD-After study drug administration, AI-After intubation

Table 10: Mean duration of laryngoscopy

Group	Mean (SD) duration of laryngoscopy	P value (unpaired t test)
Group B	12.47 (1.59)	0.788

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Table 11: Side effects

Side effect	Nil	Bradycardia	Hypotension	P value(Chi- square test)
Group B	25 (83.3)	2 (6.7)	3 (10)	0.065
Group F	30 (100)	0 (0)	0 (0)	

DISCUSSION

This study's comparative analysis of fentanyl and buprenorphine in attenuating the haemodynamic responses to laryngoscopy and endotracheal intubation yielded several notable findings. Consistent with existing literature, both drugs were effective in modulating the haemodynamic responses associated with these procedures, but their impact differed in certain aspects.

Comparative Efficacy of Fentanyl and Buprenorphine

The study confirms that both fentanyl and buprenorphine are effective in attenuating the haemodynamic responses during laryngoscopy and endotracheal intubation. However, their efficacy varies in specific aspects.

Fentanyl, with its potent analgesic properties and rapid onset of action, demonstrates a more stable control over haemodynamic parameters, particularly heart rate and blood pressure9. This aligns with the known pharmacological profile of fentanyl, which is effective in blunting the sympathetic response during acute stress events such as intubation. This finding is supported by previous studies that highlight fentanyl's superiority in managing stress responses during surgical procedures.[10,11]

Pharmacological Profiles and Implications

Buprenorphine, as a partial mu-opioid agonist, has a longer duration of action but exhibits less consistent control over haemodynamic responses.[14] This variability could be attributed to its unique pharmacokinetic and pharmacodynamic characteristics, which differ significantly from those of fentanyl.

While buprenorphine's safety profile, especially in terms of respiratory depression, is well established, its efficacy in managing acute stress responses is less clear. This may suggest a need for cautious application in clinical settings where haemodynamic stability is critical.[12,13]

Clinical Implications and Future Research

The findings of this study are vital for anesthetic practice, especially in managing high-risk patients where cardiovascular stability is of utmost importance. Anesthesiologists can use these insights to make more informed choices between fentanyl and buprenorphine, based on the specific needs of the patient and the nature of the surgery.

However, the study's limitations, particularly its sample size and the specific patient population, necessitate further research. Future studies with larger, more diverse cohorts are essential to validate these findings and to explore any additional variables that might influence the comparative efficacy of these drugs.

Additionally, research could also focus on the post-operative outcomes associated with the use of fentanyl and buprenorphine, providing a more holistic understanding of their impact in surgical settings.

CONCLUSION

The study establishes that both Intravenous Fentanyl (2 mcg/kg) and Buprenorphine (5 mcg/kg) are effective in mitigating the haemodynamic responses to laryngoscopy and endotracheal intubation in general anesthesia. However, Fentanyl at 2 mcg/kg proves to be more efficacious than Buprenorphine at 5 mcg/kg in managing these responses. Notably, both medications demonstrate a high safety profile with no significant adverse effects reported in either group.

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