Section: Dentistry

Original Research Article

COMPARATIVE STUDY OF LIGNOCAINE WITH KETAMINE VERSUS LIGNO-CAINE ALONE IN THE SURGICAL EXTRACTION OF IMPACTED MANDIBULAR THIRD MOLAR

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Abstract

Background: The surgical removal of the third molar is generally accompanied by postoperative incidences of complications and side effects, like pain, swelling and trismus. In our study, we aim to improve or modify the intraoperative and postoperative period for a patient undergoing surgical removal of the third molar, i.e., by modification of the immune system in an attempt to interfere with the early detection mechanism of "Toll-Like Receptors" (TLRs) and thereby reduce the swelling, as well by interfering on N-Methyl D-Aspartate receptor, reducing pain. Ketamine, a phencyclidine derivative, a dissociative anaesthetic drug, is used in this study. **Materials and Methods:** Patients with bilateral identically impacted third molar with identical difficulty scores, re-quiring surgical removal of the impacted third molar, were included in the study. A total of 20 patients were present, of which 20 were study sites, and 20 were control sites (split mouth). The sites were selected in a randomised manner to prevent bias. Radiographic evaluation and difficulty score determination were done on Orthopantomogram (OPG). A basic Preoperative Anaesthetic Evaluation (PAE) was done. Surgical sites were prepared, a combination of Ketamine and Lignocaine with Adrenaline (1:80000) was administered locally at study sites, and Lignocaine with Adrenaline (1:80000) alone was administered at control sites. Intraoperatively and postoperatively, basic vital parameters were monitored. Evaluation of preoperative swelling and mouth opening, intra-operative pain, and post-operative pain swelling and mouth opening at 24hr, 48hr, and 1week time was done to determine the efficacy of Ketamine in reducing pain swelling and increasing mouth opening and the parameters were recorded and were statistically analysed. **Result:** There were significant changes between study sites and control sites for pain swelling and trismus after surgical removal of the third molar. This split-mouth study with 20 patients compared pain, swelling, and trismus between two anaesthetic protocols: LAK (Ketamine 0.3 mg/kg with 2% lignocaine and adrenaline) and LAA (2% lignocaine and adrenaline alone). Pain scores on days 1 and 2 were significantly lower in the LAK group compared to LAA ($p < 0.01$). The swelling was significantly less in the LAK group on day 2, though both groups' swelling normalised by day 7. Trismus was significantly less severe in the LAK group ($p < 0.001$. **Conclusion:** Ketamine serves as a valuable adjunct to lignocaine in the reduction of post-operative pain, facial swelling and trismus after surgical removal of impacted mandibular third molars.

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INTRODUCTION

The spectrum of oral and maxillofacial surgery has recently expanded in many directions, but the focus remains on dentoalveolar surgery.[1,2] The atraumatic removal of impacted teeth remains one of the most commonly performed procedures in the speciality of oral and maxillofacial surgery. To perform successful surgical removal of impacted third molars, thorough theoretical knowledge and extensive clinical training are required.[3] Recently, the number of complications has quadrupled when general practitioners performed the procedure. Reduction of postoperative discomfort and efficient local anaesthesia are essential for success in surgical practice. Lignocaine 2% with adrenaline 1:100,000 is considered the standard against which all local anaesthetics are compared. Multi-modal (balanced) analgesia is a newer approach to pain management that uses more than one agent or class of agents in low doses, reducing adverse effects and providing better pain relief through multiple mechanisms. Various adjuvants have been used for local anaesthetics to prolong the duration of analgesia.[5,6] These include non-steroidal anti-inflammatory drugs, opioid analgesics, alpha-2-adrenergic and ketamine. Ketamine is a well known general anaesthetic, short acting intraoperative analgesic and anti-inflammatory agent used for over four decades. However, delirium, hypertension and tachycardia have been limitations of its use.[7-9] A high dose of ketamine acts as an intravenous general anaesthetic, and low dose ketamine as an analgesic. In small doses (0.1-0.5 mg/kg), ketamine has a noticeable analgesic effect that can be used as an adjunct to local anaesthesia with minimal side effects. Several studies suggest that the administration of ketamine before the onset of noxious stimuli is even more effective.[10-11] This effect is called pre-emptive analgesia. According to the review of the literature, the present study aimed to evaluate the effect of lignocaine with ketamine versus lignocaine alone in the surgical extraction of the impacted mandibular third molar.

MATERIALSANDMETHODS

Study type: This is a split-mouth randomised clinical comparative study.
Study settings: Patients referred to the Department of Oral and Maxillofacial Surgery, Krishnadevaraya College of Dental Sciences and Hospital, Bengaluru, Karnataka.
Study period: February 2021 to January 2023.
Inclusion Criteria
Identical bilateral impacted third molar
• Pederson difficulty score 7-10 (Difficult)
• ASA I and ASA II
• The patient is willing to participate in the trial.
Exclusion Criteria
• Systemic comorbidity.
• Pregnancy.
• History of drug allergy and addiction.
Study Groups
LAA: Control site (Local anaesthetic alone)
LAK: Case study site (Local anaesthetic plus Ketamine).

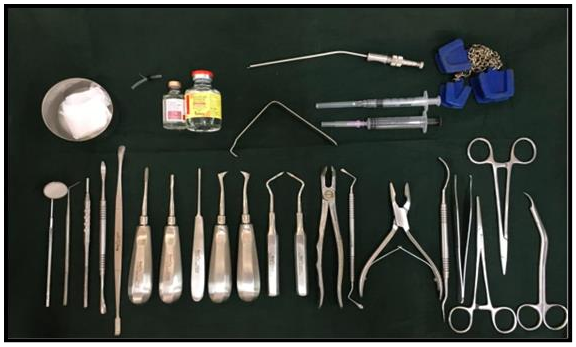
Figure-1: Armamentarium

Procedure
The study included a total of 20 patients who are classified under American Society of Anaesthesiologists status I & II, with bilateral symmetrical impacted mandibular third molar requiring surgical removal under local anaesthesia. Ketamine and 2% lignocaine & adrenaline (1:80,000) solution were used as an adjunct to reduce the post-surgical discomforts at the study site (impacted mandibular third molar). Written consent was obtained from every patient willing to undergo the procedure. The consent form contained information regarding the benefits, nature and possible complications expected during or after the procedure. At the study site, a combination of 2% lignocaine and adrenaline (1:80000) with ketamine is administered as a block before surgery and is checked for pain, swelling and mouth opening at 24 hrs, 42 hrs and 1 week post-operative. Control site 2% lignocaine and adrenaline (1:80000) is administered as a block before surgery and is checked for pain, swelling and mouth opening at 24 hrs, 42 hrs and 1 week post-operative.

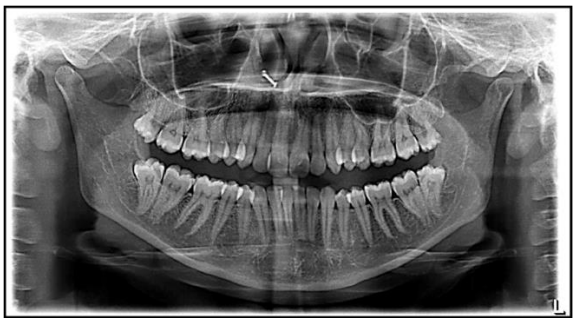
Image 1: Orthopantomograph (OPG) representative of bilaterally symmetrical impacted mandibular 3rd molar.

Study Site
The procedure is explained, and consent from the patient is taken. Blood pressure, respiratory rate, and pulse rate were recorded. Preparation of surgical site

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with the standard aseptic condition using 2% povidone iodine (mouth rinse). The procedure is carried out under a combination of local anaesthesia, 2% lignocaine hydrochloride with epinephrine 1:80000 with ketamine hydrochloride. Wards/modified wards incision placed. Full thickness mucoperiosteal flap reflected. Guttering of bone was done. Sectioning of the tooth, luxation and removal of the tooth was done. Intraoperative vitals (Blood pressure, SpO2, heart rate are monitored throughout the procedure. Debridement and irrigation of the surgical wound was done with normal warm saline. Surgical wound closure was done using 3-0 sterile silk. Antibiotics and analgesics (Cap. Amoxicillin 500 mg TID for 5 days and Tab. Diclofenac Sodium 50 mg + Paracetamol 400 mg TID for 3 days) was prescribed. Post-operative monitoring of pain, swelling and trismus was done after 24 hrs, 48 hrs and after 1 week.

Control site:

The procedure is explained, and consent from the patient is taken. Blood pressure, respiratory rate, and pulse rate were recorded. Preparation of surgical site with the standard aseptic condition using 2% povidone-iodine (mouth rinse). The procedure is carried out under local anaesthesia with 2% lignocaine hydrochloride and epinephrine 1:80000. Wards/modified wards incision placed. Full thickness mucoperiosteal flap reflected. Guttering of bone was done. Sectioning of the tooth, luxation and removal of the tooth was done. Intraoperative vitals (Blood pressure, SpO2, heart rate are monitored throughout the procedure. Debridement and irrigation of the surgical wound was done with normal warm saline. Surgical wound closure was done using 3-0 sterile silk. Antibiotics and analgesics (Cap. Amoxicillin 500 mg TID for 5 days and Tab. Diclofenac Sodium 50 mg + Paracetamol 400 mg TID for 3 days) was prescribed. Post-operative monitoring of pain, swelling and trismus was done after 24 hrs, 48 hrs and after 1 week.

Observations

Pre-operative parameters like pain, swelling (baseline measurement) and mouth opening (baseline measurement), and post-operative pain, swelling and mouth opening on days 1, 2, and 7 was measured.

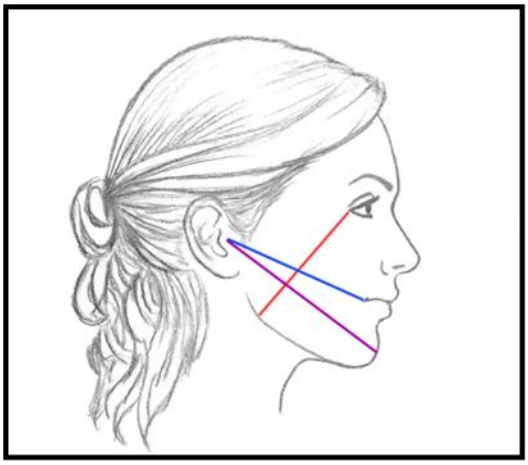

Image 2: Gabka and Matsumara Technique: Illustration of facial swelling evaluation:- (i) Red line: lateral corner of the eye to the angle of the mandible (LCE-AM). (ii) Blue line: tragus to the outer corner of the mouth (T-OCM). (iii) Purple line:

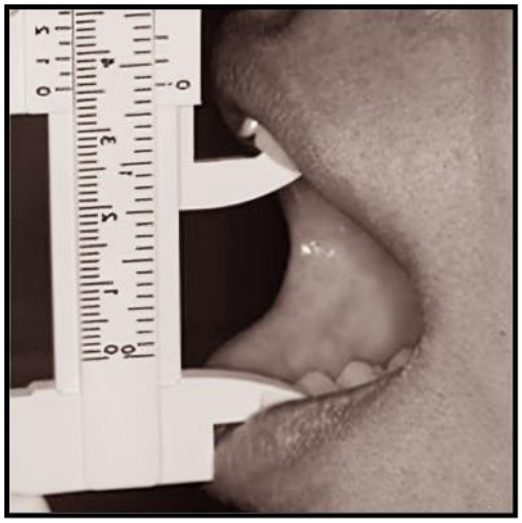

Figure 2: Illustration of evaluation of mouth opening using vernier calliper (inter incisal distance measured).

Statistical Analysis

The data was expressed in mean and standard deviation. Statistical Package for Social Sciences (SPSS 20.0) version used for analysis. The chi-square test was applied to find the statistical significance between the groups. p value less than 0.05 is considered statically significant at a 95% confidence interval.

RESULTS

Pain

Pain was compared on pre-operative and post-operative days 1, 2 and 7 between the LAA and LAK groups using a visual analogue scale (VAS). The LAA group showed a high pain score compared to the LAK group. It was observed that a comparison of mean pain scores on postoperative days 1, 2 and 7 showed significant differences on Day 1 from other days (p-value <0.001). [Table 1].

Swelling

Mean swelling values were compared between the LAA and LAK groups. Pre-operatively, neither of the groups showed any significant difference. Day 1 also did not show any significant difference between LAA and LAK groups. On Day 2, the LAA group showed a higher swelling score compared to the LAK group. Day 7 did not show any significant difference between the LAA and LAK groups (p-value <0.001). [Table-2,3 and 4].

Trismus

Mean mouth-opening values were compared between the LAA and LAK groups. At pre-operative and day 7, compared mean mouth opening values between the

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groups did not show any significant difference. In a comparison of day 1 and day 2, the mean mouth opening values showed a significant difference on day 2 than day 1 (p-value <0.001). [Table-5].

Table 1: Comparison of Pain at Pre-op, Day 1, Day 2 and Day 7 between Group 1 (2% Lignocaine with Epinephrine) and Group 2 (2% Lignocaine with Epinephrine + Ketamine) using Independent T-test.

Time interval	Groups	MEAN±SD	p value
Pre-OP	Without Ketamine	1.30±1.26	**0.001**
	With Ketamine	0.20±0.41*	
Day-1	Without Ketamine	4.95±1.23	**0.0001**
	With Ketamine	1.70±1.12*	
Day-2	Without Ketamine	4.15±1.42	**0.0001**
	With Ketamine	1.20±0.76*	
Day-7	Without Ketamine	2.20±1.23	**0.0001**
	With Ketamine	0.30±0.47*	

(*p<0.05 significant)

Table 2: Comparison of Swelling at Pre-op, Day 1, Day 2 and Day 7 between group 1 (2% Lignocaine with Epinephrine) and group 2 (2% Lignocaine with Epinephrine + Ketamine) within T-OCM using Independent T-test.

Time interval	Groups	MEAN±SD	p value
Pre-OP	Without Ketamine	103.46±6.80	**0.63**
	With Ketamine	102.41±6.93	
Day-1	Without Ketamine	107.88±6.30	**0.05**
	With Ketamine	103.72±7.01	
Day-2	Without Ketamine	112.63±7.17	**0.002**
	With Ketamine	104.98±7.01	
Day-7	Without Ketamine	103.97±6.62	**0.54**
	With Ketamine	102.65±6.97	

(*p<0.05 significant)

Table 3: Comparison of Swelling at Pre-op, Day 1, Day 2 and Day 7 between group 1 (2% Lignocaine with Epinephrine) and group 2 (2% Lignocaine with Epinephrine + Ketamine) within T-STP using Independent T-test.

Time interval	Groups	MEAN±SD	p value
Pre-OP	Without Ketamine	121.88±8.33	**0.74**
	With Ketamine	121.01±8.16	
Day-1	Without Ketamine	127.00±8.25	**0.11**
	With Ketamine	122.79±8.20	
Day-2	Without Ketamine	132.05±8.30	**0.004**
	With Ketamine	124.27±7.91	
Day-7	Without Ketamine	122.61±8.29	**0.64**
	With Ketamine	121.39±8.29	

(*p<0.05 significant)

Table 4: Comparison of Swelling at Pre-op, Day 1, Day 2 and Day 7 between group 1 (2% Lignocaine with Epinephrine) and group 2 (2% Lignocaine with Epinephrine + Ketamine) within LCE-AM using Independent T-test.

Time interval	Groups	MEAN±SD	p value
Pre-OP	Without Ketamine	103.70±4.52	**0.27**
	With Ketamine	102.21±3.87	
Day-1	Without Ketamine	108.61±5.04	**0.003**
	With Ketamine	103.91±4.25*	
Day-2	Without Ketamine	113.60±6.74	**0.0001**
	With Ketamine	105.50±4.82*	
Day-7	Without Ketamine	103.68±3.89	**0.33**
	With Ketamine	102.46±3.99	

(*p<0.05 significant)

Table 5: Comparison of mouth opening at Pre-op, Day 1, Day 2 and Day 7 between group 1 (2% Lignocaine with Epinephrine) and group 2 (2% Lignocaine with Epinephrine + Keta-mine) using Independent T-test.

Time interval	Groups	MEAN±SD	p value
Pre-OP	Without Ketamine	47.66±2.81	**0.30**
	With Ketamine	70.22±96.70	
Day-1	Without Ketamine	41.76±3.52	**0.001**
	With Ketamine	46.72±2.39*	
Day-2	Without Ketamine	38.24±3.97	**0.0001**
	With Ketamine	45.71±2.65*	
Day-7	Without Ketamine	48.59±9.09	**0.95**
	With Ketamine	48.48±1.99	

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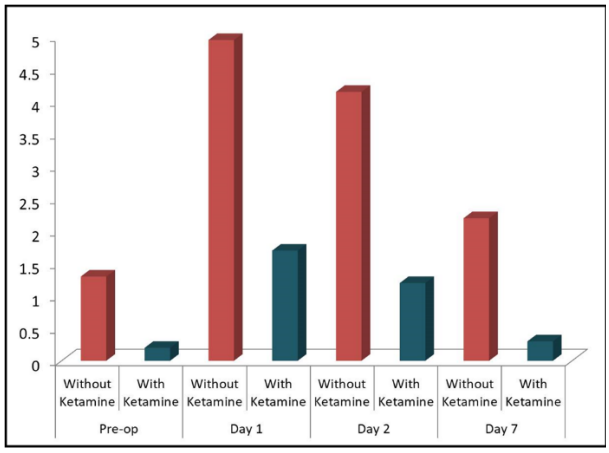
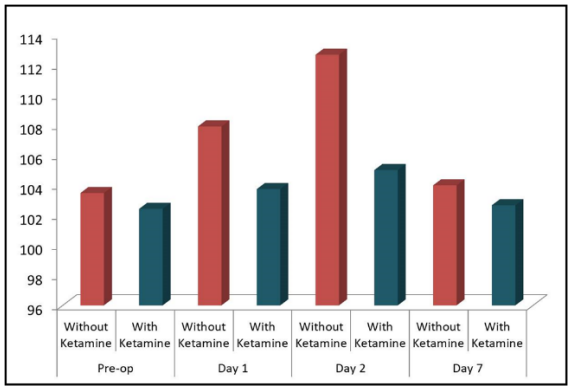
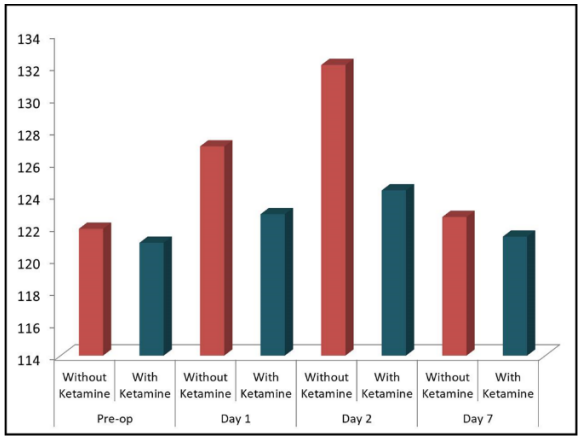


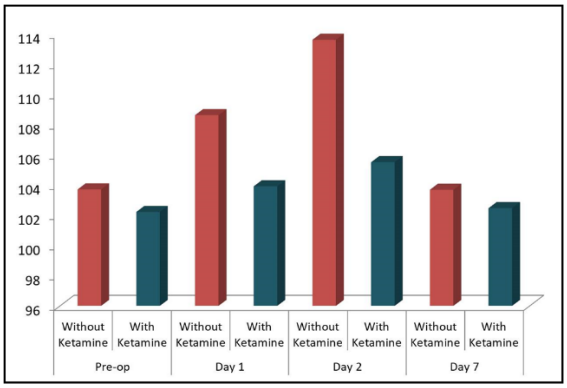
Graph 1: Comparison of Pain at Pre-op, Day 1, Day 2 and Day 7 between LAA group (2% Lignocaine with Epinephrine) and LAK group (2% Lignocaine with Epinephrine + Ketamine) using Independent T-test.



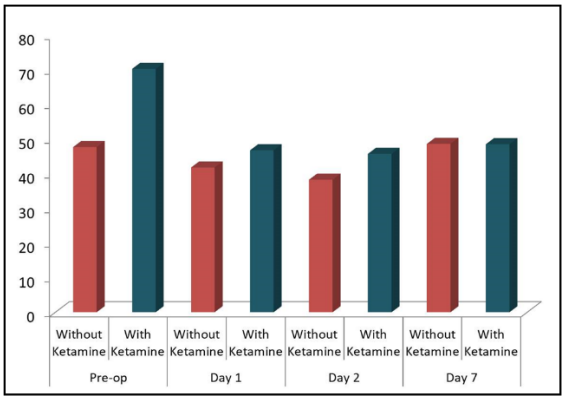
Graph 2: Comparison of Swelling at Pre-op, Day 1, Day 2 and Day 7 between the LAA group (2% Lignocaine with Epinephrine) and LAK group (2% Lignocaine with Epinephrine + Ket-amine) within T-OCM using Independent T-test.



Graph 3: Comparison of Swelling at Pre-op, Day 1, Day 2 and Day 7 between the LAA group (2% Lignocaine with Epinephrine) and LAK group (2% Lignocaine with Epinephrine + Ket-amine) within T-STP using Independent T-test.



Graph 4: Comparison of Swelling at Pre-op, Day 1, Day 2 and Day 7 between the LAA group (2% Lignocaine with Epinephrine) and LAK group (2% Lignocaine with Epinephrine + Ket-amine) within LCE-AM using Independent T-test.



Graph 5: Comparison of mouth opening at Pre-op, Day 1, Day 2 and Day 7 between the LAA group (2% Lignocaine with Epinephrine) and LAK group (2% Lignocaine with Epinephrine + Ketamine) using Independent T-test.

DISCUSSION

Evaluation of the difficulty of third molar surgery is the fundamental basis of optimal treatment planning aiming for minimal complications. A correlation of clinical and radiographic information is necessary for an intelligent estimate of the time to be taken to remove a tooth. Patient factors may be as influential as the increasing difficulty of third molar surgery, including age, gender, size and ethnic background; however, only age has been previously associated with increased surgical time and complications. [12, 13] This split-mouth clinical controlled study allowed the same operating surgeon to bilaterally remove, on the same patient, a matched pair of symmetrically impacted 3rd molars to eliminate operator bias and patient factor bias. Surgical removal of impacted mandibular third molars is one of the most common dento-alveolar procedures carried out by oral surgeons and is usually followed up post-operatively by pain, varying degrees of swelling and trismus. Pain, swelling, and trismus are common post-

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operative complaints and mostly influence the quality of life in the days following surgery.[14-16] Minimising post-operative pain, swelling, and trismus enables patients who have undergone the surgical procedure to remove their third molars to return to normal work-related and social activities within a shorter time. The availability of a myriad number of potent local anaesthetic solutions makes satisfactory analgesia possible during dental surgical procedures. Conventional local anaesthetics are adequate but of short duration; however, in most oral surgical procedures, a prolonged duration of analgesia would be desirable. It has been clearly stated above that total or optimal pain relief allowing for normal activity cannot be achieved by a single drug or modality, thus, combined analgesic protocols or a multimodal approach to postoperative pain therapy is recommended. The rationale for this is the achievement of adequate analgesia because of the synergistic effects of various analgesics with concurrent reduction of side effects of each agent.

Ketamine is frequently known as a "unique drug" due to its hypnotic (sleep-inducing), analgesic (ache relief), and amnesiac (short-time period remin-iscence loss) effects. No other drug used in clinical practice combines these three important properties simultaneously. Ketamine is chemically (+/-) 2- (2-chlorophenyl)-2-(methylamino)-cyclohexanone.

Ketamine has a molecular weight of 274.4 M and a chemical formula of C 13 H 16 ClNO. The melting point of ketamine is 258°C to 261°C. Ketamine is water- and fat-soluble, which makes it convenient to administer by a variety of routes, but it crosses the blood-brain barrier quickly.[17] Ketamine induces a state of anaesthesia called "dissociative anaes-thesia." It is characterised by analgesia, arousal and cognitive changes but is not a sedative or hypnotic. Ketamine appears to selectively disrupt the thalamocortical system. The patient soon goes into a trance-like state, with wide-open eyes and nystagmus. It causes unconsciousness and amnesia and is deeply analgesic. The airway is remarkably patent, and the pharyngolaryngeal reflex is only slightly suppressed, which is maintained in almost all patient head positions, far superior to other anaesthesia. Dissociative anaesthesia is the result of decreased activation of thalamocortical structures and increased activity in the limbic system and hippocampus. Bioavailability is 93% after intramuscular administration, 25-50% after intranasal administration, and only 17% after oral administration. Ketamine rapidly distributes to the brain and other highly perfused tissues. 12% is plasma-bound protein. Oral administration reduces the peak concentration of ketamine but increases the abundance of the metabolites nor ketamine and dehydronorketamine. [18]

This study includes a total of 20 patients (split-mouth study- 20 study sites 'LAK'- a combination of ketamine (0.3 mg/kg body weight) with 2% lignocaine and adrenaline 1:80000 and 20 control sites,' LAA'- 2% lignocaine and adrenaline 1:80000 alone) out of which 8 (40%) were female and 12 (60%) were male. In this study, we compared pain intensity in both groups using a visual analogue scale (VAS) on days 1, 2 and 7 after surgery. Pain scores were highest on postoperative day 1 in LAA sites compared to LAK sites and gradually decreased on postoperative day 2 and 7th day. The postoperative day 1 and day 2 pain scores were statistically significantly higher in the LAA group than in his LAK group, with $p < 0.01$. In our study, using the combination of local anaesthetic and sub-anaesthetic ketamine during surgical extraction of third molars produced long-lasting post-operative pain control. Postoperative swelling was measured by the tape measurement method described by Gabka and Matsumura. In this method, he took a sum of three measurements between her five fiducial points on the face and measured the difference between the preoperative and postoperative values. [19]In both groups, swelling increased on the first postoperative day and gradually decreased to preoperative levels on the seventh postoperative day. In both sites, the swelling increased on the first day after surgery, though the swelling was slightly significant in LAA sites compared to LAK sites, whereas the swelling was highly significant in LAA sites compared to LAK sites on day 2 and gradually decreased to preoperative levels on the seventh day after surgery. No statistically significant difference was found between the two groups on the 7th postoperative day. However, overall, the swelling was significant in LAA sites compared to LAK sites.

Trismus was calculated by measuring the distance between the mesic-incisal angles of the upper right and lower central incisors and calculating the difference from the preoperatively measured value. Mouth restriction was greatest at both sites on postoperative day 2, followed by postoperative day 1 and lower on postoperative day 7. The swelling was highly significant at LAK sites compared with LAA sites, and no significant statistical difference between the two groups was found on any postoperative day. Overall, had a highly significant opening at the LAK site compared to the LAA site ($p < 0.001$). The present results show that patients in the LAK group had a statistically significant reduction in pain perception on postoperative days 1 and 2 and a significant reduction in postoperative swelling on postoperative day 2. This is related to the synergistic effect of ketamine in enhancing analgesia. The relief of pain is in tune with the conclusion of a recent study done by Hadhimane et al., which concluded that pain scores on VAS at 30 minutes, 1, 4, 12 hours, and 1 day post-operatively were significantly lower in the Test group than in the Placebo group ($p<.05$). And in their trial concerning facial swelling and mouth opening the test group and placebo group showed overall no statistically significant difference ($p>.05$) on the 1st, 3rd and 7th-day postoperatively. [20]

In contrast to the current study, Kumar et al. concluded that there was a statistically significant difference in mouth opening between the LAA and

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LAK groups and a significant difference in facial swelling immediately after surgery and on the first postoperative day between the two groups. In their study, the dose of injected ketamine was slightly higher than ours, at 0.3 mg/kg. [21] Because the doses of these solutions in dental research are much lower than those used in medical practice, the associated risks can be considered low. It is used as a means of anaesthesia induction by the intravenous/ intramuscular route. A slow intravenous injection of a dose of 1-2 mg/kg over 60 seconds produces surgical anaesthesia within 1-2 minutes, which is expected to last 5-10 minutes. At doses of 6-8 mg/kg by deep intramuscular injection, surgical anaesthesia occurs within 3-5 minutes and is expected to last up to 25 minutes. After induction, administer successive doses of 50% of the original intravenous dose or 25% of the intramuscular dose as required.[22] Pical side effects after ketamine anaesthesia include memory loss, short-term memory changes, decreased concentration, decreased attention, cognitive changes, hallucinations, nightmares, headaches, dizziness, nausea and vomiting, blurred vision, excessive salivation and lacrimation.[23] With sub-anaesthetic doses, these reactions are infrequent. In our study, transient headache and transient dizziness were seen in three patients soon after administering the combination of 2% lignocaine and adrenaline 1:80000 with ketamine (0.3 mg/kg) and no adverse reaction was reported in patients administered with 2% lignocaine and adrenaline 1:80000 alone.

CONCLUSION

The anti-inflammatory action of ketamine is known, and ketamine has a distinct advantage during third molar extraction because of this anti-inflammatory property. We need to have some backup and alternative pain relievers. Low-dose ketamine is an additional tool that can be added to our belts. The use of ketamine in patients who may experience problems with opioid use (opioid tolerance, increased opioid pain, true allergies) is another indication for this promising drug. To summarise, the role of low-dose ketamine as an analgesic and anti-inflammatory is clear in our study. The combination of local anaesthetic and sub-anaesthetic doses of ketamine injected for surgical removal of the affected third molar provides good local anaesthesia while minimising postoperative sequelae for the patient by providing a degree of postoperative pain relief with less swelling.

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REFERENCES

1. Anand Shah, Rajashekar Halli, Yash Merchant, Rajesh Kshirsagar, Jyotsana Khurana. Efficacy of Ketamine as an Adjunct to Local Anaesthesia in the Surgical Removal of Impacted Mandibular Third Molars- A Split Mouth Prospective Controlled Clinical Study. Journal of Clinical and Diagnostic Research 2016;l-10(10):29-33.
2. Lytle JJ. Indications and contraindications for removal of the impacted tooth. Dent Clin of North America 1979;23(3):333-46.
3. White P, Ham J, Way WL, et al. Pharmacology of ketamine isomers in surgical patients. Anesthesiology 1980;52:231–239.
4. Welters ID, Hafer G, Menzebach A, et al. Ketamine inhibits transcription factors activator protein 1 and nuclear factor-kappaB, interleukin-8 production, as well as CD11b and CD16 expression: studies in human leukocytes and leukocytic cell lines. AnesthAnalg2010;110:934–41.
5. Hill GE, Anderson JL, Lyden ER. Ketamine inhibits the proinflammatory cytokine-induced reduction of cardiac intracellular Adenosine accumulation. AnesthAnalg1998;87:1015–19.
6. Cadieux JS, Leclerc P, St-Onge M, et al. Potentiation of neutrophil cyclooxygenase-2 by adenosine: an early inflammation signal. J Cell Sci 2001;118:1437–47.
7. Pouliot M, Fiset ME, Masse M, Naccache P, Borgeat P. Adenosine up-regulates cyclooxygenase- 2 in human granulocytes: impact on the balance of eicosanoid generation. J Immunol 2002;169:5279– 86.
8. Chiang N, Schwab JM, Fredman G, Kasuga K, Gelman S, Serhan CN. Anaesthetics impact the resolution of inflammation. PLoS ONE 2008;3:e1879.
9. LI Y, Li BWan X, et al. NMDA receptor activation stimulates transcription-independent wnt5a protein synthesis via the MAPK signalling pathway. Mol Brain 2012;5:1.
10. Ghosh S, Hayden M. New regulators of NF-kappaB in inflammation. Nat Rev Immunol 2008;8:837–848.
11. Domino E, Chodoff P, Corssen G. Pharmacologic effects of CI-581, a new dissociative anaesthetic in human. Clin Pharmacol Ther 1965;6:279–91.
12. Larenza MP, Landoni MF, Levionnois OL, Knobloch M, Kronen PW, Theurillat R, Schatzmann U, Thormann W. Stereoselective pharmacokinetics of ketamine and norketamine after racemic ketamine or S-ketamine administration during isoflurane anaesthesia in Shetland ponies. Br J Anaesth2007;98:204–12.
13. Gabka J, Matsumura T. Measuring techniques and clinical testing of an anti-inflammatory agent (tantum). Munch Med Wochenschr 1971;13:198.
14. Hadhimane A, Shankariah M, Neswi K. Pre-emptive analgesia with ketamine for relief of postoperative pain after surgical removal of impacted mandibular 3rd molars. J Oral Maxillofac Surg. 2015;15(2):156-63.
15. Kumar A, Kale TP. A comparative study between the effect of combined local anaesthetic and low-dose ketamine with a local anaesthetic on postoperative complications after impacted third molar surgery. J Contemp Dent Pract 2015;16(12):957-62.
16. Kohrs R, Durieux M. Ketamine: Teaching an old drug new tricks. AnaesthAnalg1998;87:1186- 93.
17. Launo C, Bassi C, Spagnolo L, et al. Pre-emptive Ketamine during general anaesthesia for postoperative analgesia in a patient undergoing laparoscopic cholecystectomy. Minerva Anestesiol2004;70:727-30.
18. De Kock M, Lavand'homme P, Waterloos H. 'Balanced analgesia 'in the pre-operative period: is there a place for ketamine? Pain 2001;92:373-80.
19. Tulin Satilmis, Hasan Garip DDS, Ersa Arpai DDS, Cem Sener DDS, Kamil Goker DDS. Assessment of combined Local Anaesthesia and Ketamine for Pain, Swelling, and Trismus After Surgical Extraction of Third Molars. Amerian Association of Oral and Maxillofacial Surgeons, Journal of Oral and Maxillofacial Surgery 2009;67:1206-1210.
20. Tushar Dubey, Manpreet Singh, Asish Sharma, Shyamalendu Laskar, Arpit vashistha. Combination of Articaine and Ketamine versus Articaine Alone After Surgical Extraction of Impacted Third Molar. Annals of Maxillofacial Surgery 2020;10(1):42-6.
21. Gupta R, Sharma K, Dhiman UK. Effect of Combination of Oral Midazolam and low dose Ketamine on Anxiety, Pain, Swelling and comfort during and after Surgical Extraction of

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Mandibular Third Molar. Indian Journal of Dental Research 2012;232;295.
22. Dripps RD, Lamont A, Eckenhoff JE. The Role of Anesthesia in Surgical Mortality. JAMA. 1961;178:261-66.
23. Renton T, Smeeton N, McGurk M. Factors predictive of difficulty of mandibular third molar surgery.Br Dent J 2001;190:607-10.
24. Dale O, Somogyi AA, Li Y, Sullivan T, Shavit Y. Does intra-operative ketamine attenuate inflammatory reactivity following surgery?: a systematic review and meta-analysis. AnaesthAnalg2012;115:934-43.
25. Tverskoy M, Oren M, Vaskovich M, Dashkovsky I, Kissen I. Ketamine enhances local anaesthesia and analgesic effects of bupivacaine by peripheral mechanism: a study in post-operative patients. NeuroscienceLetters1996;215:5-8.

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