A COMPARATIVE EVALUATION OF TWO TIVA TECHNIQUES FOR DAY CARE SURGICAL PROCEDURES– MIDAZOLAM AND KETAMINE VERSUS FENTANYL AND PROPOFOL

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ABSTRACT

BACKGROUND

TIVA has gained popularity recently partly in order to reduce pollution by volatile agents. The present study was designed to evaluate the comparison of Total intravenous anaesthesia (TIVA) techniques: Midazolam-Ketamine and Propofol-Fentanyl for their cardiovascular effects, intraoperative and postoperative complications and recovery profile.

MATERIALS AND METHODS

The study was a non-randomised clinical trial. After approval of the hospital ethical committee, hundred patients from either sex ranging from 20-60 years of age, undergoing short surgical procedures less than an hour of ASA grade I and II were included in this study. The patients were randomly allocated into two Groups of 50 patients each. Group A received injection midazolam 0.05 mg/kg IV and injection glycopyrrolate 0.2 mg IV one minute before injection Ketamine 2 mg/kg IV given over 60 seconds. Thereafter ketamine infusion was started at 50 mcg/kg/min. Group B received injection fentanyl 2 mcg/kg IV. and injection glycopyrrolate 0.2 mg IV one minute before the injection propofol 2.5 mg/kg IV given over 60 seconds. Thereafter, propofol infusion was started at 200 mcg/kg/min. The various parameters studied were induction time, pain on injection, heart rate, respiratory rate, SpO₂, recovery time by using Modified Steward Coma Score.

RESULTS

In Group A, there was statistically significant rise in heart rate (HR) and mean arterial pressure (MAP) 15 minutes (T₁₅) after induction whereas in Group B there was non-significant fall in HR 25 minutes after induction (T₂₅) but statistically significant fall in MAP at T₅. Recovery profile was assessed by Modified Steward Coma Score. In Group A, maximum number of patients i.e. 25 patients have score of 6, 15 minutes after stopping ketamine infusion whereas in Group B 30 patients had score of 6, 5 minutes after stopping propofol infusion.

CONCLUSION

Out of two TIVA techniques, Group B is preferred as there was minimal changes in HR MAP and the near baseline values are restored earlier and patient had early recovery with less postoperative complication rate. On analyses based on discharge criterion, both the techniques are suitable for day care surgery.

KEYWORDS

TIVA, Day care surgery, Ketamine, Midazolam, Propofol, Fentanyl.

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BACKGROUND

TIVA (Total intravenous Anaesthesia) technique became practicable in early 1970s with the availability of rapid and short-acting sedative-hypnotics and with the advent of non-barbiturate induction agent propofol. This has refocused the anaesthetist's attention on the complete provision, i.e. induction as well as maintenance of anaesthesia by intravenous route. TIVA has gained popularity recently partly in order to reduce pollution by volatile agents.⁽¹⁾ TIVA technique offers day-care anaesthesia and today many minor

procedures are performed on an outpatient basis. The goal for outpatient anaesthesia is to provide good perioperative anaesthesia with a minimum of postoperative side effects such as drowsiness, pain or nausea.⁽²⁾ It also contributes to lower incidence of infection, respiratory complications and lower procedural cost. Ketamine, a phencyclidine is a dissociative intravenous anaesthetic agent that has many favourable characteristics, including amnesia, analgesia and bronchodilation.⁽³⁾ However, the use of Ketamine as a sole anaesthetic agent is complicated by unpleasant emergence phenomena & its sympathomimetic effect.⁽⁴⁾ The sympathomimetic effect is thought to be due to centrally mediated release of catecholamines. Benzodiazepines have been reported to blunt the sympathomimetic effects and help to prevent emergence phenomena associated with Ketamine.⁽⁴⁾ This is probably related to the central inhibitory and amnesic effects of benzodiazepines.⁽⁵⁾ Midazolam is theoretically preferable to diazepam as its pharmacokinetic profile is similar to that of Ketamine.⁽⁶⁾ Midazolam is a water-soluble benzodiazepine with a rapid onset and relatively

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short duration of action.⁽⁷⁾ Ketamine has also been used as a continuous infusion for routine surgery⁽⁸⁾ and in combination with midazolam and vecuronium for military and civilian surgery.⁽⁹⁾

Although, there is still no gold standard for short outpatient anaesthesia, propofol has been claimed by many to be the best intravenous induction agent because of its good recovery profile.⁽²⁾ Propofol has become the most widely used intravenous anaesthetic for TIVA due to its favourable pharmacokinetic and dynamic profile. It may be given as a single bolus or as a continuous infusion. It has no analgesic effect and is administered therefore in combination with potent analgesic.⁽¹⁾ When combined with an opioid like fentanyl, it can provide balanced anaesthesia.⁽¹⁰⁾ There is no evidence of a pharmacokinetic interaction between propofol and fentanyl and their combination provides excellent clinical conditions.⁽¹¹⁾ Short-acting drugs allow better induction of anaesthesia and may therefore reduce the incidence of respiratory depression and permit rapid recovery which is especially desirable for day care surgery.⁽¹²⁾

There has been renewed interest in TIVA with the arrival of fentanyl and propofol on the Indian scene. Hence, this study was undertaken to evaluate and compare the two combinations i.e. midazolam - ketamine and fentanyl-propofol for TIVA technique in day care surgical procedures. These combinations were compared for their cardiovascular effects, intraoperative and postoperative complications and recovery profile.

MATERIALS AND METHODS

The study was conducted in Department of Anaesthesiology and Critical Care, Mohan Dai Oswal Cancer Treatment and Research Foundation, Ludhiana. It was a non-randomised clinical trial. Since it was a pilot trial, we took the sample size of 50 patients in each group for convenience. After approval of the Hospital Ethical Committee, hundred patients from either sex ranging from 20-60 years of age, undergoing short surgical procedures less than one hour of ASA grade I & II were included in this study. Patients excluded were those with history of allergy to any particular drug or egg allergy or previous adverse response to General Anaesthesia, patients with history of any psychiatric illness, pregnant females, patients on MAO inhibitors, history of jaundice, addiction to any drug particularly narcotics, patients having severe anaemia, hypertension, morbidly obese patients. The patients who met the inclusion criteria were alternately allocated to one of the two groups. All patients were examined in preanaesthetic clinic the day prior to surgery. A written informed consent from the patient was taken in the presence of his/her relatives. All patients were given Tab. Diazepam 10 mg orally a night before surgery. All patients were kept fasting for six hours prior to surgery.

Anaesthesia Technique

After shifting the patient on operation table, intravenous line was established. Basal recordings of systolic, diastolic and mean blood pressures (SBP, DBP, and MAP), heart rate (HR), and arterial saturation of oxygen (SpO₂) on air were noted. These observations were made before induction, one minute after induction, and every 5 minutes till the end of procedure. Patients were kept on spontaneous ventilation, i.e. on room air. During the procedure, SpO₂ was monitored and 100% O₂

was given by face mask if SpO₂ fell below 90%. Hundred patients were randomly allocated into two groups of fifty patients.

Group A

Received injection midazolam 0.05 mg/kg IV and injection glycopyrrolate 0.2 mg IV one minute before injection ketamine 2 mg/kg IV given over 60 seconds. Thereafter, ketamine infusion was started at 50 mcg/kg/minute.

Group B

Received injection fentanyl 2 mcg/kg IV and injection glycopyrrolate 0.2 mg IV one minute before injection propofol 2.5 mg/kg IV given over 60 seconds. Thereafter, propofol infusion was started at 200 mcg/kg/minute. For both groups 20 ml syringe was used for infusion, with Ketamine and Propofol as 1% solution. Syringe pump by Tzamal care SEP-10S was used for infusion.

The following observations were recorded – induction time, pain on injection and recovery time. Induction time was assessed by central fixation of eyeballs in case of ketamine anaesthesia and loss of eyelash reflex in case of propofol anaesthesia. Recovery from anaesthesia was assessed by Modified Steward Coma Score.⁽¹³⁾

Consciousness	Points
Fully awake, eyes open, conversing	4
Light asleep, eyes open intermittently	3
Eyes open on command or in response to name	2
Responding to ear pinching	1
Not responding	0
Airway	
Opening mouth ± coughing on command	3
No voluntary cough but airway clear without support	2
Airway obstruction on neck flexion but clear without Support on extension	1
Airway obstruction without support	0
Activity	
Raising one arm on command	2
Non-purposeful movement	1
Not moving	0
Table 1. Modified Steward Coma Score	

The score was calculated at 1, 3, 5, 10 & 15 minutes from the end of procedure and at discharge from the recovery room. In the post-op period, following vitals (BP, HR, RR and SpO₂) were recorded and any complications/side effects like nausea, vomiting, respiratory depression, emergence reaction were recorded.

Statistical Analysis

The Results were Analysed by using the following Statistical Tests

In order to compare different parameters at different points of time, both intra as well as intergroup, student's t-test was applied. The mean values of different parameters in two groups were also compared by applying the same test. Z-test was applied to compare two proportions of subjects. Chi-square (X²) test was applied to see the association of groups with sex.

RESULTS

A total of 100 patients of either gender scheduled for short day care procedures were prospectively evaluated. The demographic parameters of sex, weight and age in both the groups were comparable. [Table 2].

Demographic Parameter	Group A	Group B
Age (in years)	45.28 ± 11.44	41.12 ± 11.86
Sex (Male/Female)	22/28	17/33
Weight (Kg)	57.34 ± 6.14	55.14 ± 5.67
Duration of surgery (min.)	17.00 ± 6.06	18.20 ± 7.41

Table 2

Duration of surgery (in minutes)	Group A	Group B
10	14(28)	14(28)
15	13(26)	13(26)
20	16(32)	8(16)
25	4(8)	2(4)
30	2(4)	10(20)
35	1(2)	3(6)
Mean ± SD	17.00 ± 6.06	18.20 ± 7.41

Table 3. Distribution of Duration of Surgery

Figures in parenthesis indicate percentage t- value = 0.89
p- value > 0.05(non-significant)

Pain on Injection

In Group A, no patient had pain on injection as compared to Group B, in which 15 patients had pain on injection with statistically significant difference between the two groups. (p-value < 0.01). (Table 4) (Fig. 2).

Pain on Injection	Group A	Group B
Yes	0(0)	15(30)
No	50(100)	35(70)

Table 4. Distribution of Patients having Pain on Injection

Figures in parenthesis indicate percentage; z- value = 3.33, p- value < 0.01 (significant).

Fig 2 Distribution of subjects according to the pain on injection

The range of induction time in Group A was 18-24 seconds and in Group B, it was 36-42 seconds. The mean induction time in Group A was 21.30 ± 1.62 and in Group B was 38.52 ± 2.01 with significant statistical difference between the two groups (p < 0.01). (Table 5).

Induction time (in seconds)	Group A	Group B
Mean ± SD	21.30 ± 1.62	38.52 ± 2.01

Table 5. Distribution of Induction Time

t- value = 47.17, p- value < 0.01 (significant).

The observations of heart rate (HR), mean arterial blood pressure (MAP), arterial oxygen saturation (SpO₂) and respiratory rate (RR) were recorded at various points of time. In Group A, basal readings (T₀) were recorded prior to induction of anaesthesia, (T₁) one minute after induction of anaesthesia and then five minutes after induction of anaesthesia till the completion of procedure i.e. (T₅, T₁₀, T₁₅,.....). Similarly in Group B, readings were recorded at T₀', T₁', T₅', T₁₀', T₁₅',..... till the end of surgery.

The mean of basal value of heart rate (T₀) was 85.16 ± 8.23 beats per minute in Group A and T₀' was 85.32 ± 8.29 beats per minute in Group B with no statistically significant difference between them (p-value > 0.05). In group A, the maximum increase (35.5%) in heart rate was at T₁₅ from the basal heart rate at T₀ with statistically significant difference between them (T₀ and T₁₅) (p-value < 0.01). In Group B, the maximum fall of (-2.91%) was at T₂₅' from the basal heart rate at T₀' with statistically non-significant difference between them (T₀' and T₂₅') (p-value 0.05). (Table 6, Fig. 3).

Time Intervals (in minutes)	Group A	Group B
T ₀ /T ₀ '	85.16 ± 8.23 (50)	85.32 ± 8.29(50)
T ₁ /T ₁ '	95.84 ± 9.29(50)	87.52 ± 9.09(50)
T ₅ /T ₅ '	106.54 ± 8.48(50)	86.88 ± 7.75(50)
T ₁₀ /T ₁₀ '	112.28 ± 7.47(50)	85.68 ± 7.72(50)
T ₁₅ /T ₁₅ '	115.39 ± 7.63(36)	86.22 ± 8.46(36)
T ₂₀ /T ₂₀ '	113.55 ± 8.13(22)	86.24 ± 8.05(25)
T ₂₅ /T ₂₅ '	109.71 ± 11.14(7)	82.83 ± 6.87(12)
T ₃₀ /T ₃₀ '	100.00 ± 11.55(3)	85.60 ± 5.77(5)
T ₃₅ /T ₃₅ '	114.00 ± (1)	80.00 ± 6.00(2)

Table 6. Trends in Heart Rate

Figures in parenthesis indicate number of patients in the group.

The mean of basal value of Mean Arterial Pressure at T_0 in Group A was 95.59 ± 8.21 mmHg and in Group B at T_0' was 98.03 ± 8.56 mmHg with statistically non-significant difference between them (p -value >0.05).

In Group A, there was a rise in MAP (24.9%) at T_{15} with mean value of 119.38 ± 7.24 mmHg from the basal value of 95.59 ± 8.21 mmHg at T_0 with statistically significant difference between the two values. (T_0 and T_{15}) (p -value < 0.01).

In Group B, there was a fall in MAP (-12.03%) at T_5' with mean value of 86.24 ± 7.38 mmHg from the basal value of 98.03 ± 8.56 mmHg at T_0' with statistically significant difference between the two values. (T_0' and T_5') (p -value < 0.01). (Table 7, Fig. 4)

Time Intervals (in minutes)	Group A	Group B
T_0/T_0'	95.59 ± 8.21 (50)	98.03 ± 8.56 (50)
T_1/T_1'	103.27 ± 8.45 (50)	96.43 ± 8.06 (50)
T_5/T_5'	111.20 ± 7.57 (50)	86.24 ± 7.38 (50)
T_{10}/T_{10}'	116.03 ± 6.57 (50)	91.90 ± 6.88 (50)
T_{15}/T_{15}'	119.38 ± 7.24 (36)	92.97 ± 6.84 (36)
T_{20}/T_{20}'	119.39 ± 6.41 (22)	94.50 ± 6.61 (25)
T_{25}/T_{25}'	112.00 ± 6.71 (7)	94.37 ± 6.67 (12)
T_{30}/T_{30}'	105.78 ± 7.17 (3)	97.17 ± 7.59 (5)
T_{35}/T_{35}'	$97.34 \pm (1)$	96.23 ± 8.51 (2)

Figures in parenthesis indicate number of patients in the group.

The mean of basal value of Respiratory Rate at T_0 in Group A was 15.00 ± 2.03 breaths per minute and in Group B at T_0' was 16.02 ± 3.44 breaths per minutes with statistically non-significant difference between them (p -value >0.05). In Group A, there was a rise in RR (11.47%) at T_{10} with the mean value of 16.72 ± 2.05 breaths per minute from the basal

value of 15.00 ± 2.03 breaths per minute at T_0 with statistically significant difference between the two values (T_0 and T_{10}) (p -value <0.01). In Group B, there was a fall in RR (-30.83%) at T_5' with the mean value of 11.08 ± 2.16 breaths per minute from the basal value of 16.02 ± 3.44 breaths per minute at T_0' with statistically significant difference between the two values (T_0' and T_5') (p -value < 0.01) (Table 8 Fig. 5).

Time Intervals (in minutes)	Group A	Group B
T_0/T_0'	15.00 ± 2.03 (50)	16.02 ± 3.44 (50)
T_1/T_1'	15.60 ± 2.06 (50)	15.08 ± 2.07 (50)
T_5/T_5'	15.88 ± 2.37 (50)	11.08 ± 2.16 (50)
T_{10}/T_{10}'	16.72 ± 2.05 (50)	13.36 ± 2.23 (50)
T_{15}/T_{15}'	16.33 ± 1.87 (36)	14.33 ± 2.26 (36)
T_{20}/T_{20}'	15.57 ± 1.78 (22)	14.52 ± 2.32 (25)
T_{25}/T_{25}'	15.50 ± 1.34 (7)	14.50 ± 2.35 (12)
T_{30}/T_{30}'	16.67 ± 2.52 (3)	14.67 ± 2.52 (5)
T_{35}/T_{35}'	$18.00 \pm (1)$	16.67 ± 2.52 (2)

Table 8. Trends in Respiratory Rate

Figures in parenthesis indicate number of patients in the Group.

The mean of basal value of SpO_2 at T_0 in Group A was $97.52 \pm 1.79\%$ and in Group B, was $97.16 \pm 1.90\%$ at T_0' with statistically non-significant difference between them (T_0 and T_0') (p -value >0.05). In Group A, there was fall in SpO_2 (-2.67%) at T_{10} and in Group B, there was fall in SpO_2 at T_5' (-6.83%) with statistically significant difference (p -value <0.01) from the basal SpO_2 within both the groups i.e. between T_0 and T_{10} and T_{10} in Group A and T_0' and T_5' in Group B. (Table 9).

Time Intervals (in minutes)	Group A	Group B
T_0/T_0'	97.52 ± 1.79 (50)	97.16 ± 1.90 (50)
T_1/T_1'	96.24 ± 1.44 (50)	95.88 ± 1.87 (50)
T_5/T_5'	95.00 ± 2.56 (50)	90.52 ± 3.35 (50)
T_{10}/T_{10}'	94.92 ± 2.36 (50)	92.68 ± 1.65 (50)
T_{15}/T_{15}'	95.47 ± 1.95 (36)	94.11 ± 2.13 (36)
T_{20}/T_{20}'	95.65 ± 1.54 (22)	94.22 ± 2.01 (25)
T_{25}/T_{25}'	95.25 ± 1.41 (7)	94.60 ± 2.56 (12)
T_{30}/T_{30}'	94.00 ± 1.65 (3)	96.00 ± 2.86 (5)
T_{35}/T_{35}'	$94.00 \pm (1)$	94.00 ± 0.00 (2)

Table 9. Trends in SpO_2

Figures in parenthesis indicate number of patients in the group.

In Intraoperative period, the incidence of respiratory depression in both the groups were studied. In Group A, 5 patients had respiratory depression and in Group B, 16 patients had respiratory depression with a statistical significant difference between the two groups. (p-value < 0.01) (Table 10, Fig. 6).

Incidence of Respiratory Depression	Group A	Group B
Yes	5 (10)	16 (32)
No	45 (90)	34 (68)

Table 10. Incidence of Intraoperative Complications

Figures in parenthesis indicate percentage, z-value= 2.70, p-value< 0.01 (significant).

In postoperative period, the incidence of emergence delirium, nausea and vomiting in both the groups were studied. In Group A, 8 patients had emergence delirium and 16 patients had nausea and vomiting. In Group B, no patient had emergence delirium and 5 patients had nausea and vomiting with a statistical significant difference between the two groups (p-value< 0.01) (Table 11).

Group	Emergence Delirium (Number of Patients)	Nausea and Vomiting (Number of Patients)
A	8(16)	16(32)
B	0(-)	5(10)
Z-value	2.95	2.70
p-value	<0.01 (significant)	<0.01 (significant)

Table 11. Incidence of Postoperative Complications

Figures in parenthesis indicate percentage.

Variations in Recovery Profile of Patients Acquiring Modified Steward Coma Score of Six

In Group A and Group B, recovery of patients was assessed at (ST₁/ST₁'), (ST₃/ST₃'), (ST₅/ST₅'), (ST₁₀/ST₁₀'), (ST₁₅/ST₁₅') i.e. at 1, 3, 5, 10, 15 minutes after stoppage of infusion of both the respective drugs. The numbers of patients having score of six at a particular time were studied. In Group A, the mean of patients having score of six was 11.42 ± 4.10 minutes and in Group B, it was 5.50 ± 3.14 with statistically significant difference between the two groups. (p-value <0.01) (Table 12, Fig. 7).

Time Interval (in minutes)	Group A	Group B
ST ₁ /ST ₁ '	0 (-)	5 (10)
ST ₃ /ST ₃ '	2 (4)	5 (10)
ST ₅ /ST ₅ '	8 (16)	30 (60)
ST ₁₀ /ST ₁₀ '	15 (30)	8 (16)
ST ₁₅ /ST ₁₅ '	25 (50)	2 (4)
Mean ± SD	11.42 ± 4.10	5.50 ± 3.14

Table 12. Distribution of Patients having Score of Six

Figures in parenthesis indicate percentage, t-value = 8.11, p-value < 0.01 (significant).

DISCUSSION

Total intravenous anaesthesia offers day-care anaesthesia and the availability of rapid, shorter acting anaesthetic, analgesic drugs have facilitated the recovery process, allowing more extensive procedures to be performed on a wide variety of outpatients.⁽¹⁴⁾ The drugs used in the present study i.e. midazolam, fentanyl, ketamine, propofol also fulfil the conditions applicable to be used for day care surgery, hence providing greater flexibility in scheduling operation, low morbidity and mortality, lower incidence of infection and respiratory complications, shorter surgical lists, lower overall procedural costs, less preoperative testing and postoperative medication.

The combination of ketamine with shorter acting, water soluble, less irritant benzodiazepine-midazolam was evaluated in our study as it eliminates emergence delirium which was demonstrated by Cartwright and Pingle.⁽⁵⁾ Similarly, Langrehr D et al and White PF found that benzodiazepines also cause muscle relaxation, anxiolysis, central sedation and attenuates cardiostimulatory response of ketamine.^{(15),(16)} In the other combination, short opioid fentanyl was combined to provide analgesia since propofol lacks analgesic effect.

In our study, in Group A no patient had pain on injection because of non-irritant effect of midazolam and ketamine. In Group B, 15 (30%) patients had pain on injection propofol which was comparable to study by Klement W., Arndt J.O. which showed 30% to 90% incidence of pain on injection of propofol.⁽¹⁷⁾ The incidence of pain on injection can be decreased by injection into large veins as was demonstrated by Irwin MG et al.⁽¹³⁾

In Group A, the induction time was 18-24 seconds {ketamine has onset of action within 30 seconds and peak effect in 1 minute (Ronald D Miller)}. The induction time was

assessed by central fixation of eyeballs after injection ketamine. In Group B, the induction time was 36-42 seconds (The peak effect of propofol is attained at 90-100 seconds as demonstrated by Rolly G, Verseichellen L et al⁽¹⁸⁾).

In our study, the maximum increase in heart rate in Group A was 35.5% after 15 minutes from the baseline value. A similar study by Chudnofsky et al showed the increase in heart rate by 25%. The higher heart rate in our group is probably due to the additive effect of glycopyrrolate as in their group premedication with glycopyrrolate was not used. In our study in Group A, the maximum rise in MAP (24.9%) from the baseline value was after 15 minutes which was comparable to MAP changes shown by Chudnofsky CR et al.⁽¹⁹⁾

In the present study, ketamine did result in a transient increase in MAP and heart rate. However, this was well tolerated as no patient required treatment for hypertension or experienced any cardiovascular or central nervous system sequelae. Ketamine inhibits the reuptake of catecholamines, resulting in mild-to-moderate increases in blood pressure, heart rate and cardiac output which were shown by Reich DL et al and white PF et al.⁽³⁾ ⁽²⁰⁾ Hernandez et al compared three TIVA techniques and found significant higher number of hypertensive peaks in midazolam-ketamine group.⁽²¹⁾ Similar results have been shown by Krithika et al.⁽²²⁾ Fortunately, stimulation of the cardiovascular system may be blunted with concurrent administration of a benzodiazepine was also shown by Reich DL et al in 1989.⁽³⁾

In our study, in Group B, there was statistically non-significant fall in heart rate (-2.91%) from the baseline value which is comparable to study done by Jenstrup M et al⁽¹⁾ which also showed only slight change in heart rate in fentanyl-propofol anaesthesia. In Group B, there was significant reduction in mean arterial pressure (-12.03%) from the baseline value, 5 minutes after induction of anaesthesia which is comparable to the fall in mean arterial pressure as demonstrated by Jenstrup M et al and by Vermeyen MM et al.^{(1).} ⁽²³⁾ This fall in mean arterial pressure is due to the combined hypotensive effect of both mean blood propofol concentration being at or slightly above the target value within 5 minutes of commencing the infusion. Similarly, in our study, the maximum hypotensive effect was produced after 5 minutes.

In our study, the maximum increase in respiratory rate (11.47%) in Group A, from baseline value was after 10 minutes of induction of anaesthesia. There was fall in SpO₂ (-2.67%) from baseline value, 10 minutes after induction of anaesthesia.

In Group B, there was maximum decrease in respiratory rate (-30.83%) from the baseline value, 5 minutes after the induction. The minimum breaths per minute which the patients had were 9 and the respiratory rate did not recover to baseline, even after 25 minutes. This fall in respiratory rate is due to the combined apnoeic effect of fentanyl and propofol as shown by Gill SS et al.⁽²⁴⁾ There was accompanied fall in SpO₂ (-6.83%) to lowest value of 84%.

The postoperative recordings of haemodynamic and respiratory variables were not comparable because of variable duration of procedures, so they were not considered in the study.

In both the groups, the incidence of respiratory depression was studied as the major intraoperative

complication. Respiratory depression was considered if there was fall in SpO₂ below 90% and patient required oxygen supplementation.

In Group A, 5 (10%) patients had respiratory depression with a maximum fall in SpO₂ of 88% which recovered soon after oxygenating the patients with 100% oxygen. Out of these, 2 patients had history of chronic bronchitis. The rest 3 patients were obese. The study by Chudnofsky et al showed respiratory depression incidence of 4%.⁽¹⁹⁾

In Group B, 16 (32%) patients had respiratory depression with fall of SpO₂ below 90%, who were supplemented with 100% oxygen. In these patients, oxygen supplementation was continued till the end of procedure. The Maximum fall in SpO₂ was up to 84% which improved, but did not recover to baseline value till the end of procedure. The high incidence in respiratory depression with fentanyl & propofol group was due to combined apnoeic effect of both, as commented by Sanderson JH and Taylor MB in their study.⁽²⁵⁾ ⁽²⁶⁾

In both the groups, the incidence of emergence delirium and nausea and vomiting was noted in postoperative period. In Group A, 8 (16%) patients had emergence delirium in postoperative period as compared to Group B in which no patient had emergence delirium. In Chudnofsky et al study, 7% of patients had emergence delirium.⁽¹⁹⁾ The variation in incidence could be explained, as the dose of midazolam we have used (0.05 mg/kg) is less than the dose of midazolam (0.07 mg/kg) they have used.

The incidence of vomiting in Group A was 32% and in Group B was 10%, i.e. in Group A, 16 patients and in Group B, 5 patients had vomiting. The incidence of vomiting associated with the use of ketamine is approximately 8% as studied by Green SM et al in paediatric age group.⁽²⁷⁾ The higher incidence in our study could be because of maintenance infusion of ketamine in surgeries lasting maximum for thirty five minutes.

In Group B, the incidence of vomiting (10%) was less compared to Jenstrup M et al study in which the incidence was 20%, this could be because they had used fentanyl infusion throughout the procedure thus increasing the incidence of vomiting.⁽¹⁾ Akbult et al in their study concluded that in upper gastrointestinal endoscopic procedures midazolam-ketamine combination was comfortable as compared to propofol-fentanyl combination but propofol-fentanyl combination had fewer side effects.⁽²⁸⁾

In both the Groups, recovery of patients was assessed by modified Steward Coma Score, maximum of six. It was seen that points comprising recovery in consciousness level were less in Group A as compared with Group B, than the points comprising the recovery in airway and activity.

In Group A, maximum number of patients i.e. 25 patients had score of six, 15 minutes after stopping ketamine infusion whereas in Group B, 30 patients had score of six, 5 minutes after stopping propofol infusion, similar results were shown by Akbult et al that recovery time was less in propofol-fentanyl combination.⁽²⁸⁾

Similar to Irwin MG et al study, it was observed that the patients were calm and quiet at the score of six in Group B.⁽¹³⁾ In Group A, 46 patients were fit for discharge within two hours of completion of procedure and out of the 4 patients who were not discharged, 3 patients had severe emergence delirium so they were given sedation by injection diazepam and so could not be sent home. One patient had excessive

vomiting so was not discharged. In Group B, all patients were fit for discharge except one who had excessive vomiting. At the time of discharge, in both groups, patients were asked about intraoperative awareness. No patient in either group had intraoperative awareness. They were asked whether or not they would be happy to receive the same anaesthetic combinations again. All patients in both the groups were satisfied by the two techniques irrespective of the complications.

CONCLUSION

Hence, it can be concluded that on comparison of two TIVA techniques, Group B combination is preferred as there are distinct advantages of minimal changes in HR, MAP and the near baseline values are also restored earlier with early recovery, less postoperative complication rate. However, Group B combination possesses the disadvantages of having greater induction time, pain on injection and incidence of intraoperative respiratory depression which is not there in Group A. However, on analysis based on the discharge criterion, it can be concluded that both the techniques are suitable for day care surgery.

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