e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(11); 36-41

Original Research Article

Fentanyl Vs Dexmedetomidine Nebulization as Adjuvant to Lignocaine: A Comparative Study during Awake Flexible Fiberoptic Bronchoscopy

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Received: 25-08-2024 / Revised: 23-09-2024 / Accepted: 26-10-2024

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Conflict of interest: Nil

Abstract:

Background: Awake flexible fiberoptic bronchoscopy (AFFB) is a critical procedure in respiratory medicine, necessitating optimal patient comfort and minimal discomfort. Fentanyl and dexmedetomidine, known for their analgesic and sedative properties respectively, are investigated as adjuvants to lignocaine to enhance procedural efficacy and patient tolerance.

Methods: This double-blind, randomized study involved 90 ASA Physical Status I/II patients, undergoing AFFB at a tertiary center from November 2018 to March 2020. Participants were divided into three groups: Fentanyl with lignocaine, dexmedetomidine with lignocaine, and lignocaine alone. Primary outcomes measured included mean arterial pressure (MAP), Ramsay Sedation Score (RSS), additional doses of lignocaine, and rescue doses of propofol required during the procedure.

Results: Significant differences were noted in MAP and RSS between the fentanyl and dexmedetomidine groups, particularly during and after the procedure. Dexmedetomidine group showed better sedation depth (80% reaching RSS level 3, $p<0.001$) and stability in MAP compared to the fentanyl group, which showed higher variability and rescue propofol requirements. Additional lignocaine requirements were also lower in the dexmedetomidine group (21.30 mg) compared to the fentanyl group (28.40 mg, SD 10.39, $p=0.019$).

Conclusion: Dexmedetomidine as an adjuvant to lignocaine in AFFB is superior to fentanyl in providing stable hemodynamic profiles, deeper sedation levels, and reduced need for additional sedation and local anesthetic. These findings support the use of dexmedetomidine over fentanyl to improve patient comfort and procedural outcomes in AFFB.

Keywords: Dexmedetomidine, Fentanyl, Awake Flexible Fiberoptic Bronchoscopy, Lignocaine, Sedation, Hemodynamics.

Introduction

Awake flexible fiberoptic bronchoscopy (AFFB) is a vital diagnostic and therapeutic procedure in respiratory medicine, enabling direct visualization of the airways and related structures. While AFFB is less invasive than other bronchoscopic techniques, it requires careful management of patient comfort and cooperation due to the potential for cough and discomfort during the procedure. The administration of local anesthetics like lignocaine is standard practice to minimize these sensations.

However, the augmentation of lignocaine's effect with adjuvants has become a focal point of research to improve patient tolerance and procedural success. [[1,2,3] Fentanyl and dexmedetomidine are two agents that have garnered interest as adjuvants due to their distinct pharmacological profiles. Fentanyl, a potent opioid analgesic, provides rapid onset analgesia, making it a favored choice for pain management in various medical procedures. Its use in AFFB primarily aims to reduce the discomfort associated with airway manipulation. Conversely, dexmedetomidine, a highly selective α2-adrenergic agonist, offers both sedative and analgesic effects without significant respiratory depression, promoting patient comfort and safety during procedures requiring minimal sedation. [4]

The rationale for incorporating these adjuvants into AFFB procedures lies in their potential to enhance the effectiveness of lignocaine, thereby reducing the procedural discomfort and improving patient outcomes. Several studies have suggested that the addition of adjuvants can significantly decrease the need for additional sedative medications, minimize

patient movement, and improve overall satisfaction and cooperation during bronchoscopies. Furthermore, the use of adjuvants like fentanyl and dexmedetomidine might reduce the incidence of cough, a common reflex that can complicate the procedure and affect diagnostic accuracy. [5,6,7]

This comparative study aims to explore the efficacy and safety of fentanyl and dexmedetomidine when nebulized along with lignocaine in patients undergoing AFFB. Specifically, the study seeks to evaluate the differences in patient comfort levels, the incidence of cough, hemodynamic stability, and overall procedural satisfaction. By directly comparing these two adjuvants, the study intends to provide evidence-based recommendations for enhancing patient management during AFFB, potentially setting a new standard of care that could be adopted widely in pulmonology. [8,9]

Given the increasing prevalence of pulmonary diseases and the corresponding need for diagnostic accuracy and patient comfort in bronchoscopic examinations, optimizing the adjunctive medication regimen during AFFB is of paramount importance. This study's findings could have significant implications for clinical practice, offering insights into more effective and patient-centric approaches to bronchoscopy. Through a meticulous design and robust methodology, this research aims to contribute meaningfully to the field of respiratory medicine, enhancing both patient experiences and clinical outcomes in bronchoscopic procedures.

Materials and Methods

Patient Selection and Preparation Patients were examined the day before the bronchoscopy to ensure understanding of the procedure and to gather baseline health information. Those with uncontrolled hypertension, diabetes, heart blocks, hemodynamic instability, use of beta blockers, history of bleeding diathesis, inability to maintain oxygen saturation, refractory hypoxemia, or who were already intubated were excluded from the study. Informed consent was obtained from all participants.

Randomization and Treatment Groups Patients were randomized into three groups (30 patients each) using a computer-generated sequence, which was kept concealed in opaque, sealed envelopes until the time of assignment:

- **Group I:** Nebulized with a mixture of 4 ml of 4% lignocaine and 2 mg/kg fentanyl.
- **Group II:** Nebulized with a mixture of 4 ml of 4% lignocaine and 1 mg/kg dexmedetomidine.
- **Group III:** Nebulized with 4 ml of 4% lignocaine and saline.

The total volume of nebulization for all groups was standardized to 6 ml. Pre-medication included intramuscular glycopyrrolate 0.2 mg and intranasal xylometazoline 0.1%, administered 20 minutes before nebulization.

Procedure and Monitoring Upon transfer to the procedure room, intravenous access was secured, and standard monitoring equipment was connected to measure baseline electrocardiography, oxygen saturation, and non-invasive blood pressure. Nebulization was carried out over 20 minutes, followed by flexible fiberoptic bronchoscopy (FFB) using a Karl Storz bronchoscope. Supplemental oxygen was delivered at 2 L/min through the working channel of the bronchoscope, adapted with a modified syringe connected to the oxygen supply.

Outcome Measures and Data Collection The primary physiological parameters monitored included heart rate, mean arterial pressure (MAP), and oxygen saturation, measured at baseline, every five minutes during the first 20 minutes, and then at 25, 30, 45, and 60 minutes after the procedure. The Ramsay Sedation Score (RSS) was used to assess the depth of sedation. Cough and gag reflexes were documented from the start of the bronchoscope insertion to the end of the procedure. Additional sedation needs were met with intermittent doses of intravenous midazolam (1mg).

Post-procedure Assessment Patient comfort was evaluated using a 3-point scale, and satisfaction was gauged on a 4-point scale, both documented two hours post-procedure. Episodes of coughing and any adverse events, including signs of lignocaine toxicity or over-sedation, were recorded.

Statistical Analysis Data were analyzed using SPSS software, version 20. Continuous variables were expressed as means ± standard deviation, and categorical variables as percentages. Statistical significance among the groups was determined using Analysis of Variance (ANOVA) for continuous variables and Chi-square tests for categorical variables.

Results

The study aimed to compare the effects of Fentanyl versus Dexmedetomidine nebulization as adjuvants to lignocaine during awake flexible fiberoptic bronchoscopy (AFFB) on various physiological parameters and patient comfort measures. The results revealed significant differences in mean arterial pressure (MAP), Ramsay Sedation Score (RSS), additional doses of lignocaine required, and rescue doses of propofol administered between the two groups.

Mean Arterial Pressure (MAP) As detailed in **Table 1**, the initial MAP readings at the beginning of the procedure did not significantly differ between Group LD (Lignocaine + Dexmedetomidine) and Group LS (Lignocaine +

Fentanyl) with a p-value of 0.298 at 0 minutes and 0.276 at 10 minutes.

However, significant differences emerged as the procedure progressed. Starting from 20 minutes of nebulization, Group LS consistently showed higher MAP than Group LD, with the most notable differences observed during the active bronchoscopy phase (AFOI) at 1 minute (p=0.003), 3 minutes (p=0.002), and 7 minutes (p=0.042). This trend continued throughout the procedure, with significant differences persisting up to 20 minutes post-AFOI (p=0.038).

Ramsay Sedation Score (RSS) Table 2 highlights substantial differences in sedation levels, as indicated by the RSS. Group LD showed a higher propensity towards deeper sedation with 80% of participants reaching RSS level 3, in stark contrast to Group LS where no participants reached this level. The differences were statistically significant across all RSS levels (p<0.001).

Additional Dose of Lignocaine Required The requirement for additional lignocaine doses differed significantly between the groups. As shown in **Table 3**, Group LD required a consistent additional dose (21.30 mg) across all cases, whereas Group LS needed higher and more variable additional doses (mean 28.40 mg, SD 10.39), with a significant p-value of 0.019, suggesting a reduced local anesthetic effect in the fentanyl group.

Rescue Dose of Propofol Required Table 4 reveals that while not reaching statistical significance (p=0.080), there was a trend towards higher and more variable rescue doses of propofol in Group LS (26.67 mg ± 10.00) compared to Group LD (20.00 mg), indicating potentially less effective sedation and analgesia control in the fentanyl group during critical phases of the bronchoscopy.

Figures Figure 1 provides a graphical representation of MAP changes over time, clearly illustrating the temporal dynamics of the hemodynamic response in each group. **Figure 2** displays a bar chart of RSS score distribution, effectively visualizing the differences in sedation depth achieved by the adjuvants.

Table 1: Comparison of Map between Group LD and Group Ls1

Time Point	Group LD Mean ± SD	Group LS Mean ± SD	p-value
MAP 0 min	89.76 ± 9.59	92.84 ± 11.07	0.298
MAP 10 min of nebulization	88.64 ± 8.93	91.64 ± 10.27	0.276
MAP 20 min of nebulization	86.28 ± 7.83	91.92 ± 10.21	0.033
MAP during AFOI 1 min	89.72 ± 7.61	97.28 ± 9.83	0.003
MAP during AFOI 3 min	92.84 ± 7.31	100.72 ± 9.78	0.002
MAP during AFOI 5 min	96.14 ± 8.09	103.45 ± 10.73	0.076
MAP during AFOI 7 min	96.40 ± 13.28	114.00 ± 2.00	0.042
MAP immediately after AFOI	87.16 ± 7.76	91.72 ± 9.37	0.067
MAP 5 min after AFOI	84.84 ± 7.62	89.88 ± 8.77	0.035
MAP 10 min after AFOI	82.20 ± 7.36	87.40 ± 8.70	0.027
MAP 15 min after AFOI	79.56 ± 7.41	84.68 ± 9.29	0.036
MAP 20 min after AFOI	76.60 ± 7.53	81.28 ± 8.03	0.038

Table 2: Distribution of RSS between Group LD and Group LS

RSS Level	Group LD No. (%)	Group LS No. (%)	p-value
1	0 (0%)	4 (16%)	<0.001
2	5 (20%)	21 (84%)	<0.001
3	20 (80%)	0 (0%)	<0.001

Table 3: Comparison of Additional Dose of Lignocaine 2% Required

Group	Mean ± SD (mg)	p-value
Group LD	21.30 ± 0.00	0.019
Group LS	28.40 ± 10.39	0.019

Table 4: Comparison of Rescue Dose of Propofol 1% Required

Group	Mean ± SD (mg)	p-value
Group LD	20.00 ± 0.00	0.080
Group LS	26.67 ± 10.00	0.080

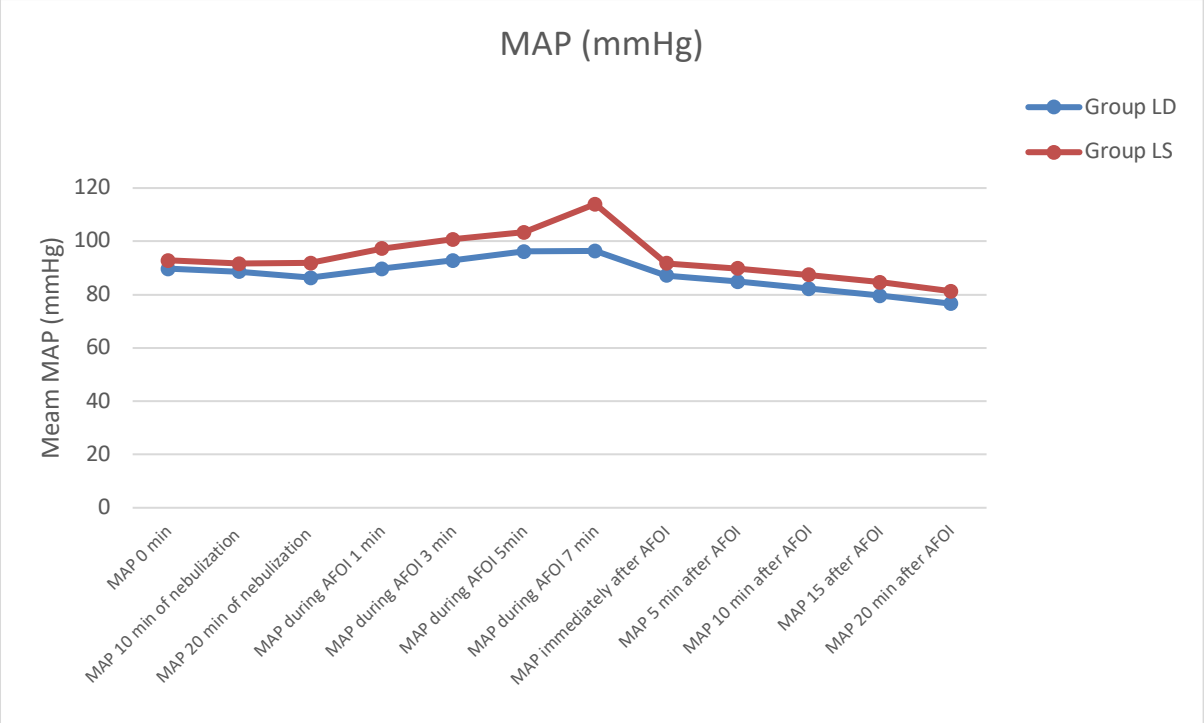

Figure 1: Graphical Representation of Map Changes Over Time

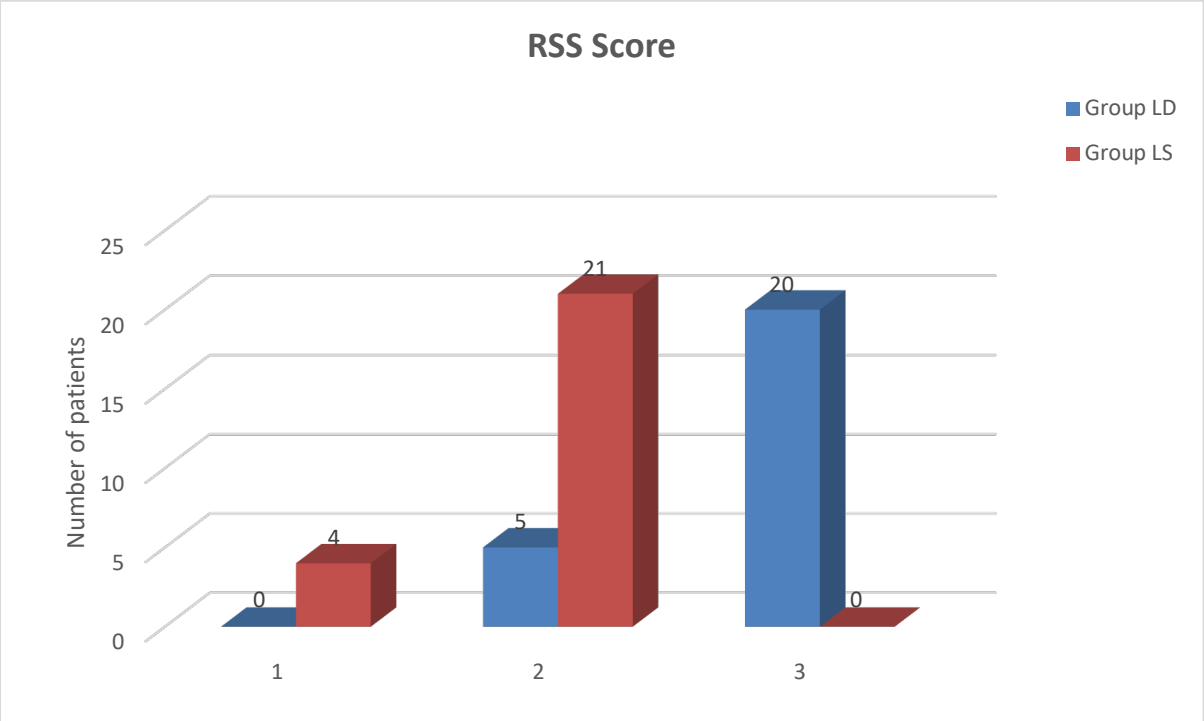

Figure 2: Bar Chart of RSS Scores Distribution

Discussion

The findings of this study underscore significant differences in the efficacy of Fentanyl and Dexmedetomidine when used as adjuvants to lignocaine in awake flexible fiberoptic bronchoscopy (AFFB).

These differences manifest in various clinical parameters, which are crucial for enhancing patient comfort and procedural safety. [11] Firstly, the variation in mean arterial pressure (MAP) between the two groups points to a crucial aspect of patient management during AFFB. Dexmedetomidine's ability to maintain a more stable MAP compared to Fentanyl, especially during critical moments of the procedure, underscores its potential in managing procedural hemodynamics more effectively. This stability could be attributed to Dexmedetomidine's

known profile of providing sedation without significant respiratory depression, a highly desirable characteristic in procedures where maintaining spontaneous ventilation is critical. [12,13]

The profound differences in the Ramsay Sedation Scores (RSS) highlight another pivotal outcome. Patients in the Dexmedetomidine group achieved deeper levels of sedation more consistently than those in the Fentanyl group.

This level of sedation not only facilitates patient tolerance to the procedure but also minimizes patient movement, which can be critical for both the safety and efficacy of the bronchoscopy. The ability of Dexmedetomidine to achieve deeper and more stable sedation levels without compromising respiratory function could explain its superior performance in maintaining RSS levels. [14]

Furthermore, the requirement for additional doses of lignocaine was notably lower in the Dexmedetomidine group, which could indicate a more potent local anesthetic effect when combined with this adjuvant. This is particularly relevant as it suggests that Dexmedetomidine might enhance the local anesthetic properties of lignocaine, thereby improving patient comfort and potentially reducing the procedural time by minimizing interruptions for additional anesthetic administration. [15]

The trends observed with the administration of rescue doses of propofol align with the overall findings regarding sedation and pain management. Although not reaching statistical significance, the higher and more variable doses in the Fentanyl group suggest that Fentanyl may not provide as consistent an analgesic effect as Dexmedetomidine, necessitating additional interventions to manage discomfort. The implications of these findings are twofold. Clinically, they suggest that Dexmedetomidine could be considered a more effective adjuvant to lignocaine in AFFB for enhancing both patient comfort and procedural efficiency. From a pharmacological perspective, the results may encourage further exploration into how Dexmedetomidine enhances the efficacy of local anesthetics and moderates physiological responses during invasive procedures.

Conclusion

This comparative study of Fentanyl versus Dexmedetomidine as adjuvants to lignocaine during awake flexible fiberoptic bronchoscopy reveals that Dexmedetomidine offers superior control over procedural hemodynamics, achieves deeper sedation levels, and reduces the need for additional local anesthetic and rescue analgesic doses. These findings suggest that Dexmedetomidine not only enhances patient comfort but also contributes to the overall safety and efficiency of bronchoscopic procedures. Therefore, it presents a compelling case for its preferred use in clinical settings where maintaining patient stability and comfort is paramount.

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