

KETAMINE AS A SOLE ANAESTHETIC AGENT IN SHORT SURGICAL PROCEDURES – A CLINICAL STUDY

Shilpashri. A. M, Shivakumar. K. P, Nalinakshamma Sajjan

1. Assistant Professor, Department of Anaesthesia, J. J. M. Medical College, Davangere, Karnataka.
2. Assistant Professor, Department of Anaesthesia, SSIMS & RC, Davangere, Karnataka.
3. Professor, Department of Anaesthesia, J. J. M. Medical College, Davangere, Karnataka.

CORRESPONDING AUTHOR

Dr. Shivakumar K.P

#2051, 2nd Main 2nd Cross,

Behind Modi Compound,

MCC 'A' Block, Davangere, Karnataka.

E-mail: drshivukumarkp@gmail.com

Ph: 0091 9902006367

ABSTRACT: BACKGROUND AND OBJECTIVES: Present clinical study was conducted to evaluate the features of Ketamine hydrochloride such as rapid induction, profound analgesia and minimal cardiovascular and respiratory depression with good airway maintenance.

METHODS: Study was conducted on one hundred patients of either sex of different age group for various short surgical procedures. All patients were premedicated with Inj. Atropine 0.02 mg/kg IV and Inj. Diazepam 0.2 mg/kg IV. Following this Inj. Ketamine 2 mg/kg was given intravenously. During the course of anaesthesia patient was observed for the time of onset, duration of action, haemodynamic parameters, respiration, recovery from anaesthesia and certain side effects. **RESULTS:** The onset of anaesthesia after intravenous injection of ketamine was within 20-54 sec (Mean 34.3 ± 8.7). Duration of effect of initial dose was between 9 – 20 min. (Mean 16.9 ± 2.9). There was 14.5 ± 4.7 beats / min rise in pulse rate with 6 to 30 mm of Hg (Mean 15.6 ± 6.2) rise in systolic blood pressure and 0 to 30 mm Hg (12.1 ± 8.8) rise in diastolic blood pressure. There was transient apnea in 5% of patients and airway was well maintained. Recovery was complete with in 9-30 minutes (Mean 19.8 ± 5.2). Vomiting was seen in 11%, hallucinations in 8%, dreams in 9% and involuntary movements in 40%. **CONCLUSION:** Ketamine can be used as a sole anaesthetic agent for short surgical procedure, with minimum adverse effects and maximum safety.

KEYWORDS: Anaesthesia – Dissociative-Ketamine, Anaesthetics – Intravenous – Ketamine, Intravenous – Ketamine – minor surgery

INTRODUCTION: Ketamine hydrochloride, a phencyclidine derivative, was introduced into clinical anaesthetic practice by Domino, Chodoff and Corssen in 1965. It was proved to be an excellent analgesic.¹

Ketamine is an intravenous drug with special properties that make it the only agent that presently serves as an anesthetic, sedative, amnesic and analgesic. Although it is sometimes forgotten, Ketamine is still considered a valuable drug.²

Water soluble, stable and non-irritant when administered intravenously, Ketamine has rapid onset and provides acceptable anaesthesia, minimal depression of cardiovascular and respiratory system, rapid degradation to inactive non-toxic metabolites and rapid and smooth emergence with minimal side effects with no hypersensitivity reaction. These properties make Ketamine useful for total intravenous (IV) anaesthesia.²

ORIGINAL ARTICLE

The main disadvantage of this drug is emergence delirium. Patients may pass through a phase of vivid dreaming with or without psychomotor activity manifested by confusion or irrational behaviour. This is seen more commonly in young adults, more so in females. They are less common in children and older age groups.¹

The present study is to assess the suitability of Ketamine as a sole anaesthetic agent for short surgical procedures with Diazepam to attenuate the emergence phenomenon.

OBJECTIVES:

To evaluate the features of Ketamine hydrochloride such as:

1. Rapid induction.
2. Profound analgesia.
3. Minimal cardiovascular and respiratory depression with good airway maintenance.
4. And its complications.

METHODOLOGY: The present study was done on hundred patients, at Chigateri General Hospital, Bapuji Hospital, Women and Children Hospital, Davangere from November 2005 to May 2007. One hundred patients of either sex and various age groups ranging from 10 to 40years were selected for the study.

PATIENT SELECTION: Inclusion criteria: Patients of ASA grade I and grade II, either sex between 10-40years. Exclusion criteria: Patients with history or clinical evidence of Ischemic heart disease, Hypertension, Diabetes mellitus, Raised intraocular pressure, Epilepsy, Cerebrovascular disorders, Personality disorders, Old age, Surgery on head and neck, Psychiatric disorders.

PREOPERATIVE ASSESSMENTS: All patients were screened thoroughly and investigations like Hb%, urine for sugar and albumin, fasting blood sugar and ECG were done. Physical examinations were carried out and body weight was recorded in each case. Basal preoperative pulse rate, blood pressure and respiratory rate were recorded.

PREMEDICATION: All patients were premedicated with Atropine 0.02mg/kg body weight and Diazepam 0.2mg/kg body weight intravenously 2-3minutes before the injection of Ketamine.

INDUCTION: Initial dose of Ketamine 2mg/kg body weight was given intravenously.

MAINTENANCE: Subsequent doses of Ketamine were given after the signs of waring off of anaesthesia like phonation, return of nystagmus and movements on surgical stimulation were seen. The dose repeated was half the initial dose.

METHOD: When the patient was brought to the operation room pulse rate, blood pressure and respiratory rate were recorded and an intravenous line was started. All patients were premedicated and Ketamine 2mg/kg body weight was given intravenously slowly over a period of 30-40seconds. After injecting Ketamine, time taken to obtain the surgical anaesthesia was noted. Patient was closely monitored for vital signs at 2, 5 and every 5 minutes thereafter including airway maintenance. Patient was also observed for side effects. The time taken by the patient to recover from the initial dose was noted. A subsequent dose of Ketamine was given if the procedure was continued further. The duration of action of the subsequent dose was also

ORIGINAL ARTICLE

noted. Once the procedure was over, the patient was allowed to recover in a calm place. The patients were said to be completely recovered from anaesthesia when they started responding to oral commands. They were then shifted to the ward.

At the end of operation, the quality of anaesthetic conditions produced was graded as shown in table1:

Table1- Quality of anaesthetic conditions.

Excellent	Patients remained calm. There were no movements, no interference with surgery.
Good	Patients remained calm. Minor movements not interfering with surgery.
Fair	Moderate movements interfered with surgery but no supplementary anaesthesia was required.
Poor	Patients required conventional general anesthesia.

The patients were interviewed the next day morning for any unpleasant dreams or untoward experience during recovery or during their sleep over night.

STATISTICAL ANALYSIS: Descriptive data included mean, standard deviation and percentage which were determined for the study group. Paired 't' test was used to compare the mean values at different intervals with baseline measurements. P value of <0.05 was considered for significant difference.

RESULTS: Of the hundred selected patients of either sex, 42 patients were male and 58 were female. The age range was 10-40yrs and the mean age was 24.4 ± 8.1 . The majority of the patients belonged to the age group 21-30. The distribution of weight of the patients ranged from 20-75kgs with the mean weight of 46.7 ± 12 kgs.

Table2 shows the different surgical procedures conducted.

Table2: List of surgeries

Sl. No.	Type of Surgery	No. of Cases
1	Abdominal tubectomy	10
2	I and D	17
3.	Skin grafting	01
4.	Stunt removal	04
5.	Secondary suturing	01
6.	Excision <ul style="list-style-type: none">● Fibroadenoma● Lipoma● Ganglion● Sebaceous cyst	14 4 4 6
7.	Wound debridement	2
8.	K-wire removal	3

ORIGINAL ARTICLE

9.	Lymph node biopsy	6
10.	Circumcision	13
11.	Disarticulation	3
12.	Visualization of internal urethra	1
13.	Cystoscopy	1
14.	Perineal tear repair	1
15.	External Fixator removal	3
16.	MTP	1
17.	D and C	3
18.	Incisional biopsy	1
19.	Bone marrow aspiration and infiltration	1

Injection Ketamine 2-mg/kg body weight intravenous was given to the patients 2-3min after the injection of Diazepam and Atropine. The following were observed and noted during anaesthesia and in the recovery period.

Time of onset of anaesthesia: The time of onset of anaesthesia was taken from the time of intravenous administration of Ketamine to surgical anaesthesia. The time of onset of anaesthesia ranged from 20-54sec. The mean duration of onset was 34.3 ± 8.7 sec.

Duration of action of initial dose and subsequent dose: The duration of action of initial dose of Ketamine after intravenous administration is was noted. The least duration was 9min, and maximum was 20min, mean duration of action of initial dose was 16.9 ± 2.9 .

70patients required only the initial bolus dose while the other 30patients required a top up dose. The subsequent dose repeated was half the initial dose. The duration of action of the subsequent dose ranged from 7-12min and mean duration was 9.6 ± 1.5 min.

Cardiovascular changes: Pulse rate: In the study, all the patients showed rise in pulse rate. The mean rise in pulse rate was 14.5 ± 4.7 beats per min. The rise was statistical significant ($P < 0.05$) at 5 min and the pulse rate came to preanaesthetic levels at 30-35 min.

Blood pressure: The blood pressure was recorded in all the cases. A rise in both systolic and diastolic pressure were seen in the cases.

Changes in systolic blood pressure: Maximum rise in systolic pressure was 30 mm Hg and minimum was 6 mm Hg and mean rise 15.6 ± 6.2 . There was a statistically significant rise ($P < 0.055$) in systolic blood pressure at 5 min and rise in systolic blood pressure came to its preanaesthetic level at 30 min.

Changes in diastolic blood pressure: The maximum rise in the diastolic blood pressure observed was 30 mm Hg and the minimum was 0 mm Hg with the mean rise being 12.1 ± 8.8 mm Hg. There was a statistically significant rise at 5 min and the rise in diastolic blood pressure came to preanaesthetic value at 30min.

RESPIRATORY CHANGES: There was increase in respiratory rate in 25patients and decrease (apnea) in 5patients and in 70patients there was no significant change.

AIRWAY MAINTENANCE: Airway was well maintained in all patients. There was evidence of intact pharyngeal reflex as seen by occasional swallowing movements. Jaw tone was well maintained during anaesthesia. 5cases of apnea were noted when Ketamine was given intravenously undiluted and rapidly. The apnea was transient and apnea was relieved by readjusting the patient's head, jaw or by insertion of an oropharyngeal airway.

ORIGINAL ARTICLE

ADEQUACY OF ANAESTHESIA: Anaesthesia conditions were excellent in 74cases, good in 19cases and fair in 7cases and there was no case with poor anaesthetic condition.

INVOLUNTARY MOVEMENTS: Swallowing, blinking of the eyes, movements at the wrist and fingers were noted in 40patients and these movements did not interfere with the surgery.

RECOVERY: Recovery time was recorded by noting the time from the last dose, to the time the patient responded to simple verbal commands. The recovery time was ranging from 9-30min. Mean recovery time was 19.8 ± 5.2 min.

COMPLICATIONS: Nystagmus was present and was seen more during induction and wearing of anaesthesia in the recovery period. Vomiting was seen in 11patients. Hallucinations was present in 8 patients and dreams was present in 9 patients. Among them, some were pleasant and some were horrifying dreams.

Immediate postoperative period: In majority of patients it was uneventful. Patients became fully conscious and coherent within half an hour but remained drowsy. The prolonged somnolence seen in these patients could be associated with diazepam. All patients were found to be fully awake, conscious and well orientated to place. Not a single case of respiratory depression occurred in the postoperative period.

ANALGESIA: All patients had satisfactory analgesia and they required no analgesics in the immediate postoperative period.

DISCUSSION: An increasing interest in intravenous anaesthetic techniques has resulted from the availability of more efficacious intravenous agents, the rising cost of traditional volatile agents, and the concern over anaesthetic gas pollution in the operating room.³

Infact, Ketamine is the only available agent which can function as a sole anaesthetic because of its unique sedative, amnesic, analgesic, and anaesthetic properties³ and thus Ketamine may prove to be a useful addition to the armamentarium of an anaesthetist.⁴

Many authors have studied the characteristics of Ketamine hydrochloride as a sole anaesthetic agent in minor surgical procedures with regard to the duration of action, cardiovascular and respiratory changes and complications.

The present study was conducted to evaluate the features such as induction time, analgesia and cardiovascular and respiratory effects.

In a study conducted by Dhar et al on 110patients undergoing minor surgical procedures using Ketamine as sole anaesthetic agent, it was observed that the incidence and severity of the unwanted side effects of Ketamine hydrochloride was significantly reduced by prior administration of diazepam intravenously.⁵ So, I have taken diazepam 0.2mg/kgIV and atropine 0.02 mg/kg IV as premedication in our study.

A study by White P F et al stated that Ketamine 2mg/kg IV, given as a rapid bolus injection produced significant reduction in PaO₂. In contrast, premedicated patients with Diazepam, Who received Ketamine 2mg/kg IV over 60seconds showed no significant change in PaO₂.³

So, in our study we have injected Ketamine 2 mg/kg body weight IV, over 60seconds.

Table3. Time of onset of anaesthesia:

Authors	Mean time of onset (Sec)
Jyotsna et al. ⁶	36
Diwale et al ⁷	60
Bala subrahmaniyam ⁸	45-60
Present study	34.3 ± 8.7 (20-54)

In the present study the time of onset of anaesthesia was 34.3 ± 8.7 (20-54)seconds which is in acceptance to the studies shown in Table3.

Table4: Duration of anaesthesia:

Authors	Time in minutes
Knox et al ⁹	13.2 ± 1.25
Dhar et al ⁵	16-20
Diwale et al ⁷	5-17
Present study	16.9 ± 2.9

The present study correlates with Dhar et al shown in Table4.

A study by Gudi et al stated that when the surgery was prolonged or when patients were coming out of the initial dose, subsequent dose of 1mg/kg of Ketamine was given.¹⁰

Even in our study, when the time of surgery was prolonged or when the patient came out of the initial dose, subsequent dose of 1mg/kg of Ketamine was given in 30patients. The duration of action of the subsequent dose was 9.6 ± 1.5 (7-12)min.

Table5: Rise in pulse rate:

Authors	Rise in pulse rate
Knox et al ⁹	13
Paul F. White et al ¹¹	35 ± 4
Diwale et al ⁷	20 %
Dhar et al ¹²	17
Present study	14.5 ± 4.7

The present study comes in between Knox et al and Dhar et al's findings in relation to rise in pulse rate shown in Table5.

BLOOD PRESSURE CHANGES:

Table6: Systolic blood pressure:

Authors	Rise in S.B.P in mm of Hg.
Knox et al ⁹	28 ± 7.2
White et al ¹¹	32 ± 3
Diwale et al ⁷	20
Present study	15.6 ± 6.2(30-6)

ORIGINAL ARTICLE

The present study correlates with Diwale et al finding shown in Table6. Statistically significant rise in systolic blood pressure occurs at five minutes. In our study the rise in systolic blood pressure is not as high as other studies, this is due to usage of Diazepam as premedication in our study.

Diastolic blood pressure:

Dhar et al stated that there was 1-10mm of Hg rise in diastolic blood pressure in 40.9%of the patient and 11-20mm of Hg rise in 17.8% of the patient.¹ In our study diastolic blood pressure rise was 12.1 ± 8.8 mm of Hg. There was a statistically significant rise in diastolic blood pressure at five minutes.

A study by White P F et al quoted, the time taken to return of rise in pulse rate to pre-anaesthetic value, was 16min and blood pressure was 18 ± 7.2 min.¹¹

In our study it was 30min for both pulse and blood pressure to come to its preanaesthetic value.

In a study, it was quoted that a second dose of Ketamine produced hemodynamic effects less than or even opposite to those of the first dose.¹³ In our study we observed that there were no significant hemodynamic changes with the subsequent dose of Ketamine. Table7: Changes in respiratory rate:

Authors	Decrease in respiratory rate in patients
Morgan et al ¹⁴	11.5%
Prasad et al ¹⁵	18.33%
Bala subrahmaniyam ¹⁶	10%
Present study	5%

In our study, we observed transient apnea in 5patients, which was < 60seconds shown in Table7. All of them responded by readjusting the position of patient head or jaw or by insertion of an oropharyngeal airway.

ADEQUACY OF ANAESTHESIA: In a study by Dhar et al, the anaesthesia was excellent in 68.2%, good in 25.4% and fair in 6.4% and in no case were the anaesthetic conditions termed poor.²⁶

Our study has similar observations of 74% excellent, 19% good, 7% fair and no case had poor anaesthetic condition.

Airway and Jawtone were well maintained during anaesthesia in our study. Patients were able to swallow during the course of anaesthesia. This is in correlation with Morgan M et al.¹⁴

Table8: Recovery:

Authors	Recovery time (minutes)
Knox et al ⁹	20
Prasad et al ¹⁵	18.85 ± 8.24
Present study	19.8 ± 5.2

ORIGINAL ARTICLE

The recovery time in our study correlates to Knox et al and Prasad et al findings shown in Table8. Majority of patients remained calm intra-operatively. In 40patients, swallowing, blinking of the eyes and movements at the wrist and fingers were noted and these movements did not interfere with the surgery. This is in acceptance to Dhar et al.⁵

Nystagmus was seen in all patients during induction following administration of Ketamine and nystagmus was uniform on emergence from Ketamine. This was noticed in a study of 560patients done by Gudi et al.¹⁰

Sialorrhoea was not seen, which might have been due to administration of injection atropine as premedication. In a study by Heinz et al it was concluded that Atropine reduces hypersalivation and lower the incidence of post-operative vomiting.¹⁷

In the present study 11 patients had vomiting. This is close to observations of Prasad et al¹⁵ in which, vomiting was present in 11.66%.

Table9: Dreams:

Authors	% of patient having dreams
Prasad et al ¹⁵	36.66
Diwale et al ⁷	16
Cartwright et al ¹⁸	26.7
Present study	9

In the present study, dreams were present in 9% and this is not in correlation with any authors shown in Table9. This is because dreams depends on the racial, geographical, nutritional and psychological makeup of patient in study. As the above studies were done in patients of different race, different geographical area, the finding were different.

Table10: Hallucinations:

Authors	% of patient having hallucinations
Gudi et al ¹⁰	7
Dhar et al ⁵	10.255
Present study	8

In the present study, findings of hallucinations come in between the findings of Gudi et al and Dhar et al shown in Table10.

Immediate postoperative period was uneventful. Only one patient had pain at the site of operation, all others had satisfactory analgesia. This correlates with the study of Dundee J W et al¹⁹ which stated that the analgesic effect of Ketamine produced even at subanaesthetic doses extends well into postoperative period.

Ketamine has certain absolute contraindications like recent myocardial infarction and uncontrolled hypertension. Nevertheless, its cardiostimulatory properties can be exploited in hypovolemic shock and critically ill patients where blood pressure is low and life threatening. Remarkable preservation of pharyngeal and laryngeal reflexes was an asset in Ketamine anaesthesia, as it can be used where difficult intubation is anticipated.

As far as the cost of anaesthesia is concerned, it is economical for routine use particularly for procedures of shorter duration. However it also plays a very useful role in mass

ORIGINAL ARTICLE

casualties and places where sophisticated anaesthetic equipment is not found as in warzones and high altitudes.

Although the present study is not to rewrite the indications of Ketamine it is only to reiterate its place in the anaesthetic armamentarium. Studies on Ketamine have established the usefulness of the anaesthetic agent in a variety of clinical conditions and have confirmed the safety, reliability and effectiveness of Ketamine as sole anaesthetic agent in short surgical procedures. In selected patients where intense analgesia is needed without any muscular relaxation, Ketamine comes almost to the ideal.

CONCLUSION: By the present study conducted, it can be concluded by evaluation and clinical trail that Ketamine can be used as a sole anaesthetic agent with minimum adverse effects and maximum safety. It has the advantage of rapid and smooth onset of action, minimal depression of respiratory system and intense analgesia during intra-operative and post-operative period. However the undesirable side effect of Ketamine can be effectively countered by the use of benzodiazepines.

Hence Ketamine can be used as a sole anaesthetic agent with considerable amount of success in most of the short surgical procedures.

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