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A Comparative Analysis of Nalbuphine and Fentanyl in Total Intravenous Anesthesia for Short Surgical Procedures

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KEYWORDS
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Abstract: Background: Total Intravenous Anesthesia (TIVA) is a method of general anesthesia characterized by the exclusive use of intravenous agents, completely excluding inhalational agents like nitrous oxide (Gas Anesthesia) [1]. TIVA, primarily employing a combination of Propofol and an opioid, has gained widespread popularity as an anesthesia technique. This study aims to evaluate and compare the analgesic efficacy of nalbuphine and fentanyl, along with their associated side effects, when used as adjuncts to Propofol in TIVA [2]. **Methods:** This research study involved 40 adult patients with American Association of Anesthesiologists (ASA) Grade I/II classifications who were scheduled for minor surgical and gynecological procedures of short duration. The patients were randomly allocated into two equally-sized groups, consisting of 20 individuals each, usinga statistical random number table. The groups were designated as follows: Group N, where patients received a preinduction medication of Inj. Nalbuphine at a dosage of 0.05 mg/kg, and Group F, where preinduction medication involved Inj. Fentanyl administered at a dosage of 1 mcg/kg [3]. **Results:** The fentanyl group exhibited superior control over hemodynamic parameters such as heart rate, systolic blood pressure, and mean arterial pressure at intraoperative time points of 5 minutes, 10 minutes, and 15 minutes. On the other hand, the nalbuphine group demonstrated enhanced postoperative analgesia, as evidenced by reduced scores on the Visual Analog Scale and a decrease in the incidence of respiratory depression. **Conclusion:** Fentanyl demonstrated superior intraoperative hemodynamic stability, while nalbuphine offered improved postoperative analgesia witha lower risk of respiratory depression.

INTRODUCTION

Total Intravenous Anesthesia (TIVA) can be described as a method of general anesthesia that exclusively employs a combination of intravenously administered agents while completely excluding inhalational agents, including nitrous oxide (Gas Anesthesia) [4]. TIVA offers several advantages, including a decreased occurrence of postoperative nausea and vomiting, a reduction in environmental pollution, more predictable and swift recovery, improved hemodynamic sta- bility, preservation of hypoxic pulmonary vasoconstriction, decreased intracerebral pressure, and a lowered risk of or- gan toxicity. The primary categories of drugs frequently employed in TIVA consist of hypnotics and short-acting opioids. The utilization of Propofol in combination with an opioid has made total intravenous anesthesia (TIVA) a widely adopted anesthetic technique. This approach per- mits the separate adjustment of various aspects of anesthe- sia, providing flexibility in its administration. Propofol is commonly paired with an analgesic agent, with the most favored combinations being Propofol with either Fentanyl or Ketamine. This pairing is crucial as providing effective pain relief to the patient is a vital component of balanced anesthesia. Fentanyl is a widely used analgesic due to its relatively rapid onset of peak analgesic action, quick termi- nation of its effects, and its favorable cardiovascular safety profile. The dosage for achieving analgesia typically ranges from 2 to 50 mcg/kg. Fentanyl contributes to reducing the required dosage of Thiopentone or Propofol for anesthesia by providing antinociceptive effects that

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intravenous hypnotic agents alone do not offer. Nalbuphine belongs to the opioid family and exhibits a unique pharmacological profile [5]. It acts as an antagonist receptors but functions as an agonist at kappa receptors. This distinct mechanism was developed in an effort to provide analgesic effects without the undesirable side effects associated with alpha 1 agonists. Nalbuphine is associated with a significantly lower risk of respiratory depression and abuse potential. In contrast, while fentanyl is widely used for its potent analgesic properties, it is often more expensive and requires special licensing due to its narcotic classification [6]. Hence, this study aims to compare the analgesic effects of nalbuphine and fentanyl, along with an assessment of their respective side effects.

I. MATERIALS AND METHODS

This study is designed as a prospective, double-blind, ran- domized trial. The data collection period for this study spanned for 1 Year. Following approval from the institution's ethics committee, this research was carried out on a cohort of 40 adult patients classified as American Association of Anesthesiologists (ASA) Grade I/II, all of whom were scheduled for brief minor surgical and gynecological pro- cedures conducted under General Anesthesia. The patients were divided into two equal groups, each comprising 20 individuals [7].

- Group N: Preinduction medication involved the admin- istration of Inj. Nalbuphine at a dosage of 0.05 mg/kg.
- Group F: Preinduction medication consisted of Inj. Fen-tanyl administered at a dosage of 1 mcg/kg.

In this study, we established specific criteria for the inclusion and exclusion of patients. To be included in the research, pa-tients needed to fall within ASA Grade I & II, be between the ages of 20 and 60, and display hemodynamic stability along with normal laboratory test results. Additionally, patients were required to express their willingness to participate in the study, and the surgical procedures they underwent had to have a duration of less than 30 minutes.Conversely, patients falling into ASA Grade 3 or higher, those who declined to be part of the study, and individuals currently taking pain perception- modifying drugs were excluded. We also excluded patients with known sensitivities or allergies to any of the drugs under investigation, and surgeries lasting longer than 30 minutes did not meet the inclusion criteria. These carefully defined criteria helped ensure a focused and homogeneous patient population for our study. The patient's premedication regimen included the administration of Inj. Ondansetron at a dosage of 4 mg and Inj. Glycopyrrolate at a dosage of 0.2 mg intravenously. Preoxygenation was performed using 100% oxygen. Subsequently, the patient received the randomly allocated drug, which could either be Fentanyl or Nalbuphine as per the study's design. The induction phase began with an initial bolus of 0.6-1.2 mg/kg of the assigned drug, adminis- tered at a rate of 30 mg/10 seconds, until the desired clinical effect was attained. Additional boluses ranging from 20 to 30 mg were administered to maintain the patient in a deeply sedated state. Propofol infusion was halted approximately 5-10 minutes before the intended time of emergence [8]. Throughout the intraoperative phase, comprehensive records of vital signs were diligently maintained. Furthermore, in the postoperative period lasting for 2 hours, assessments included the monitoring of the Visual Analog Scale (VAS) score, Modified Aldrete score, observation of side effects, and measurement of respiratory rate. Subsequently, the pa- tient was transferred to the post-anesthesia care unit (PACU)

Time interval	Fentanyl (Mean ± SD)	Nalbuphine (Mean ± SD)	p Value
Baseline	72.62 ± 8.54	73.13 ± 8.41	0.820
1 Minute	71.80 ± 7.59	70.70 ± 8.09	0.694
2 Minute	70.43 ± 7.50	72.70 ± 8.09	0.121
5 Minute	69.23 ± 7.31	74.10 ± 8.30	0.017
10 Minute	67.30 ± 6.58	77.37 ± 8.06	0.000
15 Minute	69.70 ± 7.18	74.83 ± 8.17	0.014
30 Minute	71.10 ± 8.04	71.77 ± 8.40	0.755
1 Hour	72.53 ± 8.54	71.67 ± 6.77	0.629
2 Hour	72.23 ± 8.51	71.20 ± 5.93	0.587

TABLE 1: Comparison of mean heart rate between Fentanyland Nalbuphine at different time internal

where continuous monitoring and care were administered to ensure their well-being and a smooth recovery process. [9]

II. RESULTS

The average diastolic blood pressure showed no significant difference and was comparable between the two groups. However, concerning mean arterial pressure, the fentanyl group exhibited a lower reading at 2, 5, 10, and 15 minutes, and this difference was clinically noteworthy, highlighting a distinct impact based on the administered drug. The average oxygen

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saturation (SpO2) levels in the fentanyl group were notably lower at 1 hour and 2 hours into the postoperative pe- riod. [10] This clinical significance in the reduction of SpO2 suggests a distinct effect associated with the administration of fentanyl in comparison to the other group.

In the postoperative period, the Modified Aldrete score was observed to be lower in the nalbuphine group, and this difference was deemed clinically significant. This finding suggests that there were notable variations in postoperative recovery or readiness for discharge between the two groups, with nalbuphine demonstrating a distinct impact.

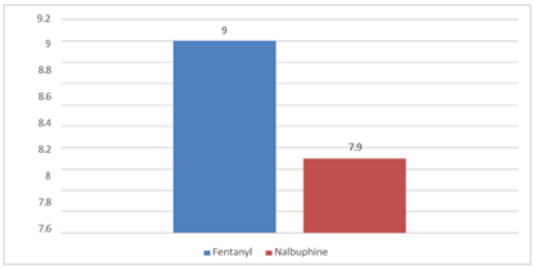

FIGURE 1: Comparison of modified aldrete score in both thegroups

In the postoperative period, the Visual Analog Scale (VAS) scores were notably lower in the nalbuphine group, and this difference was considered clinically significant, as indicated in Figure 3. This suggests that patients receiving nalbuphine experienced lower levels of postoperative pain compared to the other group. The time to require rescue analgesia was significantly longer in the nalbuphine group, with patients in the fentanyl group needing rescue analgesia at an average of 62.30 8.82 minutes, whereas those in the nalbuphine group required it at 130.87 8.99 minutes. The respiratory rate was observed to be lower in the fentanyl group, and this difference was clinically significant. This suggests that fentanyl had a more pronounced effect on respiratory rate compared to nalbuphine [11]. There was no discernible difference in the incidence of nausea between both groups. However, vomiting occurred in one patient in the nalbuphine group, and pruritus was observed in three patients in the fentanyl group. These findings provide insights into the side effect profile of the two drugs under investigation.

III. DISCUSSION

The demographic data, including age, weight, and the type of surgery, were found to be comparable between both study groups. Importantly, the differences observed in these param- eters were statistically insignificant. Moreover, it's notewor- thy that the nature of the procedures conducted in the study remained consistent, with any surgeries exceeding the 30- minute threshold being intentionally excluded from the study. This ensured a uniform and controlled experimental setup for evaluating the effects of the administered drugs [12]. Kay and Rolly introduced Propofol in 1977 as part of their quest for an optimal intravenous anesthetic agent. However, Propofol's initial limitation lay in its lack of inherent anal- gesic properties. This limitation prompted the exploration and development of supplementary agents for use during Total Intravenous Anesthesia (TIVA), such as Ketamine andFentanyl. In our study, we are specifically comparing the combination of Propofol and Fentanyl with the combination of Propofol and Nalbuphine. The primary focus of our re- search is to assess the efficacy of Nalbuphine as an adjunct in this anesthesia regimen, shedding light on its potential role in enhancing the overall anesthesia experience. In a separate study conducted by Khanday et al [13]. in 2019, they compared the effects of fentanyl versus nalbuphine on the at-tenuation of the hemodynamic response during laryngoscopy and endotracheal intubation in patients undergoing general anesthesia. Interestingly, the study observed that there was a more noticeable variation in the nalbuphine group compared to the fentanyl group, although this difference did not reach statistical significance. This finding suggests that both drugs had a similar overall impact on the hemodynamic response in the context of laryngoscopy and endotracheal intubation during general anesthesia. In a study conducted by Khan et al. in 2002, similar observations were made regarding the effects of nalbuphine. This study found a significant difference in systolic blood pressure at specific time points, including 2, 3, and 5 minutes post-induction when maintenance doses of propofol were initiated, as well as at the time of incision. Notably, in this case, the nalbuphine group exhibited higher systolic blood pressure values compared to the other group. These findings suggest that nalbuphine may have a distinct impact on hemodynamic responses during the perioperative period, particularly in the context of propofol administration and surgical incision. In the nalbuphine group, there was an observable increase in diastolic blood pressure up to 10 minutes, although this change did not reach statistical significance. However, after the initial increase, there was a

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subsequent decline in diastolic blood pressure starting around 30 minutes post-administration. Conversely, in the fentanyl group, a reduction in diastolic blood pressure (DBP)was noted, although this change was also not statistically significant. These findings suggest that both nalbuphine and fentanyl had some influence on diastolic blood pressure, but the variations observed were not statistically significant in this study. In our study, we employed the Modified Aldrete Score as a measure to evaluate the recovery profiles and the safety of discharging patients from the postanesthesia care unit (PACU). Interestingly, the results revealed that the Modified Aldrete Score was lower in the nalbuphine group compared to the fentanyl group, indicating a more favorable and quicker recovery in the fentanyl group [14]. These findings align with a study conducted by Khan et al. in 2002, which also investigated the recovery profilesof these drugs. Khan et al. noted that the recovery profiles were similar in both the groups but emphasized an earlier recovery in the fentanyl group. This consistent observation across studies underscores the potential advantages of using fentanyl in terms of achieving a faster and more efficient recovery process in patients undergoing anesthesia.

IV. CONCLUSION

Based on the comprehensive analysis of this study, sev- eral important conclusions can be drawn. Firstly, Fentanyl demonstrated a superior ability to control intraoperative hemodynamics compared to Nalbuphine, signifying its effec-tiveness in maintaining stable blood pressure and heart rate throughout the surgical procedure. Secondly, Nalbuphine ex- hibited better postoperative analgesia, highlighting its poten- tial for providing effective pain relief during the recovery pe- riod following surgery. In terms of recovery, Fentanyl showed an earlier and more efficient profile, indicating that patients who received this drug were likely to regain consciousness and mobility more rapidly. [15] However, it's crucial to note that the Fentanyl group experienced a higher incidence of respiratory depression in the postoperative period, which is an undesirable side effect requiring vigilant monitoring. In summary, while Fentanyl may offer advantages in terms of intraoperative hemodynamic control and quicker recovery, Nalbuphine may excel in providing superior postoperative analgesia. The choice between these drugs should be made carefully, considering the specific needs and risks associated with each patient and surgical procedure.

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AUTHORS CONTRIBUTION

Authors have contributed equally.

CONFLICT OF INTERESTS

Author declared that there is no conflict of interest.

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