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Efficacy of Ketamine as Sole Anaesthetic Agent in Maintaining Perioperative Analgesia and Intraoperative Hemodynamics During Various Short Surgeries at a District Hospitals in Assam: A Prospective, Observational Study

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ABSTRACT

Background: ketamine is unique in the sense that it produces dissociative anaesthesia rather than generalized depression of the CNS. **Aim**: The aim of this study was to evaluate the effect of administration of ketamine as the only anesthetic drug utilized to induce the patients, maintain intraoperative hemodynamics, postoperative analgesia, and analgesia during certain operations like appendectomy, Hernia, Hydrocele and circumcision at a district hospital in Assam. **Settings and Design**: This prospective, observational study was conducted from January2023 to December2023, over a period of 12 months in a District hospital in Assam. **Materials and Methods:** Fifty individuals aged 15 to 40 who were scheduled for various procedures were enlisted. Before surgery, ketamine was administered at a dose of2 to 3 mg/kg. During the procedure, this dose was repeated every ten to fifteen minutes at a rate of .5 to 1 mg/kg. For the first five hours, hemodynamic parameters, the duration until the first rescue analgesia, and complications were noted. **Results**: Within the first five hours following surgery, 90% of the patients did not require any postoperative rescue analgesics. 10% of the patients experienced mild postoperative problems, and none of the patients reported pain right away after finishing of procedure. **Conclusion**: Ketamine with inducing doses have been shown to be effective analgesics, especially during procedures like conventional appendicectomy, operations for Hernia, Hydrocele and Circumcisions.

Key Words: Hemodynamics, Appendicectomy operation, Hernia, Hydrocele, ketamine, postoperative analgesia.

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INTRODUCTION

Ketamine is a widely used anaesthetic agent that produces dissociative anaesthesia. It has a strong analgesic effect that lasts longer than the duration of anesthesia and is present even at sub anesthetic doses[1].Ketamine, in order to effectively prevent pain, needs to be administered throughout the procedure to lessen the sensitivity of central and peripheral pain pathways[2].Appendicectomies and other short procedures as mentioned above are believed to result in less tissue damage and can even be done as a day care procedure, particularly on young, thin built individuals. Ketamine produces dose-related unconsciousness and analgesia.

Previous research using a single preemptive dosage of ketamine had inconsistent findings[(3-14)] In addition, extra analgesic adjuncts have been administered in each of these studies. This research is distinctive as it examines the preemptive and intraoperative effects of ketamine in individuals having various short procedures, without the use of any further analgesic adjunct. We have also assessed how long the procedure takes and how effective ketamine is as an analgesic. Patients anesthetized with ketamine have profound analgesia, but keep their eyes open and maintain many reflexes. Concomitant administration of benzodiazepines, which is a common practice, can prolong the effect of ketamine. There is a considerable period of postoperative analgesia after ketamine used as general anesthetic, and sub anesthetic or low doses can consequently be used to produce analgesia.

Materials and Methods:

Over the course of twelve months, from January 2023 to December 2023, this prospective observational study was carried out. Signed informed consent were obtained, and 50 individuals scheduled for four different procedures were

enrolled for the study following approval from the Institutional Ethical Committee. Patients' ages ranged from 15 to 40 years old, and they were all classified as Class I and II of the American Society of Anesthesiologists (ASA). Individuals with a history of ketamine allergies, substance misuse, mental illness or communication disorders, hypertension, cardiac diseases, chronic pain syndrome, alcoholism, or weight greater than 45 kg were not included in the study. Likewise, those who used prescription opioids or other medications having established analgesic effects during the 24 hours prior to surgery were not included in the study. The visual analogue scale of VAS was explained to all patients before they were moved to surgery. The anesthesiologist was administering the drugs. No other analgesic drug was planned to be added other then Diazepam in the study. Due to ethical considerations, no control group has been set up. All the patients were given glycopyrrolate 0.2 mg and diazepam .1 to .2 mg/kg both by IV route as premedication. This was followed by IV ketamine 2 mg/kg as an induction dose. Injection Diazepam instead of Midazolam was used as a sedative primarily for reasons like-Diazepam has skeletal muscle relaxant properties which midazolam doesn't. The patients were usually induced between 30 to 60 seconds and procedural analgesia is achieved within this time range at the dose mentioned above and if not, another 1mg/kg of ketamine in next five minutes was injected and when there was no response to noxious stimuli, operation was started. Patients were not given opioids perioperatively neither was put to nitrous oxide or any form of anaesthetic gases, later during the operation if patient seemed to respond to pain .5mg to 1mg/kg ketamine was given IV after every 10 to 15 minutes which was usually the case. No other inducing agents except ketamine was used. Not any form of airway devices like ET tube, LMA were used except patients respiration and SPO2 was closely monitored and if transiently patients saturation falls below 93% supplemental oxygen via face mask was provided. All patients breathed spontaneously throughout the procedure. In a skilled hand- relatively thin built selected cases of conventional appendicectomy and other short procedures are usually safe. The primary aim of operating this type of procedures at hospitals far away from tertiary care units is to avoid complications of intubations and extubations and other hazards of general anaesthesia involving multiple drugs and gases. At a district hospital in certain locations in Assam where there is still obvious need for better medical instruments and appliances , efficient manpower, ICU care and dedicated and sufficient 24/7 health care team, it is quite understandable that long and complicated operations have to be avoided.

The anesthesiologist managing the cases recorded hemodynamic measures like blood pressure (BP) and heart rate, respiratory pattern and SPO2 on monitor. Records were taken just before and, shortly after induction and then every 5 min thereafter till patient were sent to recovery room following procedure. When the VAS score was equal to or greater than 4, rescue analgesia in the form of an IM injection of 75 mg diclofenac was administered, and the duration from the initial rescue analgesia was recorded. The length of the procedure, the total quantity of ketamine utilized, any noteworthy intraoperative observations, and any immediate postoperative problems were also noted.

Results

The mean age in the study was 24.08±7.48 years. Various short duration surgeries were performed in the selected 50 patients [Table 1].Co-morbid conditions such diabetes and hypothyroidism, which were well controlled with medications, were present in ten of the individuals. The length of anesthesia was computed using the interval from the beginning of induction and the final skin stitch given, with a mean of 24.06 minutes, and it varied from 15 to 40 minutes. Four groups of patients were formed according to how long the anesthetic action lasted.The length of surgery was contrasted to a number of characteristics, including the amount of ketamine that was used, the proportion of patients who did not require rescue analgesia, and the percentage of postoperative problems [Table 2]. After the procedure, none of the patients reported any pain, and they were all at ease when they were moved to recovery room. Regardless of the length of the procedure, no postoperative rescue analgesia was needed in 40(80%) patients (even 6 hours after the procedure). Within one hour of operation, only 10 patients(20%), required rescue analgesia with diclofenac. Hemodynamic measures, including pulse rate, diastolic blood pressure (DBP), and systolic blood pressure (SBP), SPO2 were measured prior to surgery, during induction, and then every five minutes until the procedure was finished. Matched Ketamine impact on these hemodynamic parameters was assessed using the Student's t-test . Statistical significance was defined as $P<0.05$ for a 95% confidence interval. SBP, DBP and pulse rate variations were there in those 50 patients undergoing various operations during induction, intraopratively and postoperative period but values were statistically significant. The variations in SBP, DBP, and pulse rate have been found to be statistically significant at 15,20 and 35 minutes during the operations[Depicted in Graphs 1-3and table 3].Complications of surgery have been reported only in 9 patients, as shown in Table 4. All these patients had minor postoperative complications which were treated medically with good recovery. In most of our patients, delays in awakening were not observed except, the Ramsay sedation score of 5 was observed just after surgery in only 5 patients, (10%).

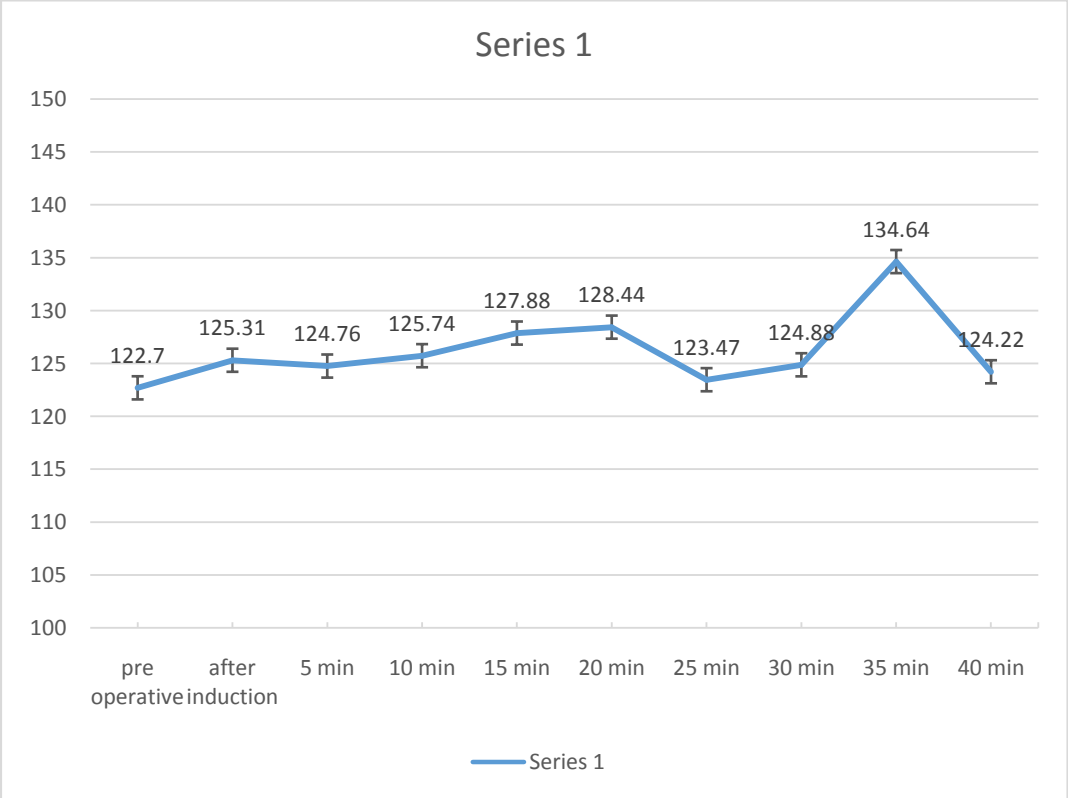
Table 1: Various short surgeries performed

Name of surgery	Number of patients
Conventional appendicectomy	18
Hernia repair	12
Hydrocele operations	10
Circumcision	10

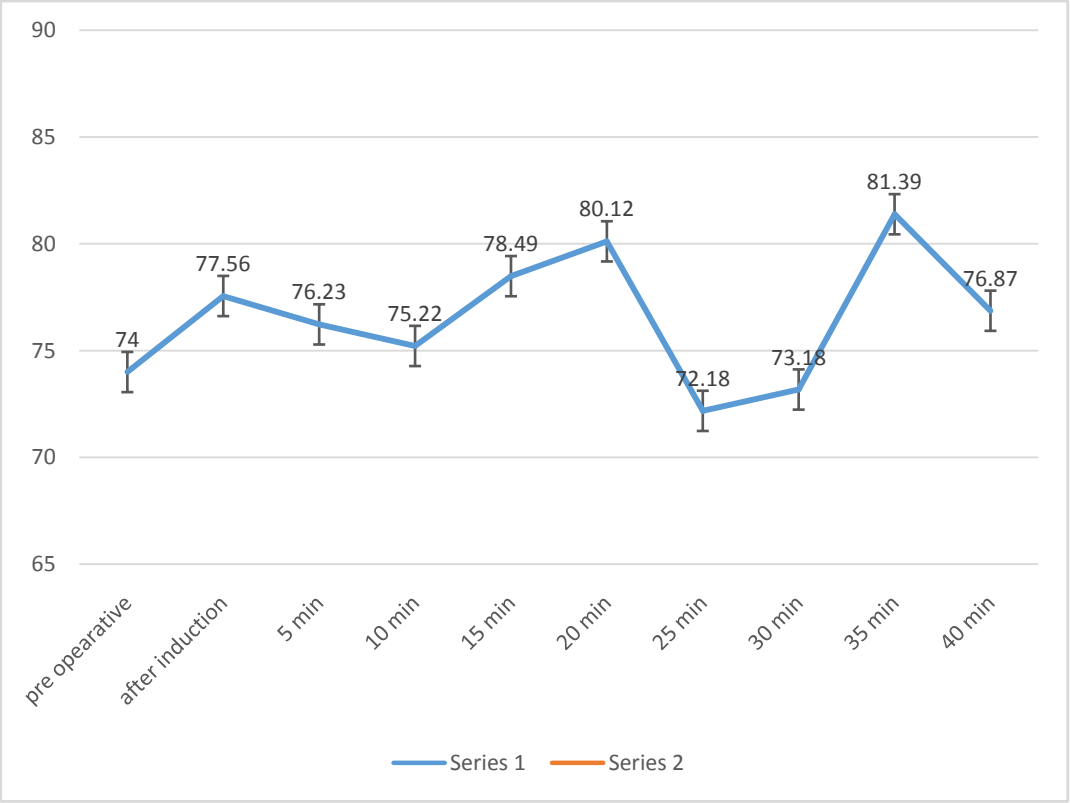
Table 2:Various parameters observed on the basis of duration of surgery					
Duration(min)	**Number of patients**	**Mean age±SD (years)**	**Mean ketamine required (mg/kg)**	**Number of patients (%) requiring rescue analgesia till 6 h**	**no Postoperative complications**
Up to 15	**5**	**27±6.40**	**2.4**	**4**	**0**
15-20	**8**	**35.12±3.94**	**2.4**	**6**	**1**
20-30	**15**	**33.6±5.23**	**2.5**	**12**	**2**
30-40	**22**	**29.40±8.18**	**2.6**	**18**	**2**

Table 3: Changes in various hemodynamic parameters before, during and after surgery						
Duration(min)	SBP (mean)	P	DBP (mean)	P	Pulse (mean)	P
Preoperative	122.7		74		84.34	
Postinduction	125.31	.20	77.56	.07	85.12	.34
5	124.76	.36	76.23	.06	87.33	.29
10	125.74	.28	75.22	.72	86.35	.47
15	**127.88**	**.00012**	**78.49**	**.03**	**94.12**	**.002**
20	**128.44**	**.0005**	**80.12**	**.006**	**96.48**	**.003**
25	123.47	.07	72.18	.08	86.69	.57
30	124.88	.26	73.18	.06	87.12	.07
35	**134.64**	**<.0001**	**81.39**	**.004**	**98.47**	**.0003**
40	124.22	.41	76.87	.08	86.78	.50

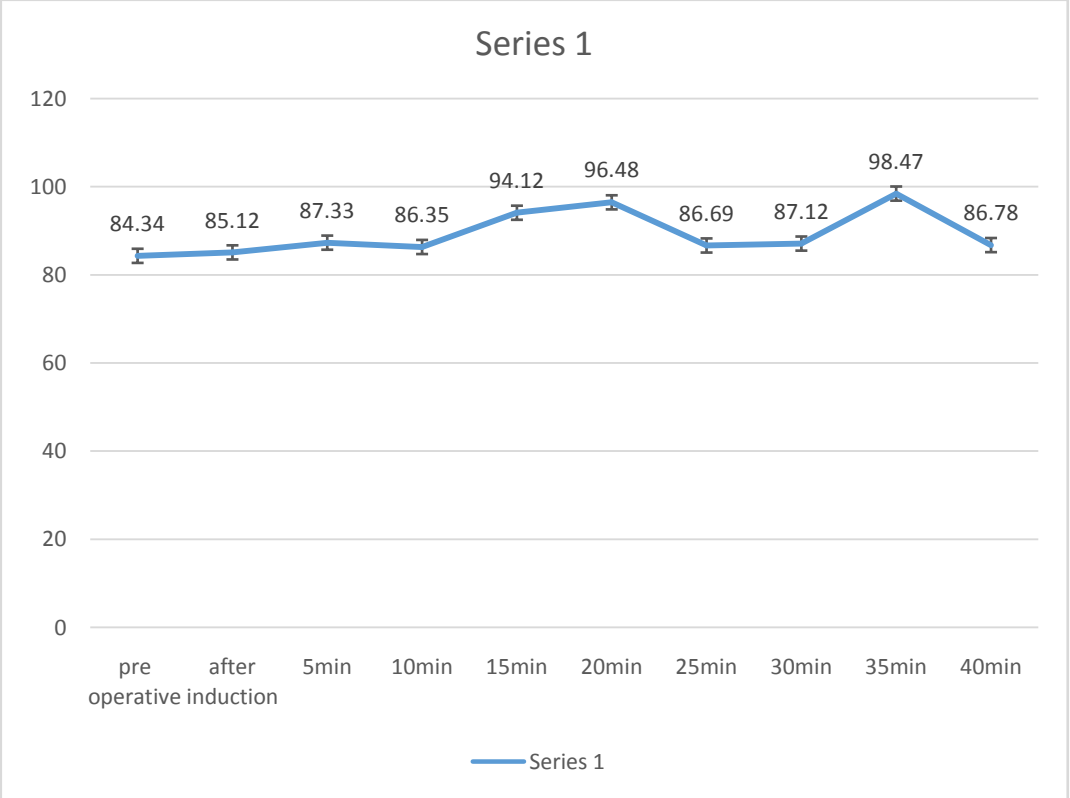
*Significant (P<0.05). SBP=Systolic blood pressure, DBP=Diastolic blood pressure



Graph 1: Variations in systolic blood pressure



Graph 2: Variations in diastolic blood pressure



Graph 3: Variations in pulse rate

Table 4: Postoperative complications	
Postoperative complicationsn (%)	
Sedation	5 (10)
Secretions	0 (0)
Giddiness0 (0)	
PONV	0 (0)
Psychotomimetic reactions	0 (0)
Delayed mobilization	3(6)
Retention of urine 1 (2)	
Bronchospasm	0(0)

PONV=Postoperative nausea and vomiting

DISCUSSION

The purpose of this study was to assess the effectiveness of 2 to 3 mg/kg of ketamine as an anaesthetic as well as analgesic dose, not only before surgery but dose ranging from .5 to 1 mg/kg subsequently also as 'when needed basis' during the intraoperative period. This study's main objective was to evaluate the effectiveness of the analgesic property of ketamine, not its ability to spare opioids, and moreover no additional analgesic was used. . Our results demonstrated that ketamine, when used as a soleinducing agent as well as intraoperatively when needed, not only provides anaesthesia but also gives excellent analgesia for relatively short procedures as discussed above where out of fifty patients no single patient needed any form of additional opioids or any form of airway devices like SGA, ET Tubes except occasional patients requiring supplemental oxygen via face mask that too for a very short period. Out of fifty patients 16 patients oxygen saturation fell below 93% intraoperatively and was managed by providing supplementary oxygenation via face mask for a short period of time . Here we noticed eight patients tongue fell and when 'head tilt jaw thrust' followed by oxygenation done-the SPO2 returned to normal within minutes. We never used other inducing agents, volatile gases. The number of patients who needed rescue analgesia within the first five hours after surgery did not rise in a linear fashion as the procedure's length increased or type changed. In almost 90% of operations, analgesia was not needed until five hours after the procedure, which lasted roughly fortyminutes. This is explained by the brief procedures and low tissue handling while the ketamine remains effective. It is noteworthy that, in our study, most patients underwent surgeries lasting up to 40 minutes without needing rescue analgesics. This highlights the necessity of repeatedly administering low-dose ketamine intra-operatively in order to improve analgesia following surgery. Published research employing IV ketamine (bolus or infusion) to reduce postoperative pain from 1966 to 2010 was included in a systematic review conducted by Laskowski et al. They came to the conclusion that the analgesic impact of ketamine was unaffected by the kind of intraoperative opioids used, the time it was given, and the dosage[14]. Our study also demonstrates that the length of the procedure and, consequently, the ketamine dosage have no bearing on how long analgesia lasts. Few trials with patients undergoing laparoscopic surgery have used ketamine as a single preventive dosage. Preemptive ketamine at a dose of 0.15 mg/kg induced analgesia for 108 minutes in procedures with an average duration of 80 minutes, according to a research by Kwok et al[15] In their study, Singh et al. examined patients undergoing laparoscopic cholecystectomy and found that analgesia comparable to higher dosages was produced when a dose of 0.5 mg/kg ketamine was administered shortly before induction.[16] In this trial, the first rescue analgesia was observed after 119 minutes. Nevertheless, the length of the surgery was not stated in this study.[16] Similar research was done by Atashkhoyi et al. on patients undergoing laparoscopic gynecological surgery using a single, preemptive dose of 0.5 mg/kg ketamine. In their trial, the average length of analgesia was 165 minutes, while the average duration of surgery was 45 minutes.[17] We observed that the average analgesic duration for procedures with a mean duration of 30 minutes was 360 minutes when we used intermittent low-dose ketamine in our trialwhich is significantly higher than above studies. This highlights the fact that using ketamine both before and during surgery is linked to a more effective and prolonged analgesic effect. Few studies have been conducted with continuous IV infusions of ketamine, and those have shown inconsistent results due to the wide variety of dosage regimens used. In contrast to our study, which used ketamine as the only analgesic, other studies employed analgesics such as tramadol, paracetamol, ketoprofen, and/or epidural analgesia; as a result, the analgesic effect seen cannot be solely attributed to ketamine.[18,19] Argiriadou et al. investigated the use of ketamine preincisionally and repeatedly during surgery in patients having major abdominal surgery under general and epidural anesthesia. Following their awaking three and six hours later, they reported lower pain scores than those who received a placebo.[20] According to Mendes et al.'s research, for patients having major abdominal surgery, perioperative S(+)-ketamine administration is preferable to intraoperative use. This conclusion contradicts our observations, most likely as a result of the types of operation. Comparatively speaking, our procedures results in less tissue damage than major abdominal surgery. Intraoperative hemodynamic parameters were better controlled with the use of ketamine. Our patients demonstrated significant variations in SBP,DBP or heart rate in two or three occasions without any hemodynamic compromise. Oxygen saturation, as demonstrated on monitor when fell down below 93% were promptly taken care off by providing 100% oxygen via face mask, returned to normalcy without further intervention. In-fact all our patients breathed spontaneously throughout procedures under anaesthesia and in the recovery room without even oxygen support. The variations fell within the baseline's 20% range, suggesting adequate hemodynamic stability.There were not many postoperative problems, and treating them with medicine was simple. Among the three patients who responded favorably to midazolam, mild psychomimetic responses were noted. It's crucial to remember that neither the ketamine dosage nor

the length of the procedure affect the rate of complications. Our study's rate of problems is similar to those of other similar earlier investigations. After any major surgery, opioids have been the predominant analgesic used to relieve acute postoperative pain; however, opioid-related side effects impede prompt recovery and rehabilitation. Since we didn't utilize any opioids, we were able to counteract these negative effects by repeatedly using ketamine for analgesia at a dose of 0.5 to 1 mg/kg.Our study's primary constraint was the brief follow-up period. There was no long-term follow-up on mechanical hyperalgesia and the discomfort that persisted. According to Corssen and Domino, nitrous oxide is known to increase the analgesic efficacy of subanesthetic dosages of ketamine; however, nitrous oxide was not employed in this investigation.[21] Since ketamine has been shown to possess NMDA antagonist characteristics, it(NO2) might would boost NMDA receptor inhibition.[22] It is debatable, though, whether or not its effects continue beyond the postoperative phase. Since the use of other analgesics, such as NSAIDs or opioids, would have interfered with the assessment of ketamine's analgesic efficacy, there was no control group in this study. In the control group, it would not have been ethically acceptable to use no analgesic.

CONCLUSION

Ketamine can be utilized as the only anesthetic and analgesic drug in a variety of short-term procedures when the inducing dose is between 2 and 3 mg/kg. This dosage produces sufficient anesthesia and effective postoperative analgesia with few adverse effects.

In patients for whom NSAIDs are contraindicated, ketamine at half the starting dose or even at low dose subsequently exhibits adequate hemodynamic control and dramatically reduces the requirement for rescue analgesia.

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Conflicts of interest : There are no conflicts of interest.

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