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Research Article

Exploring the Effects of Sub-Dissociative Doses of Ketamine on Sedation Quality in Bronchoscopy: A Double-Blind Clinical Study

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ABSTRACT

Background: Sedation is recommended during flexible fiberoptic bronchoscopy (FFB) to aid in airway evaluation, minimize patient mobility, and enhance patient safety. This study was conducted to compare the impact of different sub-dissociative ketamine (SDK) doses on the quality of sedation within FFB.

Methods: This research utilized randomized clinical trial design involving three cohorts, each consisting of 30 participants. The cohorts were administered varying doses of ketamine: 0.2 mg/kg (SDK1), 0.4 mg/kg (SDK2), and 0.5 mg/kg (SDK3). After receiving ketamine, all participants received propofol in bolus dose 0.4 mg/kg followed by infusion 50-100 µg/kg.
FFB started when sedation level 4 was reached, according to Ramsey's sedation score.

Results: Regarding demographic variables revealed no statistically notable discrepancy among the cohorts (P>0.05). The SDK3 cohort exhibited a higher average sedation score and longer duration of sedation compared to the SDK2, with both metrics also surpassing those of the SDK1 cohort. (P>0.001). Furthermore, the satisfaction levels reported by the bronchoscopist (P=0.78) and the participants (P=0.019) were notably greater in the SDK3 cohort than in the other groups. Additionally, the amount of propofol administered to the SDK3 cohort was less than that given to the SDK2, and both cohort received lower doses than the SDK1 cohort (P>0.001).

Conclusion: Elevating the SDK from 0.2 mg/kg to 0.5 mg/kg when administered alongside propofol correlates with a rise in the score of sedation, increasing patient and bronchoscopist satisfaction, and decreasing propofol consumption in FFB in adults. A dosage of 0.5 mg/kg might be more advantageous compared to alternative dosages for FFB in adult patients.

Introduction

Flexible bronchoscopy is a canonical for airway visualization and facilitates various diagnostic and therapeutic procedures.

Sedation is recommended during flexible bronchoscopy procedures to aid in airway evaluation, minimize patient mobility, and enhance patient safety. Different drugs such as benzodiazepines, opioids, propofol, and ketamine can be used for sedation, with no standardized method for their use in bronchoscopy [1-3]. Propofol and ketamine are frequently employed as agents for inducing sedation during bronchoscopy, with ketamine showing potential benefits for the pediatric population [4-5].

Ketamine, a phencyclidine derivative, provides sedative, analgesic, and anesthetic effects, making it

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suitable for diagnostic and therapeutic procedures. It maintains muscle tone, airway reflexes, and spontaneous breathing, although [6-7] it may increase salivation and secretion theoretically [1] it has not been reported to be clinically important [2]. Propofol, on the other hand, exhibits characteristics such as inducing amnesia, alleviating nausea, and possessing anti-anxiety effects, all while demonstrating a swift onset of action and a brief recovery period. Propofol, does not possess analgesic properties and is frequently administered alongside ketamine or short-acting narcotics to enhance pain management during procedural sedation. [8-10].

Studies have shown the safety and efficacy of SDK (0.1- 0.6 mg/kg) for acute pain management, but the ideal dosage for achieving effective pain relief with minimal side effects remains to be determined [11-12]. Bronchoalveolar lavage (BAL) is a minimally invasive technique crucial for diagnosing interstitial lung disease, pulmonary infiltrates, and select infectious diseases, often performed during flexible bronchoscopy [13]. There is a growing interest with the application of ketamine in the context of bronchoscopy, especially among pediatric patients [5, 14]. Research regarding the safety and effectiveness of ketamine on adults FFB remains sparse [3].

Methods

Study design

This study was carried out as a randomized clinical trial and received ethical approval under registration number IR.mui.med.rec.1399.704 from Isfahan University of Medical Sciences.and is registered with the Iranian Registry of Clinical Trials under the identification number IRCT20180416039326N.

The period spanning from November 2020 to May 2021 involved the evaluation of 90 patients identified as candidates for FFB at Al-Zahra and Khurshid medical centers.

Participants

Inclusion Criteria

Individuals eligible for bronchial alveolar lavage in this study were those aged 18 years or older, classified as ASA II. The primary criteria for inclusion involved a suspicion of malignancy, an undiagnosed pulmonary infection, or refractory pneumonia. Participation in the study was contingent upon the provision of written informed consent.

Non- inclusion Criteria

SpO2 below 95% when breathing room air, unstable hemodynamics, failure (kidney, liver), COPD with FEVI less than 50%, platelet count below 50,000/mm2, body weight > 85 kg, impaired consciousness or cognitive function, previous history of hypersensitivity or contraindications to the use of drugs used in the study, as well as in chronic users of sedatives, alcohol and drugs, were not entry to the study.

Exclusion Criteria

Allergic reaction to the study drugs, the emergence of complications requiring a change in anesthesia strategy, transfer of the participant to the intensive care unit, or the patient's unwillingness to continue cooperation were identified as exclusion criteria.

Interventions

Patients were subjected to a preliminary assessment at the anesthesia clinic, and those who met the predetermined criteria were chosen following the acquisition of informed consent. Additionally, their demographic information was collected and documented in the appropriate form.

Upon arrival at the bronchoscopy section, patients were positioned supinely on the examination bed, where they were subjected to continuous monitoring that contained electrocardiography, pulse oximetry, and intermittent sphygmomanometer. Key physiological parameters comprised blood pressure (BP), heart rate (HR), and peripheral oxygen saturation (SpO2) were systematically assessed and documented. Additionally, participants were administered supplemental oxygen at a rate of 4 liters per minute via a nasal cannula.

In the case of all three study groups, a 2% lidocaine gel with a total volume of two milliliters was administered into the more open nostril of each patient. In order to achieve sedation, in the SDK1 cohort, administered 0.2 mg/kg of ketamine intravenously. while the SDK2 cohort was given a higher dose of 0.4 mg/kg, and the third cohort(SDK3) was administered ketamine at dosage of 0.5 mg/kg. Following the ketamine administration, propofol 1% was delivered via a pump syringe comprising 15 ml of the drug. Initially, a bolus dose of propofol at 0.4 mg/kg was infused over a period of three minutes, after which a continuous propofol infusion was maintained at a rate ranging from 50 to 100 μg/kg/min,, Upon reaching level 4 of sedation based on RSS, the bronchoscope was inserted through the nostril and subsequently passed through the throat, at this stage, using the spray-as-you-go method while moving, two milliliters of 2% lidocaine spray were sprayed in the throat and another 2 milliliters were sprayed in the vocal cords.

The supervising anesthesiologist, who was not involved in the data collection process, was responsible for the preparation and administration of the intervention drugs.

In the present investigation, both the participating and the observer responsible for data collection were blinded to the medication assignments of the patients.

In instances where additional sedation was required, a titration of 2 ml of 10% propofol was administered across all three cohorts. Management of desaturation to levels of 90% or lower involved the escalation of the oxygen flow

rate and the application of an oxygen mask. For patients experiencing pain during the recovery phase, Apotel was administered at a dosage of 15 mg/kg. Ultimately, the cumulative volume of propofol utilized was assessed and documented for each individual patient.

Outcomes measures

The primary and secondary outcomes assessed in this study encompassed several key factors, including the quality and duration of sedation, the length of the bronchoscopy procedure, levels of satisfaction reported by both patients and bronchoscopist, cardiovascular responses observed during the bronchoscopy and in the recovery room, as well as any side effects experienced in these settings. The quality of sedation was measured using the RSS [15], a six-point scale that categorizes sedation levels as follows: 1 indicates an anxious and restless state, 2 denotes calmness with responsiveness to commands, 3 reflects confusion with command responsiveness, 4 signifies sleep with a response to a stimulus applied between the eyebrows, 5 represents sleep with a diminished responsiveness to tactile stimuli, and 6 indicates a state of sleep with no response at all.

The assessment of sedation quality, its duration, and cardiovascular responses was conducted at five-minute intervals throughout the intervention and at fifteen-minute intervals during the recovery phase. Once the patients regained full consciousness, they were prompted to report their comfort and pain levels experienced during and following FFB by utilizing the Visual Analogue Scale (VAS), which ranges from 0, indicating complete comfort, to 10, signifying complete discomfort [16]. The duration of recovery was established using the modified Aldert score, this criterion includes the evaluation of five specific factors, namely the person's activity level, respiration, circulation, consciousness, and oxygen saturation. Each category is assigned a score of "0", "1", or "2", with a score of two indicating the optimal condition, when a patient attains an Aldrete score of 9 or 10, they meet the necessary criteria to be discharged from the recovery area and subsequently transferred to the inpatient department [17].

The assessment of satisfaction levels for both the bronchoscopist upon completion of the procedure and the patient following recovery was conducted utilizing a 5-point Likert scale. This scale encompassed the following answer choices: (1) Strongly Disagree; (2) Disagree; (3) Neutral; (4) Agree; (5) Strongly Agree [18]. Additionally, any adverse events that occurred during the procedure, such as desaturation, hypotension, hypertension, tachycardia, bradycardia, and pain, as well as those experienced during the recovery phase, including nausea, vomiting, and pain, were systematically evaluated and documented.

More than 20% increase or decrease in hemodynamic variables (blood pressure and pulse rate) from baseline value was considered significant [19-22]. Hypoxia was defined as a $SpO2 < 90\%$ [23].

Randomization and Blinding

The allocation of patients into the various groups in this study was conducted by the nurse anesthetist utilizing a randomization table generated by specialized software. The outcomes of this allocation process were securely stored in sealed, opaque envelopes. Upon opening these envelopes, the anesthetized nurse proceeded to assign patients into three distinct groups, each comprising 30 individuals who were administered ketamine (designated as SDK1, SDK2, and SDK3). Throughout the course of the study, neither the patients, nor the data collector had any knowledge of the specific drug group to which each patient belonged. The preparation and administration of the medications were carried out by an anesthesiologist who was not involved in the research team, ensuring an unbiased approach to the study.

Sample size

The study determined the necessary sample size by applying a sample size formula aimed at comparing means, establishing a confidence level of 95% and a test power of 80%. The standard deviation for pain intensity was set at 1.1, and a minimum significant difference of 0.8 between the groups was taken into account, leading to an estimation of 30 participants per group.

For the statistical analysis, the collected data were processed using SPSS software version 23 (IBM SPSS, Armonk, NY, USA). Various statistical tests, including Chi-square, one-way analysis of variance, Mann-Whitney test, and analysis of variance with repeated measures, were conducted at a significance level of 0.05. A 5% alpha error, corresponding to a 95% confidence interval, was utilized as the criterion for determining the acceptance or rejection of the null hypothesis.

Results

In this investigation, a total of 90 candidates for FFB were randomly assigned to three distinct groups, each comprising 30 individuals who received ketamine at varying dosages of 0.2, 0.4, and 0.5 mg/kg. The study included all participants, and the analysis was conducted on the complete cohort of 90 patients (refer to Figure 1). The results indicated no statistically significant differences among the three groups concerning demographic and baseline variables ($p>0.05$) (see Table 1). However, notable dissimilarity was seen in the average sedation scores during the procedure ($P<0.018$), the span of sedation ($p=0.001$), and period of recovery stay ($p<0.001$), with the SDK3 cohort exhibiting higher values than the SDK2 cohort, and both groups demonstrating greater scores than the SDK1 cohort.

The SDK3 cohort exhibited higher levels of bronchoscopist satisfaction ($p=0.78$) and participants satisfaction ($p=0.019$) compared to the SDK2 cohort, with both groups outperforming the SDK1 cohort. Furthermore, the average pain experienced during recovery in the SDK3 cohort was notable lower

(p=0.003) than that in the other cohorts, with no participants reporting a Visual Analog Scale (VAS) score exceeding 2, which resulted in the non-prescription of Apotel (see Table 2).

It should be highlighted that throughout the procedure, none of the patients necessitated an escalation in propofol infusion beyond doses ranging from 50 to 100 μg/kg/min.

Examination of hemodynamic parameters during the study period revealed no notable differences among the groups. However, within the SDK3 group, significant variations in DBP and MAP were identified during the intra-group analysis, while no notable variance were seen among the intra-group studies of SDK1 and SDK2. Furthermore, the repeated measures analysis of variance indicated that there were no notable disparity in the changes of SBP, DBP, and MAP across the three groups.

When evaluating heart rate (HR) across the three cohorts, it was found that during and after FFB, the SDK3 cohort exhibited the highest mean heart rate, whereas the SDK1 cohort recorded the lowest mean HR, with a statistically meaningful disparity (P=0.01). The intra-group analysis demonstrated significant differences in HR changes among the cohorts, and the inter-group analysis also revealed notable differences in HR variations (P=0.02). Lastly, the examination of SpO2 percentages at baseline, during and following bronchoscopy indicated no notable differences among the cohorts. Additionally, both intra-group and inter-group analyses showed no notable changes in SpO2 percentages within or between the cohorts, as detailed in (Table 3). The repeated measures analysis of variance indicated that the factors of gender, age and ASA classification did not significantly influence hemodynamic changes in the participts. The findings revealed that none of the participts experienced bradycardia during the bronchoscopy procedure; however, instances of Hypertension were identified in 11 individuals, while hypotension was noted in 16, and tachycardia was recorded in 19 subjects. and a decrease in Spo2 levels in 5 patients. As presented in (Table 4), the occurrence of hemodynamic disturbances did not reveal a statistically notable variation among the cohorts (P<0.05). Regarding adverse events after surgery, the incidence Regarding adverse events after surgery, the incidence of nausea was recorded as 1, 4, and 3 cases, corresponding to rates of 3.3%, in SDK1 cohort and 13.3%, and, 10%, in SDK2 and SDK3 cohorts respectively (P=0.52), with no reported cases of vomiting (P<0.05). Additionally, one subject (3.3%) from SDK3 cohort had hallucinations, although this finding was not statistically notable (P=0.99). Notably, no instances of agitation were observed in any of the subjects. The pulmonologist report was that there was no increase in salivation in the patients.

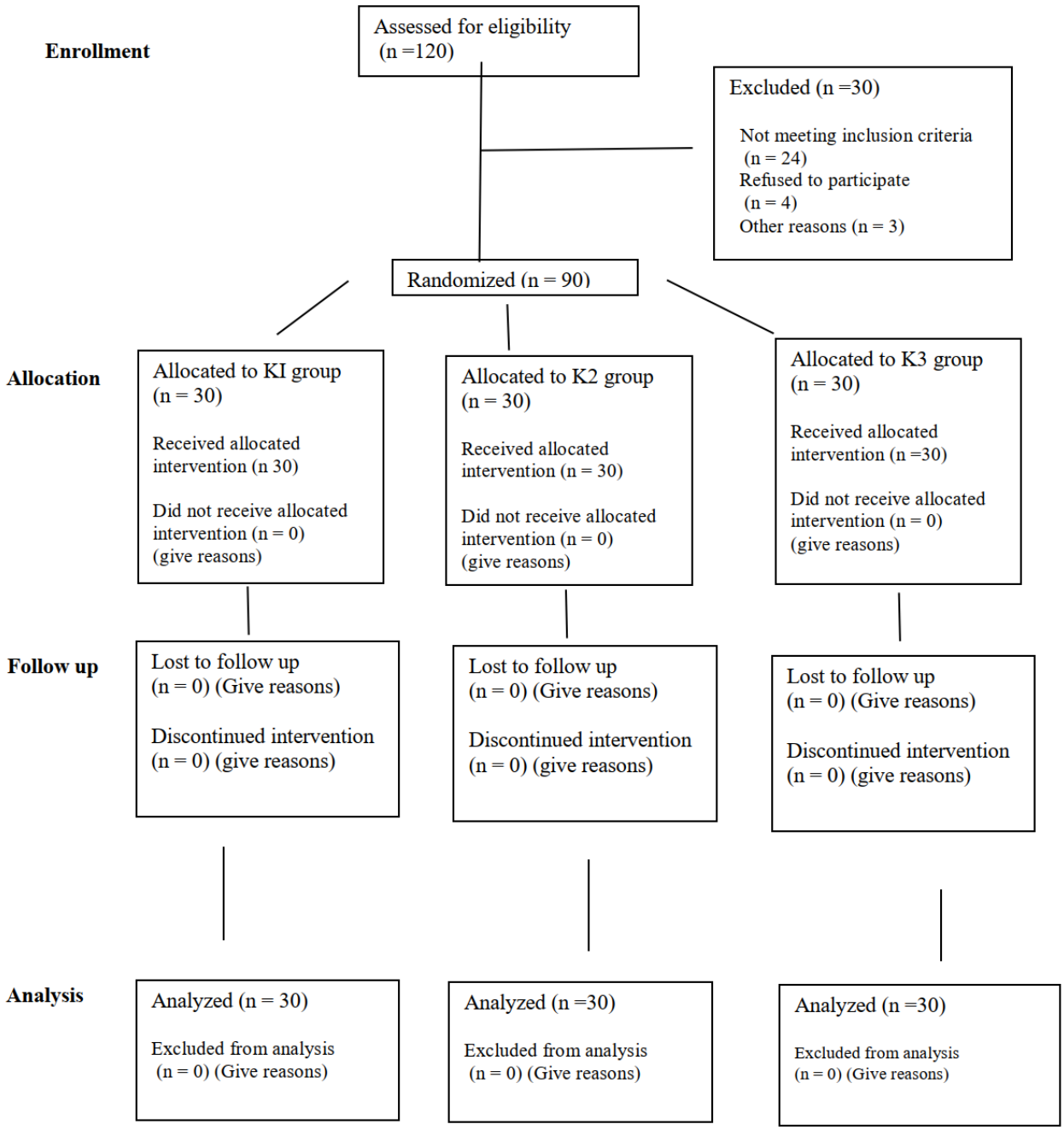

Figure 1- Consort diagram of study

Table 1- Comparison of demographic characteristics across three distinct cohorts.

Variable		SDK[1] cohort	SDK[2] cohort	SDK[3] cohort	P value
Age (yeas) (mean± SD)		52.5± 15.4	53.9±17.5	57± 16.7	0.56
Gender (N %)	Female	12 (40%)	7 (23.3%)	13 (43.3%)	0.22
	Male	18 (60%)	23 (76.7%)	17 (56.7%)	
ASA (N %))	1	21 (70%)	20 (66.7%)	23 (76.7%)	0.69
	2	16 (27.6%)	15 (25.5%)	15 (26.4%)	

The findings emerged from the application of an independent t-test and a chi-square ($\chi 2$) test, which were used to analyze both continuous and categorical data.

Table 2- Findings related to the quality of sedation and analgesia, participants and pulmonologist satisfaction, and the duration of the study across three distinct cohorts.

Variable	Group k1	Group k2	Group k3	P value
Procedure duration (min)	10(5-15)	10(7-15)	10(5-11.5)	0.16
Sedation time (minutes)	13±3,6	14.5±3.6	16.8± 4	0. 01
Sedation score (RSS)	4.47±0.36	4.49±0.28	4.49± 0.31	0.018
Recovery time (minutes)	28.8±6.5	35.8±6.3	39±8.3	<0.001
pain in recovery (VAS)	1.8±0.66	1.50±0.51	1.30±0.47	p=0.003
Satisfaction of the pulmonologist				
Dissatisfied	3(10)	1(3.3)	1(3.3)	0.78
Satisfied	9(30)	10(3.3)	8(26.7)	
Completely satisfied	18(60)	19(63.3)	32 (70)	
Patient satisfaction				
Completely dissatisfied	0(0)	1(3.3)	0(0)	0.019
Dissatisfied	1(3.3)	3(10)	0(0)	
Satisfied	8(26.7)	3(10)	1(3.3)	
Completely Satisfied	21(70)	23(76.7)	29(96.7)	

The findings emerged from the application of an independent samples t-test and a chi-square test, which were utilized to analyze both continuous and categorical data.

Table 3- Changes in hemodynamic indices across three distinct cohorts.

Variable/ Time	SDK^1 cohort	SDK^2 cohort	SDK^3 cohort	Pvalue*
SBP (mmhg)				
Pre-intervention phase	125.1±9.2	120.4±14	125.1±9.2	0.26
Intervention phase	120.5± 13.8	119.3±15.6	127.8± 17.8	0.16
Post-procedure recovery phase	122.5±31.8	119.2± 15.4	128±19.3	0.69
P**	0.79	0.88	0.35	0.71 ***
DBP (mmhg)				
Pre-intervention phase	75±10.3	78.1±9.6	74.8±8.4	0.32
Intervention phase	73.1±13	79.3±12.8	83 ±21.1	0.43
Post-procedure recovery phase	73.1±13	78.6±15	83±8.4	0.081
P**	0.66	0.90	0.015	0.23***
MAP (mmhg)				
Pre-intervention phase	91.5±10.3	92.6±9.8	92.2±8.3	0.89
Intervention phase	90.3±14.8	94.1±13.8	95.2±13.5	0.36
Post-procedure recovery phase	88.8±13.2	92.5±15.5	99.6±21	0.051
P**	0.51	0.76	0.026	0.207***
Heart Rate				
Pre-intervention phase	77.7±7.8	76.5±10.3	80.1±10.7	0.42
Intervention phase	82.6±8.7	84.5±11.7	93.2±13.4	0.001
Post-procedure recovery phase	83.8±9.6	85.1±14.9	89.7±13.5	0.19
P**	0.001<	0.001<	0.001<	0.02***
Spo2 (%)				
Pre-intervention phase	96.1±1.85	95.77±2.92	96.1±2.21	0.82
Intervention phase	96.2±3.35	96.23±1.89	96.23±1.77	0.64
Post-procedure recovery phase	96.86±2.31	95.3±9	96.76±3.75	0.52
P**	0.36	0.83	0.091	0.078***

The analysis of variance for repeated measures yielded P values, with the baseline value of SBP treated as a covariate, leading to the application of repeated measures ANCOVA.

Table 4- Comparison of the frequency of adverse events across three distinct cohorts.

Type of adverse event	SDK^1 cohort	SDK^2 cohort	SDK^3 cohort	P value*
Hypertension	1 (3.3)	3(10)	7(23.3)	0.072
Hypotension	7 (23.3)	5(16.7)	4(13.3)	0.70
Tachycardia	4 (13.8)	7(23.3)	8(26.7)	0.52
Bradycardia	0 (0)	0(0)	0 (0)	1
O2sat drop	1 (3.3)	3(6.7)	1 (3.3)	0.99
Nausea	1 (3.3)	4(13.3)	3(10)	0.52

Delirium	0 (0)	0 (0)	1 (3.3)	0.99
Agitation	0 (0)	0 (0)	0 (0)	1
laryngospasm	1 (3.3)	0 (0)	0 (0)	0.99

*Results of chi-square test for qualitative data

Discussion

In this study, all ninety participants who underwent FFB were categorized into three distinct cohorts, with each group comprising 30 individuals who were administered sub-anesthetic doses of ketamine. (0.2, 0.4, and 0.5 mg/kg) in conjunction with propofol. Analysis of demographic and fundamental parameters revealed no notable differences between the cohorts regarding average procedure time, contentment of the bronchoscopist, average pain experienced during recovery, and duration of recovery stay. Notably, the sedation scores, sedation duration, and patient satisfaction in the SDK3 cohort were notably higher than those in the SDK2 cohort, with both cohorts outperforming the SDK1 cohort. Furthermore, the average pain reported during recovery in the SDK3 cohort was lower than that in the SDK2 cohort, and both groups experienced less pain than the SDK1group, with no participants reporting a Visual Analog Scale (VAS) score exceeding 2, thus eliminating the need for Apotel prescription.

It also did not require an additional dose of fentanyl during the procedure. The analysis revealed no significant variations between the groups regarding alterations in SBP, DBP, MAP, or the percentage of SPO2. The average heart rate during bronchoscopy in the SDK3 cohort was higher than SDK2 and both higher than SDK1 cohort, which was a significant difference. There were no notable differences in the incidence of hemodynamic disorders among the three cohorts.

In Hwang's research, a comparative analysis was performed on the efficacy of two anesthetic combinations: propofol-alfentanil and propofol-ketamine, specifically in the context of controlled analgesia for patients undergoing bronchoscopy. The findings indicated that the propofol-ketamine combination demonstrated superior outcomes compared to the propofol-alfentanil combination. Notably, the sympathetic effects associated with ketamine helped to sustain blood pressure levels that were comparable to those observed prior to the surgical procedure. Furthermore, a greater proportion of subjects a regimen including ketamine plus propofol mentioned more enhanced satisfaction of bronchoscopy and a greater degree of forgetfulness regarding its experience. [25].

In Huang et al.'s reseach, the clinical effectiveness of a combination of sketamine and propofol, alongside sufentanil and propofol, in patients undergoing bronchoscopy.In patients candidates for bronchoscopy, sedation and analgesia with sufentanil/propofol (sufentanil: 0.2 μg/kg) or sketamine/propofol (sketamine: 0.2 mg/kg) were evaluated. The findings of the research indicated that sketamine was associated with a higher level of sedation efficacy [26].

In a research investigation involving patients who underwent transbronchial needle aspiration facilitated by intrabronchial ultrasound (EBUS-TBNA), participants were categorized into four distinct groups: those receiving a combination of propofol and midazolam (PM group), those administered propofol and ketamine (PK group), those treated with a combination of propofol, ketamine, and midazolam (PKM group), and those given propofol alone (P group). The findings indicated that the groups receiving ketamine exhibited a higher incidence of increased blood pressure. Notably, the PKM combination necessitated lower dosages of the administered medications. Furthermore, the recovery duration was found to be the least in the P group., while the PKM group experienced the longest recovery time. [27].

In research conducted by Fruchter and associates, examined the comparative impacts of fentanyl and ketamine during bronchoscopy procedures in adults, the findings indicated that ketamine is equally safe and non-harmful as fentanyl. Furthermore, ketamine demonstrated a reduced incidence of cardiovascular depression and exhibited a more pronounced effect of bronchodilatory. Consequently, the authors advocate for an increased application of ketamine in bronchoscopy procedures. [2].

Transbronchial needle aspiration facilitated by intrabronchial ultrasound. Their findings indicated that both blended yielded safe and effective sedation, resulting in high levels of satisfaction among both patients and bronchoscopists, with no significant advantage observed for either formulation. [28]. In their resIn a separate investigation, Dal et al. explored the efficacy of two anesthetic combinations, ketamine-midazolam and ketamine-propofol, in the context of earch, Gunathilaka et al. conducted a comparative analysis of sedation methods utilizing propofol and fentanyl during pediatric bronchoscopy. Their findings indicated that propofol, when used for flexible bronchoscopy in children, resulted in a shorter induction time, reduced incidence of coughing throughout the procedure, a quicker recovery period, and greater satisfaction among physicians compared to fentanyl [28]. Previous investigations have also examined recovery times, revealing no significant differences between the ketamine-propofol-midazolam (KPM) cohort and the fentanyl-propofol-midazolam (FPM) cohort, as well as a

lack of distinction between the ketamine-propofol (KP) and midazolam (MP) cohorts in another research [29].

A retrospective study was conducted to evaluate pediatric patients who underwent flexible bronchoscopy and compare the use of KP with P. The results of the investigation revealed that there was no statistically notable discrepancy in recovery duration among the two examined groups [30]. In Fruchter's study, it was determined that the levels of satisfaction among participants did not show notable disparity between the KPM and FPM cohorts [2], while another study reported generally high satisfaction among patients in the KPM, KP, MP, and P cohorts [27]. The current study demonstrated that an increase in the dosage of ketamine corresponded with enhanced satisfaction levels for both participants and the bronchoscopist. Furthermore, a prior study indicated that the MAP in subjects administered ketamine (KPM group) was notably elevated in comparison to those giving fentanyl (FPM cohort) [2]. Additionally, another investigation noted that the occurrence of elevated blood pressure during the bronchoscopy was significantly more frequent among Subjects administered ketamine (KPM and KP) were compared to individuals in the MP group [27].

Regarding the incidence of hypoxia, Fruchter's research indicated no significant difference among the KPM and FPM cohorts [2], while Sazak's investigation found no reduction in SPO2 levels among the KPM, KP, MP, and P cohorts [27]. The current study aligns with these previous findings, demonstrating a similar lack of hypoxia.

Yoon et al. performed a comparative investigating the impacts of propofol administered alone versus in combination with alfentanil during bronchoscopy. Their findings indicated no significant differences in either patient satisfaction or the severity of cough between the two groups [31]. In the study performed by Pazoki et al., the impact of ketamine administered at two distinct dosages (0.3 mg/kg and 0.5 mg/kg) was assessed in comparison to a standard dosage of 0.3 mg/kg of meperidin in female subjects undergoing caesarean sections. The results revealed that there were no statistically notable differences in hemodynamic variables across the three cohorts, although the higher dose of ketamine (0.5 mg/kg) was linked to improved hemodynamic stability [32].

In the current investigation, the prescribing ketamine at a dose of 0.5 mg/kg resulted in favorable hemodynamic stability.

In the study performed by Yazdi et al., the effects of administration of ketamine 0.25 mg/kg along with propofol were examined in subjects undergoing cataract surgery. The findings revealed that, two minutes post-administration, the average heart rate was elevated in the cohort receiving ketamine [33]. Similarly, our investigation indicated that the cohort who received ketamine 0.5 mg/kg exhibited increased heart rates throughout the surgical procedure

Adult patients have been reported to encounter restricted neuropsychiatric side effects such as agitation or excited delirium when administered sub-dose ketamine [34]. Conversely, the inclusion of propofol alongside ketamine has shown a notable impact in diminishing postoperative agitation among pediatric patients [35]. In the current investigation, none of the participants showed any signs of agitation, which aligns with the prior findings [34-35].

Limitations: This research encountered several limitations. Individuals classified as ASA class greater than 2 were not included in the study. The study failed to assess cough and belch variables in patients. The research was confined to a single hospital. Furthermore, the assessment of sedation levels was characterized by a deficiency in objective measurement techniques. These aspects may impact the precision of the results. Hence, it is advisable to take into account the constraints of this study in forthcoming research endeavors.

Conclusion

The application of sedation protocols incorporating ketamine appears to be effective for adult patients undergoing flexible fiberoptic bronchoscopy (FFB). Elevating the sub-dissociative dosage of ketamine from 0.2 mg/kg to 0.5 mg/kg correlates with an enhancement in the Ramsay sedation score, improved satisfaction levels among both patients and pulmonologist, and a reduction in the requirement for propofol. Therefore, a dosage of 0.5 mg/kg may be more advantageous compared to alternative dosages for the sedation of adults during fiberoptic bronchoscopy procedures.

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