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COMPARATIVE ANALYSIS OF INTRATHECAL KETAMINE HCL AND INTRATHECAL XYLOCAINE 5% FOR ANALGESIA IN LOWER ABDOMINAL AND LOWER LIMB SURGERIES

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Abstract

Background: This study compared the effectiveness of intrathecal Ketamine HCl and intrathecal Xylocaine 5% in 100 patients undergoing lower abdominal and lower limb surgeries. The study assessed onset and duration of analgesia, sensory and motor blockade, physiological changes, post-operative analgesia duration, and complications. Ketamine showed comparable analgesic efficacy to Xylocaine but had a longer duration of action and more hemodynamic changes, along with a higher incidence of emergence phenomena.

Methodology: Conducted at Government General Hospital, Gulbarga, 100 patients aged 20-55 years undergoing lower abdominal or limb surgeries were divided into four groups. Group I and II received 5% Xylocaine, while Group III and IV received preservative-free ketamine. Patients were premedicated with Phenergan and assessed for various parameters including onset and duration of analgesia, sensory and motor blockade, physiological changes, post-operative analgesia duration, and complications.

Results: Motor blockade varied across groups, with Group I and II showing higher complete motor blockade compared to Groups III and IV. Physiological changes, especially in pulse rate and blood pressure, were more pronounced in ketamine groups. Ketamine groups demonstrated longer post-operative analgesia durations compared to Xylocaine. Complications such as hypotension, nausea, vomiting, retention of urine, headache, and backache were observed, with ketamine groups showing a higher incidence of emergence phenomena.

Conclusion: Ketamine exhibited comparable analgesic efficacy to Xylocaine but had a longer duration of action and more pronounced hemodynamic changes. However, ketamine was associated with a higher incidence of emergence phenomena.

Keywords: Intrathecal Ketamine, Intrathecal Xylocaine, Analgesia, Motor Blockade, Physiological Changes

INTRODUCTION

Pain management in surgical procedures has evolved significantly over the years, with the introduction of various analgesic agents and techniques. One of the notable advancements was the "gate theory of pain" proposed by Melzack and Wall in 1967, which shifted the focus towards intraoperative and postoperative pain relief using synthetic analgesics.[1]

Ketamine, a dissociative anesthetic, has garnered attention for its potential as an intrathecal analgesic. In 1983, Ahuja and subsequently Carrasco et al. in 1984 demonstrated the safety of intrathecal ketamine administration in animal studies, observing no adverse effects on the spinal cord.[2] Building on this, Bion (1984) was the first to administer intrathecal ketamine to humans, specifically to war-injured patients. He reported distinct sensory anesthesia with motor loss lasting 45-90 minutes, highlighting the potential of ketamine as a spinal anesthetic.[3]

Further studies have explored the efficacy and safety of intrathecal ketamine in various surgical scenarios. Pragnya et al. (1993) observed that intrathecal ketamine provided effective surgical and postoperative analgesia for trauma cases, emphasizing its action via spinal nociceptors rather than systemic circulation.[4] Bansal et al. (1994) also evaluated the utility of intrathecal ketamine in emergency surgeries of the lower abdomen and limbs, concluding that it induced rapid analgesia with no significant side effects, positioning ketamine as a potential alternative to traditional local anesthetics.[5,6]

Comparatively, lidocaine (Xylocaine) has been a longstanding choice for intrathecal anesthesia due to its rapid onset and predictable duration of action. However, recent studies have suggested that ketamine, through its antagonism to NMDA receptors and involvement of descending inhibitory pathways, offers significant analgesia with a favorable safety profile.[7,8]

Given this backdrop, the current study aims to evaluate the effectiveness of intrathecal ketamine HCl compared to intrathecal Xylocaine 5% in providing anesthesia for lower abdominal and lower limb surgeries. By comparing the onset, duration, and quality of anesthesia, as well as assessing any potential side effects, we seek to provide insights that

may inform clinical practice and contribute to the evolving landscape of intrathecal anesthesia options.

METHODOLOGY

The study was conducted at tertiary care hospital in India. It included 100 patients of either sex, aged between 20-55 years, undergoing surgeries below the umbilicus. Patients were selected based on general health and systemic diseases, with only those belonging to ASA grade I & II included. Exclusion criteria comprised patients with a history of neurological, cardiovascular, liver diseases, bleeding disorders, and spinal deformities.

Patients were randomly divided into four groups. Group I received 1.5 cc of 5% Xylocaine with adrenaline (0.2 mg), Group II received 2 cc of 5% Xylocaine with adrenaline (0.2 mg), Group III received 1.5 cc (75 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1.5 cc of 5% dextrose, and Group IV received 2 cc (100 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1 cc of 5% dextrose.

All patients received injection Phenergan (promethazine) 25 mg intramuscularly 30 minutes prior to surgery to alleviate anxiety, induce sedation, and for its antiemetic and antisialogogue effects. Upon arrival in the operating theatre, pulse rate and blood pressure were recorded, and an intravenous drip was set up with lactated Ringer's solution. Patients were positioned in the left lateral position with the back parallel to the edge of the operating table, and the lumbar puncture was performed between the third and fourth lumbar spine. After skin infiltration with 2% lignocaine, lumbar puncture was made with a 23-gauge needle. Any abnormal pressure in CSF or hemorrhagic tap was excluded. Spinal anesthetic solutions were injected at a constant speed based on the assigned group.

After drug injection, the following parameters were assessed: time of injection of the spinal anaesthetic, onset of analgesia (interval between the injection of the drug and achieving the highest level of analgesia), duration of analgesia (period between the onset of analgesia and regression of analgesia by two dermatomes), degree of analgesia (sensory blockade), and degree of motor blockade (assessed using Bromage Scale). Intraoperative and postoperative complications were assessed on the day of surgery and on the 1st, 2nd, and 7th postoperative days for complications such as headache, backache, signs of meningeal irritation, and neurological symptoms.

RESULTS AND DISCUSSION

Table 1: Distribution of Surgical Procedures Across Study Groups

Operations	Group I	Group II	Group III	Group IV
Appendicectomy	4	8	4	8
Fissure in Ano	4	--	4	--
Fistula in Ano	2	--	2	--
Herniorapphy	7	--	7	--
Hydrocele	6	--	6	--
Orchidectomy	--	1	--	1
Orthopaedic lower limb surgery	--	5	--	5
Prostatectomy	--	3	--	3
Tubectomy	2	--	2	--
Vaginal Hysterectomies	--	8	--	8
Total	**25**	**25**	**25**	**25**

Patients were divided into four groups: Group I received 1.5 cc of 5% Xylocaine with adrenaline (0.2 mg), Group II received 2 cc of 5% Xylocaine with adrenaline (0.2 mg), Group III received 1.5 cc (75 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1.5 cc of 5% dextrose, and Group IV received 2 cc (100 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1 cc of 5% dextrose. All patients were premedicated with injection Phenergan (promethazine) 25 mg intramuscularly 30 minutes prior to surgery and underwent lumbar puncture for spinal anesthesia. The operations performed included appendicectomy, fissure in ano, fistula in ano, herniorrhaphy, hydrocele, orchidectomy, orthopedic lower limb surgery, prostatectomy, tubectomy, and vaginal hysterectomies. Each surgical procedure was distributed evenly across the four groups, with 25 cases in each group. The study assessed parameters such as time of injection, onset and duration of analgesia, degree of sensory and motor blockade, and intraoperative and postoperative complications. The outcomes were evaluated based on the highest level of analgesia and motor blockade, as well as the presence or absence of complications postoperatively.

Table 2: Mean Onset of Analgesia Observed in Four Study Groups

Group I	--	3 minutes
Group II	--	3 minutes
Group III	--	3 min. 40 sec.
Group IV	--	3 min. 40

		sec.

The mean onset of analgesia was assessed across the four study groups. In Group I, which received 1.5 cc of 5% Xylocaine with adrenaline (0.2 mg), the mean onset of analgesia was 3 minutes. Similarly, in Group II, which was administered 2 cc of 5% Xylocaine with adrenaline (0.2 mg), the mean onset of analgesia was also 3 minutes. For Group III, which received 1.5 cc (75 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1.5 cc of 5% dextrose, the mean onset of analgesia was slightly delayed at 3 minutes and 40 seconds. The same onset time was observed in Group IV, where patients were administered 2 cc (100 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1 cc of 5% dextrose. These findings indicate a comparable rapid onset of analgesia between the Xylocaine and ketamine groups, with a slightly longer onset observed in the ketamine groups, consistent with previous studies highlighting the potential of ketamine as a spinal anesthetic.[9]

Table 3: Duration of Analgesia Observed in Four Study Groups

Table 3: Present the duration of analgesia observation in four groups				
Time in min.	**Group I**	**Group II**	**Group III**	**Group IV**
30-60	8	5	7	--
61-90	15	8	16	3
91-120	2	12	2	10
121-150	--	--	--	12

The duration of analgesia was assessed across four study groups in specific time intervals. In Group I, which received 1.5 cc of 5% Xylocaine with adrenaline (0.2 mg), 8 patients experienced analgesia lasting between 30 to 60 minutes, 15 patients between 61 to 90 minutes, and 2 patients between 91 to 120 minutes. In Group II, administered with 2 cc of 5% Xylocaine with adrenaline (0.2 mg), 5 patients reported analgesia lasting between 30 to 60 minutes, 8 patients between 61 to 90 minutes, and 12 patients between 91 to 120 minutes. In Group III, which received 1.5 cc (75 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1.5 cc of 5% dextrose, 7 patients experienced analgesia between 30 to 60 minutes, 16 patients between 61 to 90 minutes, and 2 patients between 91 to 120 minutes. Lastly, in Group IV, administered with 2 cc (100 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1 cc of 5% dextrose, no patients reported analgesia between 30 to 60 minutes, 3 patients between 61 to 90 minutes, and 10 patients between 91 to 120 minutes. The table indicates a varied duration of analgesia across the groups, with a longer duration observed in the ketamine groups compared to the Xylocaine groups.

Table 4: Degree of Analgesia Observed in Four Study Groups

Degree analgesia	Group I	Group II	Group III	Group IV
I	24	25	20	22
II	1	--	3	2
III	--	--	1	1

The degree of analgesia was assessed across the four study groups. In Group I, which received 1.5 cc of 5% Xylocaine with adrenaline (0.2 mg), 24 patients achieved perfect analgesia (Grade I), while 1 patient had satisfactory analgesia requiring supplementation (Grade II). In Group II, administered with 2 cc of 5% Xylocaine with adrenaline (0.2 mg), all 25 patients achieved perfect analgesia (Grade I). In Group III, which received 1.5 cc (75 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1.5 cc of 5% dextrose, 20 patients had perfect analgesia (Grade I), 3 patients required supplementation (Grade II), and 1 patient experienced complete failure requiring general anesthesia (Grade III). In Group IV, administered with 2 cc (100 mg) of preservative-free ketamine with adrenaline (0.2 mg) + 1 cc of 5% dextrose, 22 patients achieved perfect analgesia (Grade I), 2 patients had satisfactory analgesia requiring supplementation (Grade II), and 1 patient experienced complete failure requiring general anesthesia (Grade III). The table demonstrates a high rate of perfect analgesia in all groups, with some variability in the need for supplementation or general anesthesia.

Table 5: Motor Blockade, Physiological Changes, Duration of Post-Operative Analgesia, and Complications Observed in Four Study Groups

Grade of motor blockade	Group I	Group II	Group III	Group IV
0 I	-- 1	-- --	-- --	-- --
II	2	1	3	2
III	22	24	22	23
Pulse rate change				
Change less than 10% from pre- operative value	-23	-22		
Changes between 11-20% from pre- operative value	-2	-3	24	22
Changes more than 20% from pre- operative value			1	3
Blood pressure change				

Change less than 10% from pre- operative value	-18	-10	17	10
Changes between 11-20% from pre- operative value	-2	-3	24	22
Changes more than 20% from pre- operative value	--	-3	--	--
Duration of Post Operative Analgesia in minutes				
30-60	5	6	--	--
61-120	--	2	10	--
121-180	--	--	14	9
181-240	--	--	--	16
Complication				
Hypotension Mild	10	18	--	--
Moderative	2	4	--	--
Severe Emergence phenomena	-- --	-- --	-- 2	-- 4
Nausea	1	2	1	1
Vomiting	--	2	1	--
Retention of urine	--	1	--	1
Headache	1	2	--	1
Backache	--	1	--	--

The degree of motor blockade varied across the groups, with a higher prevalence of complete motor blockade observed in the Xylocaine groups (Groups I and II) compared to the ketamine groups (Groups III and IV). Specifically, Group I had 2 patients with partial blockade (Grade II) and 22 with complete blockade (Grade III), while Group II had 1 patient with partial blockade and 24 with complete blockade. For the ketamine groups, Group III had 3 patients with partial blockade and 22 with complete blockade, and Group IV had 2 patients with partial blockade and 23 with complete blockade.

In terms of physiological changes, pulse rate and blood pressure alterations were more pronounced in the ketamine groups, particularly in Group III. For pulse rate, 23 patients in Group I and 22 in Group II experienced a decrease of less than 10% from the pre-operative value. In contrast, 24 patients in Group III and 22 in Group IV experienced an increase between 11-20% from the pre-operative value. Regarding blood pressure, Group I had 18 patients with a decrease of less than 10%, Group II had 10 patients, Group III had 17 patients with an increase of less than 10%, and Group IV had 10 patients.

The duration of post-operative analgesia was longer in the ketamine groups compared to the Xylocaine groups. Specifically, in Group III, 10 patients experienced analgesia lasting between 61-120 minutes, 14 patients between 121-180 minutes, and 9 patients between 181-

240 minutes. In Group IV, 16 patients had analgesia lasting between 181-240 minutes. However, in the Xylocaine groups, Group I had 5 patients and Group II had 6 patients with analgesia lasting between 30-60 minutes, and Group II had 2 patients with analgesia lasting between 61-120 minutes.

Regarding complications, Group II had a higher incidence of mild and moderate hypotension compared to other groups. Emergence phenomena, a side effect associated with ketamine, was observed in both ketamine groups, particularly in Group IV. Additionally, nausea was reported in Group I (1 patient), Group II (2 patients), Group III (1 patient), and Group IV (1 patient). Vomiting was observed in Group II (2 patients) and Group III (1 patient). Retention of urine was reported in Group II (1 patient) and Group IV (1 patient). Headache was reported in Group I (1 patient), Group II (2 patients), and Group IV (1 patient), while backache was reported in Group II (1 patient).

CONCLUSION

In conclusion, ketamine demonstrated comparable efficacy to Xylocaine in providing analgesia with a longer duration of action and fewer hemodynamic changes. However, ketamine was associated with a higher incidence of emergence phenomena.

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