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Propofol vs. Ketofol for Endoscopic Retrograde Cholangiopancreatography (ERCP) Bi-Spectral Index (BIS) Guided Sedation: A Randomized Clinical Trial

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Abstract

Objective: Sedation for ERCP with propofol related adverse events (SRAES) includes hypotension, arrhythmia, oxygen desaturation, unplanned intubation and procedure termination. The aim of this study was to evaluate the effect of adding a small synergistic dose of ketamine to propofol (Ketofol) vs. propofol alone.

Methods: 80 adults (ASAI-II) scheduled for elective ERCP categorized into Ketofol (KP) (n=40) and Propofol (P) (n=40) groups. In Propofol (P) group, 1.5 mg/kg over 3-5 min then 50-75 mic/kg/min guided by BIS (≥60). In KP group: 1.5 ml/kg of (Propofol 1%+Ketamine (50 mg)+4 ml normal saline) over 3-5 min then 50-75 mic/kg/min. Nasal airway after sedation. Induction and recovery time, Propofol consumption, haemodynamics, pain assessment, nausea and vomiting were recorded post-operative.

Results: Total dose of propofol consumption was significantly higher in group P compared with group KP (39.63 ± 13.66 vs. 28.23 ± 7.89 mg; P=0.00). Induction time: was (5.12 ± 0.85 vs. 7.15 ± 1.23 min; P=0.00) and recovery time (Guided by BIS): was (6.25 ± 0.90 vs. 9.25 ± 2.17 min; P=0.00) for P and KP group respectively and there were statistically significant prolongation in both times in KP group. Sedation with Propofol only increased the depth of sedation (BIS) during endoscopy compared to Ketofol, p<0.001. No difference between both groups in the incidence of agitation p=0.239, pain p=0.124, nausea and vomiting p=0.230, hypotension p=1, and desaturation p=0.671.

Conclusion: Despite the ability of Ketamine to a reduce propofol consumption a prolongation in induction time and recovery times with Ketofol was noticed. The effect of ketamine on BIS readings need to be further investigated.

Keywords: Propofol; Ketofol; BIS; ERCP

Introduction

Endoscopic Retrograde Cholangio Pancreatography (ERCP) is a lengthy and potentially uncomfortable procedure that needs moderate to deep sedation or even general anesthesia to facilitate high success rate and avoid patient's discomfort [1]. There were many challenges during sedation for ERCP in endoscopy unit as remote location, less familiar area, semi prone position, lengthy procedure and shared airway. It should ensure immobility, sufficient analgesia, avoid coughing or gagging and allow patient comfort to avoid any complication as perforation or peritonitis [2].

Diagnostic ERCP procedures involving bile or pancreatic duct as papillotomy, and dilation of ampulla of Vater need moderate sedation/analgesia but more complicated and lengthy procedure as lithotripsy, stone removal and implantation of the stent need deep sedation and even general anesthesia (GA) [3]. Procedural sedation and analgesia (PSA) during ERCP has the risk of serious sedation-related adverse events, increasing with the depth of sedation induced [4]. Level of consciousness is usually monitored during PSA by clinical observation, which is performed by judging a sedated patient's response to increasing levels of stimulation [5].

A standardized sedation assessment scale that assigns a numerical rank to observable clinical behaviours that are known to be associated with changes in the level of consciousness can be used to supplement clinical observation methods for assessing changes in level of consciousness during PSA. Bispectral index (BIS™ Covidien, Inc., Boulder, CO, USA) processed electroencephalogram-based depth of anesthesia (DoA) monitoring devices provide an alternative method to monitor level of consciousness that can be used in addition to clinical observation [6].

The device calculates a numerical derivative from brain electrical activity. It is calculated from an electroencephalogram measured at the forehead. BIS values range between 0, which represents a state of 'no detectable brain electrical activity', and 100, which represents the 'awake' state [7]. Values below 60 correspond to 'deep' sedation [8]. BIS monitoring during surgery with general anesthesia results in several clinically important benefits such as reduced risk of intra-operative awareness, reduced anesthetic doses and reduced recovery time [9].

Ketamine is an N-Methyl-D-Aspartate (NMDA) receptor antagonist it bind to opioid and sigma receptors. It causes amnesia and analgesia but its use as a single sedative agent has been limited because of its emergence reactions [10]. Propofol is non-opioid, non-barbiturate, popular sedative, hypnotic agent with rapid onset, short duration of

action. It has undesirable side effects as cardiovascular and respiratory depressions which need cardiopulmonary support [11].

The combination of ketamine and propofol (ketofol) with low doses of each appeared with a better hemodynamic and respiratory stability. Ketofol is physically compatible and chemically stable and it can be stored at room temperature and under light [12]. We designed this prospective comparative study primarily to compare propofol and ketofol as a sedative agent regards recovery of the. Secondary aim was to investigate the safety and efficacy of both drugs as regards hemodynamic, respiratory compromise and any psychomimetic effect (Agitation, Irritability etc.); in adult patients undergoing ERCP-BIS guided sedation.

Methods

Patient enrollment was started after ethical approval provided by the Menoufia University National Liver Institute Review Board (IRB). And the study was registered at Pan African Clinical Trial Registry (www.pactr.org) database, PACTR. NO. 201907799024111. Written informed consent. The study was a single-center; Prospective hospital based randomized clinical double-blind trial carried out in the National Liver Institute which is a tertiary, University affiliated hospital. Eighty two adult patients scheduled for ERCP were studied.

Two patients were excluded as a result of occurrence of pneumothorax during the procedure, the remaining was categorized randomly by table created computer software program technique with concealment using sealed opaque envelopes into two equal group to receive either 1st group received intravenous (Propofol sedation regimen) (P group) or 2nd group received Ketofol sedation regimen (KP group). Participants inclusion criteria, Adult patients aged ≥ 18, American Society of Anesthesiologists physical status class I-II, undergoing ERCP for diagnostic causes: Obstructive jaundice due to (Gallstones with dilated bile ducts, indeterminate biliary strictures and suspected bile duct tumors, suspected injury to bile ducts either as a result of trauma or of iatrogenic origin and Sphincter of Oddi dysfunction). Chronic pancreatitis and tumors.

Therapeutic causes: Endoscopic sphincterotomy (of the biliary or the pancreatic duct sphincter), removal of stones or other biliary debris, Insertion of bile duct stent(s) and dilation of strictures (e.g. primary sclerosing cholangitis, anastomotic strictures after liver transplantation). Participants excluded from the study if refused to enroll in the study or patients with severe cardiovascular disease, history of bronchial asthma, drug allergy to propofol or ketamine, history of long term uptake of narcotics, benzodiazepine or any neuropsychiatric medication, Pregnancy, body mass index more than 35. Any contraindication to the ERCP.

All patients were visited prior to endoscopy to be clinically assessed including general, systemic examination, and routine laboratory investigations. A preoperative surveillance includes; complete blood picture, hematocrit level, serum electrolytes, biochemical liver and renal tests, standard coagulation studies as prothrombin time-international normalized ratio (PT-INR). In addition electrocardiography and chest X-ray were ordered when needed.

For both groups, peripheral venous access by 20 G cannula. Intravenous Ringer's lactate drip was started by 8 ml/kg/h and nasal airway used after sedation. All patients in both groups were monitored with three lead ECG, non-invasive blood pressure, pulse oximetry and BIS sensor applied over forehead as the follow. Skin was wiped with alcohol and dried. Sensor positioned diagonally on the forehead, the first electrode placed at the center of forehead, approximately 2 inches (5 cm) above bridge of nose, the third electrode placed directly above eye brow, the second electrode in between, the fourth electrode placed on temple between corner of the eye and hairline. Then the edges of sensor pressed to assure adhesion and electrodes pressed firmly for five seconds then sensor tab inserted into patient interface cable.

Study protocol

Pharmacy department supplied the infusions to the anesthesia department prior to the planned ERCP. Both the anesthesia provider and the assessors were blind to the content of the infusion. Sealed opaque envelopes were only opened by the pharmacist to allocate the patient to his or her group. The 1st (P group) received an intravenous propofol loading dose of 1.5 mg/kg over 5 minute and followed by maintenance of (50-75) ug/kg/minute and 25 μg fentanyl till achieving BIS value between (60-70) and Ramsay sedation score of 5 (patients show sluggish response to light glabellar tap or loud auditory stimulus). The 2nd (KP group) received ketofol which prepared as 1 ml ketamine (50 mg/ml) and 20 ml propofol 1% (10 mg/ml) plus 4 ml normal saline.

The mixture was 25 ml by 1:4 and each ml contained 2 mg for ketamine and 8 mg for propofol. Patients were received the same doses as 1st group and 25 μg fentanyl. Nasal airway used after induction of the sedating protocol. BIS level less than 55 stop the infusion. Both bolus and maintenance doses were given using syringe pump. Basal heart rate HR, mean arterial pressure MAP, oxygen saturation SPO_2 and BIS were recorded by the resident doctor who was not involved in the study. These data were recorded baseline and every five minute till end of procedure.

Complications was noted, recorded and treated accordingly: Oxygen desaturation was considered when SPO_2 less than 92% for more than 10 seconds, apnea was defined as not having a spontaneous breathing for at least 20 s. Both were managed by supporting airway and/or assisting ventilation. Bradycardia was considered when HR was less than 50 beats/min and was managed with atropine. Hypotension was considered when MAP decreased by>20% of the baseline MAP and was managed by fluid bolus or vasopressors. Any cough or gagging, secretions were noted and recorded. The study drug infusion discontinued at the end of the procedure the recovery time and the time to achieve BIS ≥ 90 and Alderte score 9 were calculated the patient then was transferred to the recovery room and kept under observation for six hours after termination of the procedure.

Data collection

Demographic data: Age (year), sex, (BMI) (kg/m^2). Hemodynamic parameters: (HR) beats/minute and (MAP) (mmHg). Induction time (minute): (time from start administration of the drug till achieving BIS 60-70 and RSS 5. Recovery time (minute): (time from stopping administration of the drug till achieving BIS above 90 and modified Alderte 9 [13]. Total dose of anesthetic consumption (mg). Total procedure time (minute). Patient and endoscopist satisfaction (satisfaction score) [14]. Timing of measurement T0: Baseline before induction of sedation. T1-T5 (every 5 minutes interval). T End: End of the procedure.

Sample size and power of the study

A sample size of 36 participants in each group is the enough required sample size to detect an effect size of 0.87 minute is the primary outcome (recovery time (minute), with 95% power and at a significance level of 0.05). Sample size per group was increased to 40 patients per group (total sample size equal 80) to control for attrition bias [15].

Statistical Analysis

Data were collected using SPSS program for statistical analysis [16]. Data were entered as numerical or categorical, as appropriate. Complete descriptive statistics including the minimum and maximum, range, mean, standard deviation, median and inter-quartile range for each variable. Comparisons were carried out between the two studied groups using independent t-test (t-test). Mann-Whitney test was done for quantitative variables which were not normally distributed and p-value<0.05 was considered significant. Chi- square test and fisher exact test were used to measure association between qualitative variables. Box and Whiskers graphs were done. The correlation between variables was undertaken Using Spearman's correlation coefficient.

Results

Eighty two patients were enrolled in the study; two were excluded due to occurrence of pneumothorax due to perforation of duodenal papilla. Patients' characteristics of both groups were comparable. Mean (SD) of age and body mass index (BMI) values and there were no statistically significant differences between both groups, p value>0.05. Male to female ratio 19/21 in P group and 25/15 in KP group and there was no statistically significant differences between both groups, p value>0.05 as shown in Table 1.

The total time of the procedure was comparable; It was (34.03 ± 12.51 vs. 30.90 ± 11.22 minute) in P vs. KP group respectively with no statistically significant different between both groups.

	Mean ± SD		**p value**
Variable	**P group (n=40)**	**KP group (n=40)**	
Age (year)	48.00 ± 12.00	45.00 ± 13.00	0.349 NS
BMI (kg/m²)	26.71 ± 2.44	27.34 ± 2.99	0.282 NS
Sex			
Male	19 (47.50%)	25 (62.50%)	
Female	21 (52.50%)	15 (37.50%)	0.178 NS
ASA			
I	51.56%	43.75%	
II	49.44%	56.25%	0.576 NS
Induction time (min)	5.12 ± 0.85	7.15 ± 1.23	0.000*
Time(min) to achieve			
BIS ≥ 90	6.25 ± 0.90	9.25 ± 2.17	0.000*
Alderte score 9	7.23 ± 0.92	13.95 ± 2.19	0.000*
Total procedure time (min)	34.03 ± 12.51	30.90 ± 11.22	0.157 NS
Total propofol (mg) consumption	396.25 ± 136.62	282.25 ± 78.92	0.000*

Data was presented as mean ± SD; tested by student t-test; or as % tested by X^2 Chi square test; P-value<0.05 statistically significant; P group: Propofol group; KP group: Ketofol group, BMI: Body Mass Index; BIS: Bispectral Index; ASA: American Society of Anesthesiologists Physical Status Class; SD: Standard Deviation; NS: Not Significant; *: Statistically Significant (p<0.05)

Table 1: Patient's characteristics showing procedural data in both groups.

As regards HR and MAP there were no statistically significant differences between both groups at all time of measurement, P>0.05 as shown in Table 2.

Total dose of propofol consumption was significantly higher in group P compared with group KP (39.63 ± 13.66 vs. 28.23 ± 7.89 mg; P=0.00) as shown in Table 1. Induction time: was (5.12 ± 0.85 vs. 7.15 ± 1.23 min; P=0.00), recovery time (Guided by BIS): was (6.25 ± 0.90 vs. 9.25 ± 2.17 min; P=0.00) and time to achieve Alderte 9: was (7.23 ± 0.92 vs. 13.95 ± 2.19 min; P=0.00) for P and KP group respectively and there were statistically significant prolongation in all these times in KP group.

Variable	Mean ± SD		p value
Time	P (n=40)	KP(n=40)	
HR (beats/min)			
T0	80.53 ± 9.64	82.88 ± 10.22	0.123 NS
T1	77.65 ± 10.31	79.05 ± 10.79	0.013 NS
T2	79.93 ± 9.82	81.33 ± 12.10	0.105 NS
T3	82.55 ± 9.37	82.55 ± 9.37	0.108 NS
T4	85.92 ± 10.13	85.68 ± 10.81	0.887 NS
T5	85.37 ± 9.18	85.55 ± 10.10	0.795 NS
T End	84.79 ± 9.74	84.65 ± 10.52	0.891 NS
MAP (mmHg)			
T0	94.45 ± 10.89	93.73 ± 13.81	0.992 NS
T1	81.88 ± 10.49	85.60 ± 14.04	0.466 NS
T2	84.98 ± 10.25	87.35 ± 15.18	0.783 NS
T3	87.10 ± 9.17	86.88 ± 15.11	0.935 NS
T4	88.64 ± 9.80	87.43 ± 11.86	0.582 NS
T5	86.89 ± 9.36	88.88 ± 13.12	0.536 NS
T End	87.13 ± 9.35	88.48 ± 12.45	0.691 NS

Data was presented as mean ± SD; tested by student t-test; P-value<0.05 statistically significant; P group: Propofol Group; KP group: Ketofol group; SD: Standard Deviation; NS: Not Significant; *: Statistically Significant (p<0.05); T0: Before Induction of Sedation; T1- T5: Five Minute Interval after Induction of Sedation and T End: Time at End of Procedure

Table 2: Heart rate (HR) (beats/min) and Mean arterial blood pressure (mmHg) changes between both groups.

There was statistically significant differences between both groups at all time of measurement regards BIS values, P<0.05 as shown in (Figure 1).

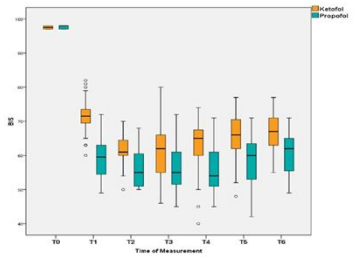

Figure 1: Box and whisker graph of BIS in the studied groups, the thick line in the middle of the box represents the median, the box represents the inter-quartile range (from 25th to 75th percentiles), and the whiskers represent the minimum and maximum after excluding outliers (black-filled circles).

There was a statistically significant negative correlation between BIS and Ramsay sedation score (r=-0.417, p=0.000) (Figure 2).

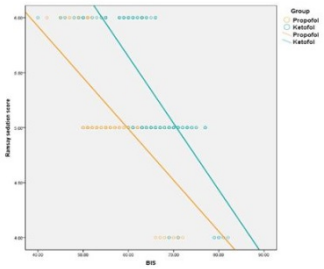

Figure 2: Scatter plot with best fit (regression line) showing significant moderate negative correlation between BIS and Ramsay sedation score in both studied group.

There was statistically non-significant differences between both groups at all time of measurement regards VAS assessment of pain, (2.65 ± 1.23 vs. 2.40 ± 1.22; P=0.123). There were no statistically significant differences between both groups as regard procedure related complication as shown in Table 3.

Variable	P group (n=40) N (%)	KP group (n=40) N (%)	p value
Brady-arrhythmia			
No	40 (100%)	37 (92.5%)	0.239 NS
Yes	0 (0%)	3 (7.5%)	
Desaturation			
No	38 (95%)	36 (90%)	0.239 NS
Yes	2 (5%)	4 (10%)	
Hypotension			
No	38 (95%)	40 (100%)	0.474 NS
Yes	2 (5%)	0 (0%)	
Hypertension			
No	40 (100%)	40 (100%)	1.0 NA
Yes	0 (0%)	0 (0%)	
Need for antispasmodic			
No	38 (95%)	37 (92.5%)	0.474 NS
Yes	2 (5%)	3 (7.5%)	
Vomiting			
No	40 (100%)	37 (92.5%)	0.239 NS
Yes	0 (0%)	3 (7.5%)	
Agitation			
No	40 (100%)	37 (92.5%)	0.239 NS
Yes	0 (0%)	3 (7.5%)	
hyper salivation			
No	38 (95%)	34 (85%)	0.264 NS
Yes	2 (5%)	6 (15%)	

Data was presented atested by X^2 Chi square test; P-value<0.05 statistically significant; P group: Propofol group; KP group: Ketofol group; NA: Non-Applicable

Table 3: Procedural and post procedure complications.

As regard respiratory compromise there was no significant difference between the two groups, only two patients in propofol group exposed to desaturation one of them desaturated due to unintended over sedation as BIS at that time as below 50 and the other patient desaturated due to bolus administration of propofol. The former managed by decreasing propofol infusion, the later managed by jaw thrust. In ketofol group only four patient desaturated two of them had previous history of common cold one week before procedure and managed by increase the depth of sedation, give zylocaine with jaw thrust and support. No cases exposed to apnea in both group.

Three patients (KP gp) experienced bradyarrhythmia (7.5%) all of them were old age and managed with intravenous atropine. Two patients (5%) in P group. developed hypotension and managed with intravenous ephedrine. Two patients (5%) in P group vs. three patients (7.5%) in KP group need for antispasmodic (Buscopan) 7.5%, 2.5% and 7.6% of patients in KP group developed agitation, Cough or Gagging and Vomiting respectively all of them were young age, while 0.0% in P group. According to patient satisfaction score, In P group 82.5% of patients their satisfaction was perfect, 17.5% good and 0% moderate. While in KP group 52.5% of patients were satisfied perfectly, 40% good and 7.5% moderate, With p value=0.008. 100% of endoscopist were satisfied perfectly in P group vs. 92% in KP group

and 0% in P group their satisfaction was good vs. 7.5% in KP group during the procedure with no significant difference between both groups, P=0.239.

Discussion

The main outcome of our study was both ketofol and propofol are safe and maintain hemodynamics in adult patients undergoing ERCP. ketofol had longer induction and recovery time compared with propofol alone. Ketofol is more efficient than propofol as it had the ability to reduce total dose of propofol consumption required to reach the same BIS and Ramsay score. The use of BIS added more safety in sedation outside operating room its use during sedation reduced sedation related adverse effect as there was no cases exposed to apnea or significant hypotension. One third to one half of the patients experienced pain and discomfort during and immediately after ERCP due to inadequate level of sedation, as well as inadequate selection of sedative agent according to patient physical and mental status. So, there was higher failure rate due to premature termination of ERCP because of inadequate sedation [17]. On the other hand, deep sedation has the advantage of saving the extra time required for general anesthesia and offering better procedure conditions in relation to conscious sedation. Moreover, pharyngeal reflexes are kept intact, preserving some protection against aspiration. The major risks in deep sedation constitute unintended general anesthesia and apnea [18].

ERCP procedure requires a high degree of patient cooperation in order to facilitate an intervention requiring precision from the endoscopist. Any movement by the patient could considerably affect the success of the procedure. It may be difficult for moderate sedation itself to fulfill these requirements. Therefore, deep sedation is preferable in ERCP. General anesthesia should be considered in patients difficult to sedate, or having difficulty in ventilation and intubation or in high risk for aspiration. Also, it should be considered in lengthy procedures. Cardiorespiratory events are considered the major complications of sedation in ERCP. Therefore, monitoring is much more demanding and sophisticated in those endoscopic procedures [19]. Pérez-Cuadrado Robles et al., who studied the Safety and risk factors for difficult endoscopies-directed ERCP sedation in daily Practice and concluded that endoscopies-directed deep sedation during ERCP is safe [20]. Motiaa et al., investigated the anesthesia for ERCP target-controlled infusion vs. standard volatile anesthesia and concluded that ERCP is the gold standard in the diagnosis and treatment of biliary and pancreatic disease. Deep sedation without intubation is the most practice anesthetic technique and intubation is recommended in very exceptional cases [21].

Propofol is the most used drug for sedation. For patients undergoing an ERCP requiring general anesthesia with intubation, target-controlled infusion allows shorter extubation time, more respiratory and hemodynamic stability, and better satisfaction of the endoscopic team than standard anesthesia. Ketofol commonly used for several procedures including gastrointestinal endoscopic procedures. The combination of propofol and ketamine reduces the total dose of the sedative drugs and reduces serious adverse effects [22]. The ratio of propofol to ketamine in preparing ketofol infusion is a challenge; in our study we used propofol combined with ketamine 4:1 ratio which was found the ideal with the least side effects. Different concentrations of ketofol were compared by Daabis et al. [23], where they compared the safety and efficacy of different concentrations of ketofol in procedural operations in children and concluded that propofol combined with ketamine (4:1) infusion for procedural operations resulted into adequate sedation and analgesia without hemodynamic and respiratory depression or psychotomimetic side effects and appears to be useful and can be safely used for procedural operations in the ambulatory setting.

Nazemroaya et al., studied the comparison of propofol and (Ketofol) and propofol and fentanyl combination (Fenofol) on quality of sedation and analgesia in the lumpectomy and concluded that. The two combinations of ketofol and fenofol cause rapid, favorable, safe anesthetic with minimal side effects and hemodynamic effects but it may be a superior alternative to fenofol combination, in terms of respiratory depression [24]. Bahrami Gorji et al. investigated sedative and analgesic effects of fenofol vs. ketofol during ERCP and concluded that the sedative effect of ketofol was equal to the fenofol combination during ERCP [25]. Similar to our results were observed by Hasanein R and El-Sayed W; as they compared ketofol vs. fenofol for sedating obese patients undergoing ERCP and concluded that the recovery time and time to discharge from the recovery room in the ketofol group was longer than that of group fenofol. Hangover effect of ketamine may be responsible for this [26].

In our study there was a significant higher total dose of propofol consumed in propofol group in comparison with ketofol group. It has been stated that ketamine in less than dissociative doses does not have anesthetic effects but rather has analgesic effects [27]. And the addition of ketamine to propofol has a synergistic anesthetic effect with propofol, potentiates the sedative activity of propofol, or produces enough analgesia to allow a lower dose of propofol to produce the desired sedation level [28,29]. Our study state of evidence on the benefits to patient safety that may be associated with using BIS monitors instead of clinical observation to monitor level of consciousness during PSA. Reducing the risk of the most common antecedent event (hypoxia from inadequate oxygenation or ventilation) for sedation related death and permanent neurological deficits would be a strong indicator that DoA monitors are likely to improve patient safety during PSA.

In contrast to our study, the study done by Hasanein R and El-Sayed W they reported significant difference between fenofol group and ketofol group with higher incidence of hypotension in fenofol group, keeping in mind that this study conducted in obese patients (BMI>30), lacking CNS monitoring [26].

Our study revealed that there was no significant difference between the two groups regarding respiratory compromise similar to our results Phillips, et al. [30] On the other side Hasanein R and El-Sayed W observed different results when comparing ketofol vs. fenofol for sedating obese patients undergoing ERCP they recorded ten cases (10%) exposed to apnea and seven cases exposed to desaturation (7%) in FP while in KP only two cases exposed to apnea (2%) and no cases of desaturation (0%) but taking in consideration that the study was performed on obese patients with BMI>25, lack of CNS monitoring and administration of a bolus of fentanyl 1.5 g/kg IV in FP group [26]. Our study revealed that sedation with Propofol only increased the depth of sedation (BIS) during endoscopy compared to Ketofol P<0.001.This was also found by Phillips et al. They stated that the higher BIS scores in the ketofol group did not reflect clinically inadequate sedation as judged by both patient satisfaction and physician assessment. And they interpreted this difference as a potential ketofol advantage of providing adequate analgesia and amnesia with less clinical sedation [30].

In our current study there was no significant difference in the incidence of pain, nausea, vomiting, agitation, emergence reaction and hypersalivation in both groups there was also no significant difference in patient and endoscopist satisfaction in both groups. Similar to our result the study done by Amornyotin S and David H, [31,28]. Conversely, the study done by Hasanein R and El-Sayed W, reported higher incidence of emergence agitation and PONV in the ketofol group compared with the fenofol group, this incidence rate is much lower than the usual incidence rate of ketamine alone [26].

Conclusion

In conclusion, our study concluded that ketofol combination is equally effective for procedural sedation compared to propofol alone. CNS monitoring by BIS provided adequate depth of sedation which maintain hemodynamic stability, prevent respiratory depression or apnea, and prevent delayed recovery and challenges of sedation outside operating room in patients undergoing ERCP. There was clinical observed lag between subjective assessment of sedation (Ramsay sedation score) and objective assessment of sedation (BIS) with delay in BIS assessment in comparison with RSS for further studies on large number of population. The correlation between RSS and BIS with ketofol sedation need to be further studied.

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