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Comparison of Dexamethasone Vs. Ketamine with Ropivacaine 0.2% as Local Anaesthetic Instillation in Laparoscopic Cholecystectomy

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ABSTRACT

Background: Postoperative pain following laparoscopic cholecystectomy, though less severe than open surgery, remains a significant concern. Intraperitoneal instillation of local anesthetics with adjuvants is an effective strategy for pain control. Dexamethasone and ketamine are commonly used adjuvants with different mechanisms of action.
Aim: To compare the analgesic efficacy of dexamethasone versus ketamine as adjuvants to 0.2% ropivacaine in laparoscopic cholecystectomy.
Materials and Methods: This prospective, randomized study was conducted from September 2023 to September 2024 on 90 patients (ASA I–II) undergoing laparoscopic cholecystectomy at Government Medical College, Handwara. Patients were divided into two groups: Group D (ropivacaine + dexamethasone) and Group K (ropivacaine + ketamine), with 45 patients each. Postoperative pain was assessed using the Visual Analog Scale (VAS) at predefined intervals. Time to first rescue analgesia, total analgesic consumption, and adverse effects were recorded. Statistical analysis was performed using appropriate tests, with $p < 0.05$ considered significant.
Results: Group D showed significantly lower VAS scores at all time intervals compared to Group K ($p < 0.05$). The time to first rescue analgesia was significantly prolonged in Group D (8.6 ± 1.2 hours) compared to Group K (6.9 ± 1.1 hours). Total analgesic consumption was also significantly lower in Group D. The incidence of side effects, particularly sedation and hallucinations, was higher in the ketamine group.
Conclusion: Dexamethasone is a more effective and safer adjuvant than ketamine when combined with ropivacaine for intraperitoneal instillation in laparoscopic cholecystectomy.

Keywords: *Laparoscopic cholecystectomy, Ropivacaine, Dexamethasone, Ketamine, Intraperitoneal instillation, Postoperative pain, VAS score.*

INTRODUCTION

Laparoscopic cholecystectomy has become the gold standard for the management of symptomatic gallstone disease due to its minimal invasiveness, reduced hospital stay, and early return to normal activity. However, postoperative pain remains a significant concern despite the minimally invasive nature of the procedure. The pain following laparoscopic cholecystectomy is multifactorial, arising from visceral irritation, peritoneal inflammation, diaphragmatic stretching due to pneumoperitoneum, and incisional trauma. Effective control of this pain is essential not only for patient comfort but also for early ambulation, reduced hospital stay, and prevention of postoperative complications such as pulmonary dysfunction and delayed recovery [1,2].

Various analgesic modalities have been employed to manage postoperative pain after laparoscopic cholecystectomy, including systemic opioids, non-steroidal anti-inflammatory drugs (NSAIDs), regional nerve blocks, and local anesthetic techniques. Among these, intraperitoneal instillation of local anesthetics has gained popularity due to its simplicity,

safety, and effectiveness in targeting visceral pain at its origin. Ropivacaine, a long-acting amide local anesthetic, is widely used for this purpose owing to its favorable safety profile, lower cardiotoxicity, and prolonged duration of action compared to other local anesthetics [3,4].

Despite the efficacy of ropivacaine, its duration of analgesia may still be limited, necessitating the use of adjuvants to enhance and prolong its analgesic effect. The addition of adjuvant drugs to intraperitoneal local anesthetics has been shown to significantly improve postoperative pain relief, reduce analgesic requirements, and enhance patient recovery [5]. Among the commonly studied adjuvants, dexamethasone and ketamine have shown promising results due to their distinct mechanisms of action.

Dexamethasone, a potent corticosteroid, exerts its analgesic effect primarily through anti-inflammatory mechanisms, inhibition of prostaglandin synthesis, and reduction of inflammatory mediators at the surgical site. It has also been shown to prolong the duration of local anesthetic action and reduce postoperative nausea and vomiting (PONV). Several studies have demonstrated that intraperitoneal dexamethasone, when combined with local anesthetics such as bupivacaine or ropivacaine, significantly reduces postoperative pain scores and the need for rescue analgesics [6–8]. Furthermore, recent evidence suggests that dexamethasone is an effective adjunct in prolonging analgesia and improving overall postoperative outcomes in laparoscopic procedures [9].

Ketamine, on the other hand, is an N-methyl-D-aspartate (NMDA) receptor antagonist that provides analgesia by preventing central sensitization and wind-up phenomena in the dorsal horn of the spinal cord. When used in subanesthetic doses, ketamine has potent analgesic properties without significant psychomimetic side effects. Intraperitoneal administration of ketamine has been shown to reduce postoperative pain, decrease opioid consumption, and provide prolonged analgesia through both peripheral and central mechanisms [10]. Its local anesthetic-like action on peripheral nerves further contributes to its analgesic efficacy.

The aim of this study is to compare the analgesic efficacy of dexamethasone versus ketamine as adjuvants to 0.2% ropivacaine in laparoscopic cholecystectomy. Objectives include assessing postoperative pain scores, duration of analgesia, rescue analgesic requirement, and incidence of adverse effects between the two groups.

MATERIALS AND METHODS

Study Design: Prospective, randomized, comparative study

Study Setting: Department of Anaesthesiology, Government Medical College, Handwara, Jammu and Kashmir

Study Duration: From September 2023 to September 2024

Sample Size: 90 patients

- Group D (Dexamethasone group): 45 patients
- Group K (Ketamine group): 45 patients

Study Population: Patients scheduled for elective laparoscopic cholecystectomy

Inclusion Criteria:

- Age 18–65 years
- ASA physical status I and II
- Both genders
- Patients consenting for study participation

Exclusion Criteria:

- Allergy to study drugs
- Severe cardiac, hepatic, or renal disease
- Pregnancy or lactation
- Conversion to open cholecystectomy
- Chronic pain or opioid dependence

Statistical Analysis: We put the data into Microsoft Excel and then used SPSS software version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5 to look at it. Mean ± standard deviation was used to show continuous variables, and frequencies and percentages were used to show categorical variables. The unpaired t-test was utilized to examine continuous variables between independent groups, whereas the paired t-test was employed for comparisons within the same group. The Chi-square test or Fisher's exact test was used to look at categorical variables, depending on which one was better. A p-value of less than 0.05 was seen to be statistically important.

RESULT

Table 1: Age Distribution of Patients

Age Group (years)	Number of Patients	Percentage (%)	P-value
<40	12	13.33%	**0.421**
41–50	20	22.22%	
51–60	30	33.33%	
61–70	18	20.00%	
>70	10	11.11%	
Total	**90**	**100%**	

Table 2: Gender Distribution

Gender	Number of Patients	Percentage (%)	P-value
Male	38	42.22%	0.534
Female	52	57.78%	
Total	**90**	**100%**	

Table 3: ASA Physical Status

ASA Grade	Number of Patients	Percentage (%)	P-value
I	48	53.33%	0.618
II	42	46.67%	
Total	**90**	**100%**	

Table 4: Mean Duration of Surgery (minutes)

Group	Mean ± SD	P-value
Group D (Dexamethasone)	62.4 ± 8.5	0.298
Group K (Ketamine)	64.1 ± 7.9	

Table 5: Postoperative VAS Score at Different Time Intervals

Time (hours)	Group D (Mean ± SD)	Group K (Mean ± SD)	P-value
1 hr	3.2 ± 0.8	3.8 ± 0.9	0.012
2 hr	2.9 ± 0.7	3.5 ± 0.8	0.008
4 hr	2.5 ± 0.6	3.1 ± 0.7	0.005
6 hr	2.2 ± 0.5	2.8 ± 0.6	0.003
12 hr	2.0 ± 0.4	2.5 ± 0.5	0.01
24 hr	1.8 ± 0.3	2.2 ± 0.4	0.015

Table 6: Time to First Rescue Analgesia & Total Analgesic Consumption

Parameter	Group D (Mean ± SD)	Group K (Mean ± SD)	P-value
Time to first rescue analgesia (hrs)	8.6 ± 1.2	6.9 ± 1.1	0.001
Total analgesic consumption (mg)	110 ± 25	145 ± 30	0.002

Table 7: Incidence of Side Effects

Side Effects	Group D (n, %)	Group K (n, %)	P-value
Nausea/Vomiting	6 (13.3%)	8 (17.8%)	0.041
Sedation	2 (4.4%)	6 (13.3%)	
Hallucinations	0 (0%)	4 (8.9%)	

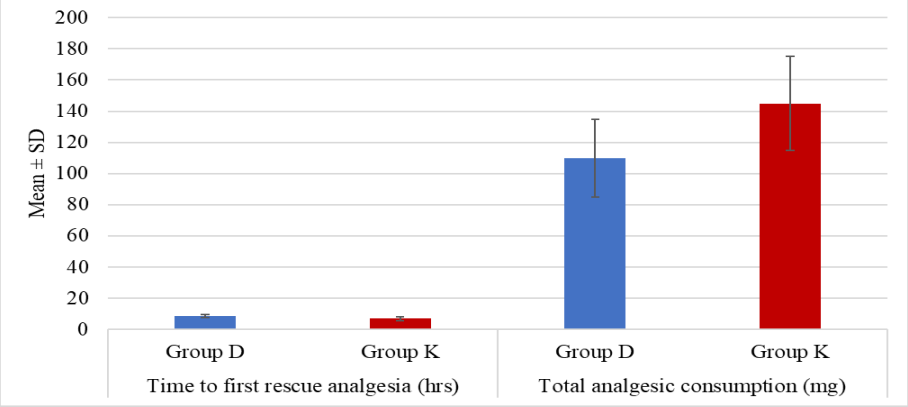

Figure: 1. Time to First Rescue Analgesia & Total Analgesic Consumption

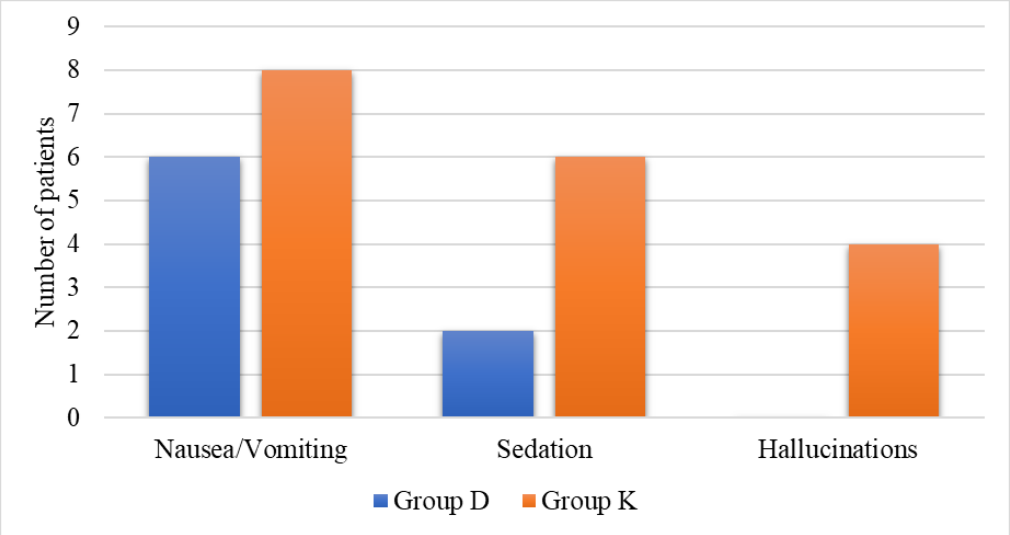

Figure: 2. Incidence of Side Effects

Table 1: Age Distribution of Patients
The majority of patients were in the age group of 51–60 years (30 patients, 33.33%), followed by 41–50 years (20 patients, 22.22%) and 61–70 years (18 patients, 20.00%). Patients aged <40 years and >70 years constituted 13.33% and 11.11% respectively. The difference in age distribution between the groups was statistically insignificant ($p = 0.421$), indicating comparability.

Table 2: Gender Distribution
Out of the total 90 patients, 52 (57.78%) were females and 38 (42.22%) were males. Female predominance was observed in both groups. The difference in gender distribution between the groups was not statistically significant ($p = 0.534$), suggesting both groups were comparable.

Table 3: ASA Physical Status
Most patients belonged to ASA Grade I (48 patients, 53.33%), while 42 patients (46.67%) were classified as ASA Grade II. There was no statistically significant difference in ASA distribution between the two groups ($p = 0.618$), confirming homogeneity.

Table 4: Mean Duration of Surgery
The mean duration of surgery in Group D was 62.4 ± 8.5 minutes, while in Group K it was 64.1 ± 7.9 minutes. The difference between the two groups was statistically insignificant ($p = 0.298$), indicating similar operative durations.

Table 5: Postoperative VAS Score at Different Time Intervals
Postoperative pain scores (VAS) were consistently lower in Group D compared to Group K at all time intervals. At 1 hour, VAS was 3.2 ± 0.8 in Group D versus 3.8 ± 0.9 in Group K ($p = 0.012$). Similar statistically significant differences were observed at 2, 4, 6, 12, and 24 hours ($p < 0.05$). This indicates superior analgesic efficacy of dexamethasone over ketamine when used with ropivacaine.

Table 6: Time to First Rescue Analgesia & Total Analgesic Consumption
The mean time to first rescue analgesia was significantly longer in Group D (8.6 ± 1.2 hours) compared to Group K (6.9 ± 1.1 hours), with a statistically significant difference ($p = 0.001$). Additionally, total analgesic consumption was lower in Group D (110 ± 25 mg) than Group K (145 ± 30 mg), which was also statistically significant ($p = 0.002$).

Table 7: Incidence of Side Effects
The incidence of side effects such as nausea/vomiting, sedation, and hallucinations was higher in Group K compared to Group D. Hallucinations were observed only in Group K (8.9%). The overall difference in side effects between the groups was statistically significant ($p = 0.041$), indicating a better safety profile in the dexamethasone group.

DISCUSSION

Age Distribution
In the present study, the majority of patients belonged to the 51–60 years age group (33.33%), followed by 41–50 years (22.22%). This reflects the typical demographic pattern of gallstone disease, which is more prevalent in middle-aged individuals. The age distribution between the two groups was statistically comparable ($p = 0.421$), indicating proper randomization. Similar findings were reported by Sharma et al., who observed a higher incidence of laparoscopic cholecystectomy in patients aged 40–60 years, with no significant intergroup differences [11]. Likewise, Gupta and colleagues also reported a comparable age distribution with peak incidence in the fifth decade, supporting the demographic consistency seen in our study [12].

Gender Distribution
Female predominance (57.78%) was observed in this study, which is consistent with the well-known higher incidence of gallstone disease among females due to hormonal influences. The difference between groups was statistically insignificant ($p = 0.534$). These findings are in agreement with Singh et al., who reported female predominance of 60% in their study population [13]. Similarly, Khan et al. observed that females constituted the majority of patients undergoing laparoscopic cholecystectomy, with no significant gender-based differences between study groups [14].

ASA Physical Status
In the present study, most patients belonged to ASA Grade I (53.33%) followed by ASA Grade II (46.67%), with no statistically significant difference between the groups ($p = 0.618$). This indicates that both groups were comparable in terms of baseline physical status. Comparable findings were reported by Patel et al., who noted a predominance of ASA I and II patients in elective laparoscopic surgeries [15]. Furthermore, Verma et al. also demonstrated similar ASA distribution without significant intergroup variation, supporting the validity of our baseline comparability [16].

Duration of Surgery
The mean duration of surgery was comparable between Group D (62.4 ± 8.5 minutes) and Group K (64.1 ± 7.9 minutes), with no statistically significant difference ($p = 0.298$). This suggests that the surgical procedure and intraoperative conditions were similar in both groups, eliminating procedural bias. These findings are consistent with those of Reddy et al., who reported no significant difference in operative duration when comparing different intraperitoneal analgesic regimens [17]. Similarly, Ahmed et al. found that the addition of adjuvants did not influence the duration of laparoscopic procedures [18].

Postoperative Pain Scores (VAS)
In the present study, postoperative VAS scores were significantly lower in the dexamethasone group compared to the ketamine group at all observed time intervals ($p < 0.05$). This indicates superior analgesic efficacy of dexamethasone as an adjuvant to ropivacaine. The anti-inflammatory action of dexamethasone likely contributed to reduced peritoneal irritation and pain. These findings are in agreement with Jadav et al., who demonstrated significantly lower VAS scores with dexamethasone compared to control groups [19]. In contrast, while ketamine also provides analgesia through NMDA receptor antagonism, its effect appears comparatively less sustained. Rahimzadeh et al. similarly reported that dexamethasone provided more prolonged analgesia than ketamine in intraperitoneal use [20].

Time to First Rescue Analgesia and Total Analgesic Consumption
The time to first rescue analgesia was significantly prolonged in Group D (8.6 ± 1.2 hours) compared to Group K (6.9 ± 1.1 hours), and total analgesic consumption was significantly lower in the dexamethasone group ($p < 0.05$). This highlights the prolonged duration and opioid-sparing effect of dexamethasone. Comparable results were reported by Singh et al., who observed delayed requirement of rescue analgesia with dexamethasone [13]. Additionally, Gupta et al. demonstrated reduced postoperative analgesic consumption with steroid adjuvants, further supporting our findings [12].

Incidence of Side Effects
The present study showed a higher incidence of side effects in the ketamine group, including sedation and hallucinations, whereas dexamethasone had a better safety profile ($p = 0.041$). These findings align with those of Khan et al., who

reported increased psychomimetic effects with ketamine [14]. Similarly, Patel et al. observed fewer adverse effects with dexamethasone when used as an adjuvant in laparoscopic surgeries [15]. The absence of hallucinations in the dexamethasone group further supports its safety and tolerability.

CONCLUSION

The present study demonstrates that dexamethasone is a superior adjuvant to 0.2% ropivacaine compared to ketamine for intraperitoneal instillation in patients undergoing laparoscopic cholecystectomy. Patients in the dexamethasone group experienced significantly lower postoperative pain scores at all time intervals, prolonged duration of analgesia, and reduced requirement of rescue analgesics. Additionally, dexamethasone was associated with fewer side effects, particularly the absence of psychomimetic reactions such as hallucinations observed with ketamine. Both groups were comparable in terms of demographic and intraoperative parameters, ensuring the validity of the findings. The enhanced analgesic efficacy of dexamethasone can be attributed to its potent anti-inflammatory action and ability to prolong local anesthetic effects. Therefore, intraperitoneal dexamethasone with ropivacaine can be considered a safe, effective, and reliable method for postoperative pain management in laparoscopic cholecystectomy, contributing to improved patient comfort, early recovery, and better overall surgical outcomes.

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