International Journal of Research in Medical Sciences
Okonkwo UN et al. Int J Res Med Sci. 2022 Jun;10(6):1211-1218
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20221474

Original Research Article

A comparison of ketamine with pentazocine for analgesia in propofol based total intravenous anaesthesia for short surgical procedures

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Received: 02 April 2022
Revised: 05 May 2022
Accepted: 12 May 2022

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ABSTRACT

Background: Total intravenous anaesthesia is advantageous in that it avoids the use of volatile anaesthetic agents associated with a high cost of its delivery devices and operating theatre pollution. The ideal drugs for TIVA are not readily available in our environment, therefore suitable alternatives need to be studied. Objectives of current study was to compare the analgesic effects using a change of ≥20% in the patient haemodynamics and side effects of ketamine and pentazocine in propofol-based TIVA for patients who underwent surgical procedures less than 60 minutes.
Methods: ASA 1 or 2 patients scheduled to have short surgical procedures were randomly allocated into two groups: PK and PP of 64 patients each. After the induction of anaesthesia, the patients received propofol infusion for maintenance of anaesthesia. Group PK, in addition, received a ketamine bolus of 0.5 mg/kg and group PP 0.7 mg/kg of pentazocine. Heart rate and blood pressure were monitored and recorded intraoperatively. The occurrence of respiratory depression, emergence reactions, PONV, were also recorded.
Results: The differences in the incidence of a ≥20% rise in both the heart rate and the systolic blood pressure were not statistically significant in the two groups ($p>0.05$). For the diastolic blood pressure (DBP), no significant change was observed in group PK ($p>0.05$). In group PP, there was a statistically significant increase from induction until the 15th minute ($p=0.006, 0.01, 0.01, 0.009$).
Conclusions: This study showed that the sub hypnotic dose of ketamine had the same analgesic efficacy as pentazocine in propofol based TIVA. It, however, ensured better stability in haemodynamics.

Keywords: Total intravenous anaesthesia, Intraoperative analgesia, Ketamine, Propofol

INTRODUCTION

Total intravenous anaesthesia is a technique of anaesthesia in which induction and maintenance of anaesthesia are achieved by a combination of drugs administered exclusively by the intravenous route.[1] Effective TIVA achieves general anaesthesia without the use of inhalational anaesthetics.[2] Any combination of intravenous (IV) hypnotics and opioids can be used for TIVA. Opioid-free TIVA techniques are also described. However, in ideal TIVA, equilibrium is achieved between adequate depth of anaesthesia and rapid recovery.[3]

In low and middle-income countries like ours, opioids are not readily available due to strict government restrictions and so, good surgical pain control is still lacking.[2] Therefore, the analgesics readily available should be

employed in doses and combinations to produce an analgesic profile close to the ideal. This study therefore, compared the use of ketamine with pentazocine as regards their efficacy for analgesia and their side effects. These drugs were not only available in our environment, but were also cheap.

METHODS

Written informed consent was obtained from the participants. The recruited participants were clinically assessed and fitness for the study verified. All of the participants received IV glycopyrrolate 4 µg/kg (Glyco-P by Khandelwal Laboratories D17213) and IV midazolam 0.05 mg/kg (by Hameln 0866817A) as premedication within 30 minutes before the commencement of anaesthesia. On the patient's arrival to the operating theatre, the baseline pulse rate, SpO_2, blood pressure and temperature were determined from a multi-parameter monitor (Mindray BeneView T5). ECG leads were also placed. The respiratory rate was obtained from the monitor or counted over 1 minute. Two wide bore intravenous cannulae (16G or 18G) were inserted; one for the administration of fluids and the other for the propofol infusion.

Randomisation was done and the patients allocated to either of the groups. Group PK received propofol 2 mg/kg and a single dose of ketamine 0.5 mg/kg IV at the induction of anesthesia, while group PP received propofol 2 mg/kg and pentazocine (Forwin Batch: 5143451) 0.7 mg/kg. The propofol infusion was prepared by withdrawing 240 ml from a 500 ml normal saline infusion bag using a 20 ml syringe and adding 60 ml propofol (Lipuro by B. Braun 1% concentration) to achieve 2 mg/ml mixture (300 ml volume).[6] This was given according to Roberts infusion scheme thus; a loading dose, followed by an infusion of 10 mg/kg/hour for 10 minutes, 8 mg/kg/hour for the next 10 minutes and 6 mg/kg/hour after that the total dose of the study drugs calculated was made up to 10 ml volume in a 10 ml syringe using sterile water for injection. This was to ensure a uniform volume to improve blinding. General anaesthesia was then induced with propofol 2 mg/kg and then either ketamine 0.5 mg/kg or pentazocine 0.7 mg/kg was given. The propofol infusion was commenced immediately after induction and set to the calculated flow rate. The patients were all on spontaneous respiration with 100% oxygen administered via a Bain circuit and facemask. This was to allow for intermittent positive pressure ventilation when assisted respiration was needed. The principal researcher who was blinded to the drugs that the patients received monitored and recorded the heart rate, blood pressure and SPO_2 before induction, immediately after induction, then at 5 minutes interval till the end of the anaesthesia. Patients were continuously observed for a vocal response, facial grimace, arm withdrawal, movement or lacrimation suggestive of awareness. If any two of these signs occurred, a supplemental bolus of propofol 10 mg was given. If the signs persisted for more than three minutes after the bolus was given, the rate of the propofol infusion was increased from 6 mg/kg/hr to 8 mg/kg/hr for another ten minutes. Half of the induction dose of analgesic was repeated from a coded syringe (to ensure blinding from the principal investigator) if the criteria for light anaesthesia (vocal response, facial grimace, arm withdrawal or lacrimation) persisted and the patient excluded from the study.[5]

The occurrence of hypotension, hypertension, changes in ECG and other complications during the procedure was noted, and appropriate corrective measures were taken. Apnoea was defined as the absence of spontaneous breathing attempts for greater than or equal to 20 seconds.[6] Hypoventilation was defined as a respiratory rate <8 c/min.[6] Desaturation was defined as SpO_2 <93%.[6] Apnoea, hypoventilation and desaturation were treated with intermittent positive pressure ventilation using a Bain circuit and facemask. A drop in the blood pressure of >20% of baseline was regarded as hypotension and was corrected with a fluid bolus (3.5 ml/kg) or a vasopressor (I.V. ephedrine 3 mg). A rise in the blood pressure of more than 20% of baseline was regarded as hypertension and was corrected with a 10 mg propofol bolus. Intravenous fluid maintenance was given at the rate of 1.5 ml/kg/hr while the ongoing, insensible losses and blood loss were corrected according to the recommended standard. The continuous infusion of propofol was stopped at the end of surgery. Surgery was said to have ended after all incisions, or procedural access routes had been closed. The time from the end of the infusion to spontaneous eye-opening (time to awakening) was noted. In the recovery room, all patients received oxygen-enriched air by simple face mask; and oxygen saturation (SpO_2), respiratory rate, blood pressure, heart rate, response to command, and temperature were monitored. The occurrence of postoperative nausea and vomiting was noted and documented. Nausea and vomiting were assessed using the scale; 0=no nausea or vomiting; 1=nausea but no vomiting; 2=vomiting once; 3=two or more episodes of vomiting. Ondansetron 4 mg was given by slow IV injection if nausea or vomiting occurred. To assess the level of confusion, thirty minutes from the time of discontinuing the propofol infusion, the following questions were asked: What is your name? Where do you live? What is today's date? What time of the day is it (morning, afternoon or night)? Are you having pains? The patients were discharged to the ward after 45 minutes in the recovery room.

Data collection and analysis

The statistical package for social sciences (SPSS) version 23 software was used for data entry and analysis. Results were presented in the form of tables and figures and expressed as frequencies, percentages as well as mean and standard deviation. The statistical association was estimated using Chi square for categorical variables and student t-test for quantitative variables. A p value of less than 0.05 was considered significant.

RESULTS

A total of 128 patients were recruited into the study, and they completed the study.

Patient's characteristics

The socio-demographic data and the ASA classification is depicted in (Table 1).

Table 1: Socio-demographics and ASA classification.

Socio-demographic		Treatment group				Test	P value
		PK		PP			
		Mean±SD	N (%)	Mean±SD	N (%)		
Age (years)		34.8±10.4		30.9±13.7		T test 0.789	0.439
Gender	Female		25 (39.1)		22 (34.4)	χ^2=3.15	0.801
	Male		39 (60.9)		42 (65.6)		
Height (meters)		1.7±0.1		1.6±1.2		T test 1.840	0.084
Weight (kg)		79.5±8.7		67.4±16.0		T test 2.314	0.030
BMI (kg/m^2)	<18.5		4 (6.3)		7 (10.9)	FT	0.193
	18.5-24.9		21 (32.8)		25 (39.1)		
	25.0-29.9		39 (60.9)		32 (50.0)		
ASA	One		46 (71.9)		44 (68.8)	χ^2=0.150	0.699
	Two		18 (28.1)		20 (31.2)		

Table 2: Mean intraoperative systolic blood pressure changes from the baseline and across the measurement intervals in each group.

Interval (minutes)	PK			PP		
	Mean difference	T test	P value	Mean difference	T test	P value
Induction	0.1	0.994	0.342	10.7	7.115	0.000
5	0.6	0.432	0.674	10.7	5.204	0.000
10	3.7	1.498	0.162	8.7	3.928	0.002
15	2.1	1.198	0.256	7.0	3.808	0.003
20	0.8	0.450	0.661	5.5	2.411	0.035
25	2.5	2.939	0.015	7.2	3.040	0.011
30	-0.4	-2.335	0.048	1.9	2.606	0.026
35	-0.4	-0.686	0.512	2.2	0.660	0.531
40	0.5	0.441	0.673	2.5	0.845	0.460
45	-0.4	-0.307	0.771	2.0	0.594	0.594
50	0.75	0.635	0.571			

The groups were comparable in age, sex distribution and height. The weight of the studied groups showed a statistically significant difference (p=0.03) but no difference in the body mass index (BMI, p=0.193). Both groups were similar in the gender distribution (p=0.801). They were also comparable with regard to ASA classification, p=0.699. There were 18 different surgical procedures that the patients underwent. There was a preponderance of excision biopsies for fibroadenoma and other conditions like lipoma

Intraoperative haemodynamics

The proportion of patients with increases in heart rate greater than or equal to 20% was more in the pentazocine group than the ketamine group. This was observed at eight intervals; at the 5th minute: 35.9% vs. 29.7%, 10th minute; 28.1% vs. 17.2%, 15th minute 20.3% vs. 9.4%, 20th minute 10.9 vs. 6.2%, 30th minute 6.2% vs. 3.3%,

35th minute 9.8% vs. 5.4%, 40th minute 18.2% vs. 10.3% and the 45th minute 16.7% vs. 8.7%. Higher proportions of increase were observed only at two intervals in the ketamine group (at induction and the 25th minute). The difference in these proportions was not statistically significant (p>0.05).

A comparison of the systolic blood pressure changes from baseline values in the study groups is shown in (Table 2). There was a statistically significant increase in the systolic blood pressure of subjects in group PK at the 25th minute, p=0.015 followed by a significant drop in the 30th minute, p=0.048. Unlike group PK, group PP had a statistically significant increase in systolic blood pressure from induction till 30 minutes of surgery. The

margin of change in both groups was wider in group PP; absolute minimal values of 1.9 and a maximum value of 10.7 mmHg in contrast to -0.4 to 3.7 mmHg in group PK.

The incidence of a ≥20% increase in systolic blood pressure was more in the pentazocine group. In the time intervals of surgery, the increase was more at eight time intervals against two time intervals where it was higher in the ketamine group thus; from induction to the 35th minute, 18.7% vs. 9.4%, 25.0% vs. 14.1%, 18.7 vs 9.4%, 15.6% vs. 7.8%, 21.9% vs. 10.9%, 17.2% vs. 9.4%, 6.5% vs. 5.0%, 5.9% vs. 5.4% respectively. Similar to the heart rate changes, the difference in the occurrence of this increase, did not differ significantly (p>0.05).

Table 3: Mean intraoperative diastolic blood pressure changes from the baseline and across the measurement intervals in each group.

Interval (minutes)	PK			PP		
	Mean difference	T test	P value	Mean difference	T test	P value
Induction	1.3	1.146	0.276	8.0	3.365	0.006
5	1.7	1.214	0.250	8.0	3.091	0.010
10	0.2	0.062	0.951	8.0	3.095	0.010
15	-2.8	-1.425	0.182	9.0	3.141	0.009
20	0.0	0.000	1.000	6.5	2.050	0.065
25	0.5	0.276	0.788	7.5	2.139	0.056
30	1.7	0.731	0.485	5.3	1.705	0.119
35	0.7	0.266	0.797	2.9	0.752	0.477
40	-0.4	-0.136	0.896	-0.5	-0.480	0.664
45	1.3	0.520	0.625	3.3	1.525	0.267
50	-0.5	-0.157	0.885			

The changes in mean diastolic blood pressure in the groups (Table 3). In group PP, there was a statistically significant increase from the baseline values from induction till the 15th minute. After the 15th minute, an increase was seen in other intervals in group PP except for the 40th minute. These other changes were, however, not statistically significant. In group PK, there were periods of a rise and fall in the diastolic blood pressure. These changes were not statistically significant. Again, the margin of difference was more in group PP than group PK (widest margin -0.5 and 9.0 mmHg against -2.8 and 1.7 mmHg respectively).

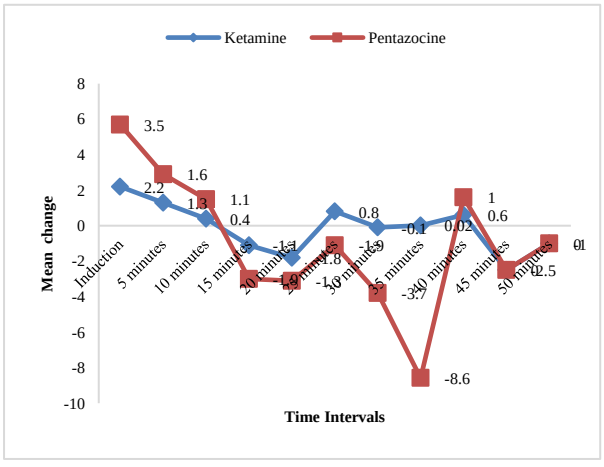

Figure 1: Comparison of the mean intraoperative heart rate changes from the baseline and across the measurement intervals in each group.

The incidence of a ≥20% rise in the diastolic blood pressure. Like the heart rate and systolic blood pressure values, was also more in the pentazocine group. This was noted at seven different time intervals; from the 5th minute to the 35th minute, 21.5% vs. 14.1%, 18.7% vs. 15.6%, 20.3% vs. 17.2%, 17.2% vs. 12.5%, 14.1% vs. 6.2%, 9.7% vs. 5.0%, 7.8% vs. 3.6% respectively. At the other three intervals, the proportion of the increase was more in the ketamine group. The difference was not statistically significant (p>0.05).

Incidence of side effects of the study drugs

There was no occurrence of respiratory depression (RR <8 c/min as defined in the objectives) in the study groups. There was no significant change in the SpO_2 values in group PK. However, in group PP, there was a statistically significant drop in the SpO_2 values from baseline at the induction of anaesthesia (p=0.001) and the 5th minute (p=0.003). Eight patients in group PP required supplemental oxygen via Bain's circuit due to a drop in SPO_2 to less than 93%.

Emergence phenomenon

When the occurrence of confusion in the study groups was assessed, few patients gave wrong answers (1.6% for where they live, 7% for date and 5.5% for time of the day). The difference in their answers between the groups did not differ significantly (p=0.87, 0.67 and 0.89 respectively). There was no incidence of postoperative nausea and vomiting for any of the subjects in both study groups. The mean heart rate changes at various intervals in comparison with the baseline values (Figure 1). There was no statistically significant difference in all the intervals for subjects in group PK, but in group PP, there

was a significant decrease in the heart rate at the induction of anaesthesia compared to baseline heart rate, p=0.047. In all the intervals, the change differed with wider margins in group PP (the widest margin -3.7 to 8.6 b/min) unlike in group PK, (the widest swings 2.2 to -2.5 b/min). These, however, were not statistically significant except for the aforementioned difference at the induction in group PP.

Time to awakening

There was no significant difference in the meantime to eye-opening in the groups. For group PK, the mean time was 11.2 minutes, while for group PP, there was a mean time of 10 minutes to eye-opening, p=0.341. The duration of surgery was similar in both groups. The average time in group PK was 39.4 minutes while those on PP was 33.8 minutes, p=0.136.

DISCUSSION

This study, showed no difference in the effectiveness of the intraoperative analgesia provided by pentazocine and a sub-hypnotic dose of ketamine. However, they differed in some other features like maintenance of stable haemodynamics and their side effect profile. For the heart rate in the study subjects, those in the ketamine group had periods of changes (an increase and a decrease) from baseline values, but none of the changes was statistically significant. Conversely, in the pentazocine group, there was a statistically significant drop in the heart rate at the induction of anaesthesia (p=0.047). This was at the time of administration of the test drug, pentazocine. There was no other significant change in heart rate observed after that. Generally, the proportion of patients with increased of greater than or equal to 20% in heart rate values was more in the pentazocine group than the ketamine group. This was observed at eight intervals. Higher proportions of increase were observed only at two intervals in the ketamine group. In all, the difference in the occurrence of these changes among the groups was not statistically significant (p>0.05). Propofol had cardio-depressive effects.[7] Pentazocine is known to cause tachycardia at doses above 60 mg.[8] This feature, in theory, may counter the cardio-depressive effects of propofol. In the index study, doses lower than 60mg were used, and this may be the reason for the drop in heart rate noted at induction as the cardio-depressive effects of propofol were unopposed. Ketamine is stimulatory to the sympathetic nervous system. It attenuates the cardio-depressive effects of propofol.[9] A better maintenance of a stable heart rate in the ketamine group in this study, unlike the pentazocine group, is therefore expected. A result similar to that of the index study was observed by Bajwa and his co-workers.[10] They used ketamine at a dose of 0.5 mg/kg in comparison with fentanyl. They noted periods of a rise in the heart rate of the subjects in the ketamine group, which though was not statistically significant. In the other group, the fentanyl group, however, there was a significant drop in heart rate values. Across the groups, this difference was statistically significant at different intervals throughout surgery (p<0.05). Conversely, Nonaka and co-workers noted stability in heart rate with the use of pentazocine.[11] Unlike the result obtained in the index study, they observed no statistically significant difference in the heart rate changes with the use of pentazocine. In their study, however, ketamine (at 0.5 mg/kg) was administered to all the subjects in both study groups at the onset of anaesthesia. The coadministration of ketamine with pentazocine may have been responsible for the cardiostability observed.

In the index study, the systolic blood pressure (SBP) in the ketamine group had statistically significant changes at two intervals. In the pentazocine group, there was a statistically significant increase in the systolic blood pressure from induction till the 30th minute. Thereafter, the increase observed till the end of surgery was not statistically significant. This showed that ketamine, unlike pentazocine, is associated with less instability in the systolic blood pressure of surgical patients. In an intergroup comparison, the occurrence of an increase greater than or equal to 20% in the study subjects' systolic blood pressure was more in the pentazocine group. This was observed in eight time intervals of comparison, from induction to the 35th minute. The ketamine group had higher proportions of occurrence in two time intervals. The difference in the occurrence of this increase, like those with the heart rate, did not differ significantly (p>0.05).

Following a bolus injection of propofol, the decrease in systolic blood pressure is dependent on vasodilation, and the attendant reduced preload and afterload, and myocardial depression (negative inotropic action).[12] These appear to be countered by the stimulatory effect of ketamine In high doses, pentazocine is known to cause an increase in systolic blood pressure, an increase in pulmonary artery pressure with an associated increase in left ventricular end-diastolic pressure[9] In the study, the dose of pentazocine used was not high (up to 60 mg) to possibly account for the significant rise in the systolic blood pressure observed in the pentazo cine group. It is unclear if the higher incidence of increased systolic blood pressure within the pentazocine group, though not statistically significant, was partly due to a lower analgesic effect of pentazocine than ketamine.

The diastolic blood pressure was also more stable in the ketamine group with no statistically significant change observed in all intervals. In the pentazocine group, there was a statistically significant increase from the baseline values from induction till the 15th minute (three intervals). This was similar in the intergroup comparison of a ≥20% increase in the diastolic blood pressure, although not statistically significant. The incidence of a greater than or equal to a 20% increase in the diastolic blood pressure was more in the pentazocine group. However, the difference in its occurrence was not statistically significant. This occurred at seven different

time intervals from the 5th minute to the 35th minute. At the other three intervals, the proportion of the increase was more in the ketamine group. These findings support the same assertion from the systolic blood pressure results.

In a study by Ramakrishna et al ketamine was given at a dose of 0.5 mg/kg in addition to propofol. All the study patients received fentanyl at 1 µg/kg immediately followed by propofol alone or propofol and ketamine. In the ketamine group, they observed less instability in the systolic blood pressure, diastolic blood pressure and mean arterial blood pressure compared to the other group. The difference in the haemodynamics in the propofol-alone group was statistically significant ($p<0.05$) throughout the 30-minute duration of the surgery. This stability with ketamine is demonstrated in the index study. Gupta et al had a similar result in a comparison of ketamine and fentanyl in TIVA. Although there were fewer alterations in the systolic, diastolic and mean arterial pressures in the ketamine group than the other study group, the changes did not differ significantly across the groups.[13]

In another study by Bajwa et al ketamine was administered at a dose of 1 mg/kg.[10] They noted significant changes across both study groups in all other intervals in the systolic and diastolic blood pressure. In an intragroup analysis of both groups, the systolic blood pressure did not vary significantly from the baseline values in the ketamine group, unlike the fentanyl group. As in the results of the study, there were also no significant haemodynamic changes with the use of ketamine. Nonaka et al noted a result different from that of the index study with the use of pentazocine.[14] They observed a significant drop in the systolic and the diastolic blood pressure at the induction of anaesthesia from the baseline values ($p=0.041$ and 0.01 for the group with patients above 61 years and $p=0.032$ and 0.03 for patients below 61 years respectively). Despite the coadministration of ketamine at induction, pentazocine administration during induction may be responsible for the drop of the systolic and diastolic blood pressure during induction. In the index study, there was no drop in the respiratory rate to less than 8 c/min in the groups. Eight patients in group PP did require supplemental oxygen via Bain's circuit due to a drop in SpO_2 to less than 93%. Propofol is a profound respiratory depressant, and apnoea following its administration usually occurs after an induction dose.[13] Ketamine attenuated propofol-induced hypoventilation in adults during monitored anaesthesia care and can only cause respiratory depression in high doses.[15] The coadministration of ketamine with propofol improves ventilation, normalises the end-expiratory $PaCO_2$ and lessens the incidence of apnoea and respiratory distress.[15] The index study supports these claims. The coadministration of pentazocine and propofol at a dose of 0.7 mg/kg of pentazocine in this study may have accounted for the periods of a decrease in the SpO_2 in the study subjects, although this decrease was not statistically significant. An intergroup comparison showed that ketamine affects respiration less and indeed attenuates propofol-induced respiratory depression better than pentazocine. This was expected given the properties of the drugs.

Similarly, in the study by Nonaka and coworkers a dose of 0.7 mg/kg of pentazocine (the same as the index study) was administered to a group of study subjects and no respiratory depression was observed postoperatively.[12] Unlike the index study, the survey subjects had endotracheal intubation and mechanical ventilation. The use of neuromuscular blockers is associated with a reduction in respiratory drive.[16] However, no respiratory depression was noted in the pentazocine group and the other study drug, fentanyl. The addition of 30-50 mg of ketamine to the propofol infusion used for maintenance in all study subjects, may have attenuated the respiratory depressive properties of both pentazocine at that dose and propofol. It is also probable that the study drugs were metabolized to a large extent, intraoperatively thereby having a reduced effective plasma concentration at the time of the assessment postoperatively. Gadani et al used a dose of 60 mg of pentazocine (approximately 0.9 mg/kg for a patient weighing 70 kg) administered intramuscularly and had results also similar to the index study.[17] They observed no significant falls in respiration. It is possible that the slow uptake of the intramuscularly administered drug reduced either the occurrence or the severity of respiratory depression. Olateju and his coworkers also had a similar outcome in respiration of their study subjects with pentazocine use.[18] However, they administered 30 mg of pentazocine intramuscularly for post-operative pain following caesarean section, which was performed using subarachnoid block, unlike the index study. Again, this lower dose, in addition to the intramuscular route of administration, may have been contributory to the absence of respiratory depression.

There was no record of postoperative nausea and vomiting in all the patients studied. Postoperative nausea and vomiting (PONV) are defined as any nausea, retching, or vomiting occurring during the first 24-48 hours after surgery in inpatients.[19] Opioid use is a known risk factor for PONV.[20] Similarly, Nalini and coworkers did not observe any PONV in their comparison of ketamine and fentanyl.[15] Shetty et al had no statistically significant difference in the rate of nausea and vomiting (one patient) in the pentazocine group when compared to tramadol for labour analgesia.[20] Gupta et al observed only nausea in the studied ketamine and fentanyl group; the incidence of which was not statistically significant.[13] Conversely, Gadani et al had a 30% incidence of PONV with the use of pentazocine in their study involving non-African study subjects.[17] The higher rate of PONV in non-Africans according to evidence may be a reason for the higher incidence in the group, unlike in the index study.[21] Olateju et al studied pentazocine for post-operative pain and noted nausea and vomiting in only one patient.[18] This was not statistically significant. While this

may not be directly related to this index study, the intramuscular use of only one dose of 30 mg for adults may account for a low incidence of vomiting with the use of pentazocine. During the assessment for emergence reactions, there were intergroup differences in wrong answers obtained when patients were asked the time of the day. The intergroup differences in these wrong answers were not statistically significant. The index study, therefore, is in agreement with previous studies which found that a low dose of 0.5 mg/kg of ketamine, its combination with propofol and midazolam attenuates the emergence phenomenon associated with ketamine.[22] Similarly, Nalini et al observed no emergence phenomenon in all 30 patients who received ketamine.[15] Brar et al also did not observe any emergence phenomenon in 30 patients who received 0.5 mg/kg of ketamine.[9] The patients in these three studies received subanaesthetic doses of ketamine. These are supportive of the absence of emergence phenomenon with subanaesthetic doses of ketamine. In contrast to these results, Mahajan and colleagues noticed a statistically significant difference in the occurrence of emergence phenomenon in a ketamine study against a dexmedetomidine group.[23] They administered 1 mg/kg at induction and then 1 mg/kg/hr subsequently. This dose exceeded the subanaesthetic dose and may be responsible for the emergence phenomenon observed in their study.

CONCLUSION

From the results of this study, it can be concluded that there is no difference in the intraoperative analgesic efficacy of a subanaesthetic dose of ketamine (0.5 mg/kg) and pentazocine (at a dose as high as 0.7 mg/kg) in procedures lasting less than one hour. Ketamine, however, provides better haemodynamic stability than pentazocine when used in propofol based TIVA. The use of pentazocine at 0.7 mg/kg is associated with respiratory depression especially immediately after administration, whereas ketamine is not. Postoperative nausea and vomiting caused by opioids, does not occur with a dose of 0.7 mg/kg of pentazocine. The concomitant use of midazolam and propofol with a subanaesthetic dose of ketamine eliminates emergence phenomenon seen with ketamine. An important limitation of this study is that different surgical procedures done for the participants, introduced heterogeneity. Limiting the surgeries to a particular type will eliminate this. This is because different sites and the extent of tissue manipulation in various surgeries may have affected the intensity of pain and the attendant effects on the patient's haemodynamics.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Okonkwo UN, Ewah RL, Ebirim LN. A comparison of ketamine with pentazocine for analgesia in propofol-based total intravenous anaesthesia for short surgical procedures. Int J Res Med Sci 2022;10:1211-8.