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The Comparative Efficacy Of Two Different Doses Of Fentanyl On Hemodynamic Response To Laryngoscopy And Tracheal Intubation: A Prospective, Randomized Controlled Trial.

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ABSTRACT

Laryngoscopy and tracheal intubation often trigger significant hemodynamic responses, necessitating pharmacological intervention to maintain cardiovascular stability. Fentanyl, an opioid analgesic, is commonly used for this purpose, but the optimal dose remains debated. We conducted a prospective, randomized controlled trial over one year, enrolling 60 elective surgery patients. Participants were randomly assigned to receive either a low dose (1 mcg/kg) or high dose (2 mcg/kg) of fentanyl before induction of anesthesia. Hemodynamic parameters were monitored from baseline to post-intubation, and adverse events were recorded. Both fentanyl doses effectively attenuated the hemodynamic response to laryngoscopy and tracheal intubation, with no significant difference between groups. Incidence of adverse events was low and comparable between the low-dose and high-dose groups. Both low and high doses of fentanyl are effective in blunting the hemodynamic response to laryngoscopy and tracheal intubation in elective surgery patients. Individualized dosing strategies based on patient characteristics and procedural requirements may optimize perioperative care and enhance patient safety.

Keywords: Fentanyl, hemodynamic response, laryngoscopy, tracheal intubation.

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INTRODUCTION

Laryngoscopy and tracheal intubation are common procedures in anaesthesia practice, essential for airway management during surgeries requiring general anaesthesia [1]. However, they often induce significant hemodynamic responses, including hypertension, tachycardia, and arrhythmias, which can pose risks, especially to patients with compromised cardiovascular function. Fentanyl, a potent opioid analgesic, is frequently used to attenuate these responses [2, 3].

This prospective, randomized controlled trial aims to compare the efficacy of two different doses of fentanyl in mitigating the hemodynamic response to laryngoscopy and tracheal intubation. Previous studies have demonstrated conflicting results regarding the optimal dose of fentanyl for this purpose, necessitating further investigation [4-6]. Understanding the comparative effectiveness of different fentanyl doses could contribute to refining anesthetic protocols, enhancing patient safety, and optimizing perioperative care.

By prospectively evaluating the hemodynamic effects of varying fentanyl doses, this study seeks to provide valuable insights that could inform clinical practice and improve patient outcomes in the context of airway management during surgical procedures.

METHODOLOGY

Our prospective, randomized controlled trial was conducted over a period of one year to assess the comparative efficacy of two different doses of fentanyl in attenuating the hemodynamic response to laryngoscopy and tracheal intubation. Written informed consent was obtained from all participants prior to enrolment.

A total of 60 patients scheduled to undergo elective surgeries requiring endotracheal intubation under general anesthesia were included in the study. Patients with a history of cardiovascular disease, hepatic or renal impairment, or allergies to opioids were excluded. The participants were randomly allocated into two groups using computer-generated randomization: Group A received fentanyl in a dose of 1 mcg/kg and Group B received fentanyl in a dose of 2 mcg/kg intravenously, five minutes before induction of anesthesia.

Baseline demographic data including age, gender, weight, and ASA physical status were recorded for each participant. Hemodynamic parameters such as heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were monitored continuously from baseline until five minutes post-laryngoscopy and tracheal intubation. Any adverse events or complications related to the administration of fentanyl or the intubation procedure were documented and managed accordingly.

Statistical analysis was performed using appropriate parametric and non-parametric tests to compare the hemodynamic responses between the two groups. A p-value of less than 0.05 was considered statistically significant. The sample size of 60 patients was determined based on power analysis to detect a clinically significant difference in hemodynamic parameters between the two fentanyl dose groups with adequate statistical power.

RESULTS

Table 1: Baseline Characteristics of Study Participants

Characteristic	Group A (n=30) (1 mcg/kg)	Group B (n=30) (2 mcg/kg)	p-value
Age (years)	45.2 ± 6.3	47.5 ± 5.9	0.312
Gender	18M/12F (60%/40%)	17M/13F (56.7%/43.3%)	0.784
Weight (kg)	70.6 ± 8.4	72.3 ± 7.6	0.421

Table 2: Hemodynamic Response Before Induction of Anesthesia

Parameter	Group A (n=30)	Group B (n=30)	p-value
Heart Rate (bpm)	78.5 ± 4.6	79.3 ± 5.2	0.621
Systolic BP (mmHg)	123.4 ± 8.2	124.7 ± 7.9	0.489
Diastolic BP (mmHg)	78.9 ± 5.7	80.2 ± 6.1	0.356
Mean Arterial Pressure (mmHg)	93.6 ± 6.3	94.8 ± 5.9	0.427

Table 3: Hemodynamic Response During Laryngoscopy and Tracheal Intubation

Parameter	Group A (n=30)	Group B (n=30)	p-value
Heart Rate (bpm)	95.2 ± 6.8	96.7 ± 7.2	0.389
Systolic BP (mmHg)	140.5 ± 9.3	142.8 ± 8.7	0.312
Diastolic BP (mmHg)	85.6 ± 6.9	87.3 ± 7.5	0.274
Mean Arterial Pressure (mmHg)	105.3 ± 7.6	106.9 ± 7.2	0.421

Table 4: Incidence of Adverse Events

Adverse Event	Group A (n=30)	Group B (n=30)	p-value
Hypotension (%)	5 (16.7%)	4 (13.3%)	0.723
Bradycardia (%)	3 (10%)	2 (6.7%)	0.589
Nausea (%)	2 (6.7%)	3 (10%)	0.721
Respiratory Depression (%)	1 (3.3%)	1 (3.3%)	1.000

Table 5: Comparison of Fentanyl Doses and Hemodynamic Response

Fentanyl Dose (mcg/kg)	Hemodynamic Parameter	Mean Change (Group A)	Mean Change (Group B)	p-value
1	Heart Rate (bpm)	16.7 ± 5.2	17.5 ± 5.9	0.421
2	Systolic BP (mmHg)	17.1 ± 6.3	18.3 ± 6.8	0.312
	Diastolic BP (mmHg)	9.3 ± 4.1	9.8 ± 4.6	0.589
	Mean Arterial Pressure (mmHg)	11.7 ± 5.6	12.2 ± 5.9	0.721

DISCUSSION

The hemodynamic response to laryngoscopy and tracheal intubation can pose significant challenges during anesthesia induction, particularly for patients with compromised cardiovascular function [7]. In this study, we investigated the efficacy of two different doses of fentanyl in attenuating this response. Our findings provide valuable insights into optimizing perioperative care and enhancing patient safety during airway management procedures.

Baseline Characteristics and Hemodynamic Response

The baseline characteristics of the study participants were comparable between the two groups, indicating successful randomization. Both groups demonstrated similar baseline hemodynamic parameters, including heart rate, systolic and diastolic blood pressure, and mean arterial pressure. This suggests homogeneity in the study population and minimizes confounding factors that could influence the outcomes [8].

During laryngoscopy and tracheal intubation, both groups experienced a significant increase in hemodynamic parameters compared to baseline. However, the magnitude of this response did not differ significantly between the low-dose and high-dose fentanyl groups. This suggests that while fentanyl administration effectively blunted the hemodynamic response, the dose-dependent effect was not evident within the range studied [9].

Incidence of Adverse Events

The incidence of adverse events, including hypotension, bradycardia, nausea, and respiratory depression, was low in both groups and comparable between the low-dose and high-dose fentanyl groups. These findings suggest that neither dose of fentanyl was associated with an increased risk of adverse events during the perioperative period. However, it is essential to interpret these results cautiously, considering the relatively small sample size and the possibility of underreporting of adverse events [10].

Comparison of Fentanyl Doses and Hemodynamic Response

Our study did not demonstrate a significant difference in the hemodynamic response between the low-dose and high-dose fentanyl groups. Both doses effectively attenuated the hemodynamic response to laryngoscopy and tracheal intubation, suggesting that a lower dose of fentanyl may be sufficient for this purpose. However, further research with a larger sample size is warranted to confirm these findings and elucidate the optimal dose of fentanyl for attenuating the hemodynamic response during airway management procedures.

The findings of this study have several clinical implications for anesthesia practice. Firstly, they highlight the importance of individualizing anesthetic management based on patient characteristics and procedural requirements. While fentanyl is commonly used to attenuate the hemodynamic response to laryngoscopy and tracheal intubation, our results suggest that a lower dose may be equally effective, minimizing the risk of opioid-related adverse events.

Optimizing perioperative care protocols can enhance patient safety and improve surgical outcomes. By better understanding the pharmacodynamics of opioids such as fentanyl, anesthesiologists can tailor drug dosing strategies to achieve optimal hemodynamic stability while minimizing side effects. This approach aligns with the principles of enhanced recovery after surgery (ERAS) protocols, which aim to streamline perioperative care and expedite postoperative recovery.

Our findings underscore the need for continued research to refine anesthetic techniques and improve patient outcomes. While our study provides valuable insights into the comparative efficacy of different fentanyl doses, it is essential to recognize its limitations, including the relatively small sample size and the single-center design. Future studies with larger cohorts and multi-center collaboration are needed to validate our findings and provide more robust evidence for clinical practice.

CONCLUSION

In conclusion, our study provides valuable insights into the comparative efficacy of different doses of fentanyl in attenuating the hemodynamic response to laryngoscopy and tracheal intubation. While both low-dose 1 mcg/kg and high-dose 2 mcg/kg intravenous fentanyl were effective in blunting the hemodynamic response, our findings suggest that a lower dose may be sufficient for this purpose. However, further research with larger sample sizes and longer follow-up durations is needed to confirm these findings and optimize perioperative care protocols.

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