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ORIGINAL RESEARCH

Comparative study of intravenous dexmedetomidine versus ketorolac for postoperative pain relief in laparoscopic cholecystectomy in our setup

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is a common minimally invasive surgery that offers advantages like reduced hospitalization and faster recovery. However, postoperative pain management remains a critical concern, with pain originating from incision sites, pneumoperitoneum, and visceral pain. A multimodal analgesia approach combining opioids and non-opioids is often employed for effective pain relief. This study compares the efficacy of intravenous dexmedetomidine and ketorolac in providing postoperative analgesia following LC. **Objective:** To evaluate and compare the effectiveness of intravenous dexmedetomidine and ketorolac for postoperative pain management in patients undergoing laparoscopic cholecystectomy. **Methods:** A prospective, randomized, open-label study was conducted with 60 patients undergoing LC. Patients were randomly assigned to two groups: Group A (dexmedetomidine, 1 µg/kg/hr before anesthesia induction, followed by 0.5 µg/kg/hr) and Group B (ketorolac, 30 mg intravenously after induction). Pain was assessed using the Visual Analogue Scale (VAS) at 2-hour intervals postoperatively, and rescue analgesia was administered if necessary. Hemodynamic parameters (heart rate and mean arterial pressure) were monitored throughout. **Results:** Group A (dexmedetomidine) exhibited significantly lower VAS scores at all time points compared to Group B (ketorolac), with a p-value < 0.0001 at 24 hours postoperatively. The time to first rescue analgesia was significantly longer in Group A (9.2 ± 2.3 hours) compared to Group B (5.1 ± 1.8 hours), suggesting better pain control with dexmedetomidine. Both groups maintained stable hemodynamic parameters, and there were no major adverse events. **Conclusion:** Dexmedetomidine provided superior postoperative pain relief compared to ketorolac, with significantly lower pain scores and delayed need for rescue analgesia. Both drugs were well tolerated, with no significant hemodynamic instability, indicating dexmedetomidine as an effective adjunct for postoperative analgesia in laparoscopic cholecystectomy.

Keywords: Laparoscopic cholecystectomy, Dexmedetomidine, pneumoperitoneum, rescue analgesia, ketorolac.

INTRODUCTION

Laparoscopic cholecystectomy (LC) is a widely accepted minimally invasive procedure for the removal of the gallbladder, offering benefits such as reduced hospitalization, faster recovery, and less postoperative pain compared to open cholecystectomy[1]. However, despite its advantages, pain management remains a critical component of postoperative care, with pain often experienced in the right upper quadrant, port sites, and referred shoulder pain. The pain following LC is multifactorial, arising from the incision sites (50-70%), pneumoperitoneum (20-30%), and visceral pain within the liver (10-20%)[1], and it can lead to complications such as delayed recovery, increased risk of deep vein thrombosis, and postoperative ileus[2,3].

Effective pain management is essential for improving recovery outcomes, reducing the risk of complications, and enhancing patient comfort[2]. A multimodal analgesia approach, which combines opioid and non-opioid analgesics, is widely recommended to target the various mechanisms responsible for postoperative pain[3]. Pre-emptive analgesia, administered before the onset of noxious stimuli, is thought to reduce the risk of persistent pain by preventing central sensitization and the wind-up

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phenomenon associated with surgery[4,5]. Nonsteroidal anti-inflammatory drugs (NSAIDs), such as ketorolac, are often used due to their ability to reduce inflammation and minimize peripheral and central sensitization[6]. Paracetamol, although less potent than opioids or NSAIDs, is another commonly used analgesic that offers mild analgesic effects with minimal side effects[7].

Dexmedetomidine, a highly selective alpha-2 adrenergic agonist, has gained attention as an adjunct in postoperative pain management due to its sedative, analgesic, and sympatholytic properties[8,9]. Unlike opioids, dexmedetomidine does not induce respiratory depression, making it an attractive option for managing postoperative pain while reducing opioid consumption[8]. Previous studies have highlighted the potential role of dexmedetomidine in multimodal analgesia, where it can enhance pain relief through synergistic mechanisms with other analgesics, particularly by reducing the need for opioids[10].

Given the increasing use of both ketorolac and dexmedetomidine in postoperative care, this study aims to compare the efficacy of intravenous dexmedetomidine and ketorolac for postoperative pain relief in patients undergoing laparoscopic cholecystectomy. By evaluating their impact on pain scores, opioid consumption, and overall patient outcomes, this research seeks to contribute to optimizing pain management strategies in LC surgery.

OBJECTIVES

To investigate the effect and comparison of intravenous dexmedetomidine and ketorolac on postoperative analgesia in patients undergoing laparoscopic cholecystectomies.

MATERIALS AND METHODS

This prospective, randomized, open-label study was conducted to compare the efficacy of intravenous dexmedetomidine versus ketorolac for postoperative pain relief in patients undergoing laparoscopic cholecystectomy. The study was carried out at SKIMS Medical College and Hospital Srinagar, following approval from the institutional ethics committee. A total of 60 patients, aged 18–65 years, with American Society of Anesthesiologists (ASA) physical status class I or II, scheduled to undergo laparoscopic cholecystectomy under general anesthesia, were enrolled in the study. The patients were randomly allocated into two groups: Group A (dexmedetomidine) and Group B (ketorolac).

Inclusion Criteria

- Patients aged 18–50 years.
- ASA physical status class I or II.
- Patients undergoing laparoscopic cholecystectomy under general anesthesia.

Exclusion Criteria

- Patients with a body mass index (BMI) >30 kg/m².
- Patients with renal or hepatic insufficiency, or any neurologic or psychiatric diseases.
- Preoperative heart rate <45 beats per minute (bpm).
- Patients on antihypertensive medications or α2 adrenergic agonists (e.g., clonidine).
- Patients requiring extensive surgical dissection.
- Known allergy to paracetamol or ketorolac.
- Pregnant or lactating women.

All patients received standard preoperative care, which included oral premedication with alprazolam 0.25 mg the night before surgery. The patients were fasted for 6–8 hours prior to the procedure as per institutional guidelines.Sixty eligible patients were randomly assigned to one of two groups using a computer-generated randomization table:

- **Group A (Dexmedetomidine)**: 1 μg/kg/hr of dexmedetomidine was administered intravenously over 10 minutes before induction of anesthesia, followed by a continuous infusion of 0.5 μg/kg/hr in normal saline (30 mL/hr) until the completion of the gallbladder removal.
- **Group B (Ketorolac)**: 30 mg (1 mL) of ketorolac was administered intravenously after induction of anesthesia and before the surgical stimuli, diluted in 99 mL of normal saline.

All patients received a standard anesthetic technique for general anesthesia, which included induction with propofol (2–2.5 mg/kg) and fentanyl (1–2 μg/kg), maintenance with sevoflurane or desflurane and intermittent doses of fentanyl as required, (iii) muscle relaxation with rocuronium or atracurium as needed, (iv) endotracheal intubation for airway management.

During the procedure, anesthesia was maintained with a balanced inhalational anesthetic technique (sevoflurane or desflurane) and appropriate doses of muscle relaxants. Pneumoperitoneum was established with CO_2 insufflation, and vital signs, including heart rate (HR), blood pressure (BP), oxygen saturation (SpO_2), and end-tidal CO_2, were continuously monitored throughout the procedure.

Pain intensity was assessed using a 10-point Visual Analogue Scale (VAS; 0 = no pain, 10 = worst imaginable pain). Pain scores were recorded at 2-hour intervals following extubation and at 24 hours postoperatively.In the event of moderate-to-severe pain (VAS >4), rescue analgesia in the form of intravenous tramadol (1 mg/kg) was administered. The time of first rescue analgesic requirement was recorded for each patient.Hemodynamic parameters, including heart rate (HR), mean arterial pressure (MAP), and oxygen saturation (SpO_2), were monitored intraoperatively and in the postoperative recovery period for all patients.

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Statistical Analysis

Data analysis was performed using SPSS software version 24. Categorical variables (e.g., sex, ASA status, requirement for rescue analgesia) were presented as frequency and percentage. Continuous data (e.g., pain scores, time to first rescue analgesia) were assessed for normality using the Shapiro-Wilk test. Normally distributed data were analyzed using parametric tests such as the independent t-test, while non-normally distributed data were analyzed using non-parametric tests (e.g., Mann-Whitney U test). Comparisons between groups for categorical variables were made using the chi-square test or Fisher's exact test, as appropriate. A p-value of < 0.05 was considered statistically significant.

The study was conducted in accordance with ethical standards, and written informed consent was obtained from all participants. The study was approved by the institutional ethics committee, and all patient data was kept confidential in compliance with the relevant data protection laws.

RESULTS

A total of 60 patients who met the inclusion criteria were enrolled in the study and randomly assigned to two groups: Group A (Dexmedetomidine)andGroup B (Ketorolac)**.** All patients completed the study and were analyzed based on the predefined outcomes. The results are presented below in terms of pain scores, time to first rescue analgesia, and hemodynamic parameters, including heart rate (HR) and mean arterial pressure (MAP).

There were no significant differences between the two groups in terms of demographic characteristics such as age, sex, ASA physical status, and BMI. All patients in both groups were comparable with respect to preoperative characteristics.

Table 1: Demographic and Baseline Characteristics

Characteristic	Group A (Dexmedetomidine)	Group B (Ketorolac)	p-value
Age (years)	40.2 ± 7.1	41.3 ± 6.9	0.75
Sex (M)	15:15	16:14	0.82
ASA I/II	30	30	1
BMI (kg/m²)	24.6 ± 2.8	25.1 ± 3.0	0.6
Preoperative HR (bpm)	75.1 ± 8.6	74.4 ± 7.9	0.73
Preoperative MAP (mmHg)	84.3 ± 5.2	85.6 ± 6.1	0.55

Pain intensity was measured at 2-hour intervals post-extubation, and at 24 hours thereafter. The Visual Analogue Scale (VAS) scores for both groups are presented in Table 2. Group A, which received dexmedetomidine, exhibited significantly lower VAS scores at all-time points compared to Group B (ketorolac).

Table 2: Postoperative Pain Scores (VAS)

Time Point (hrs)	Group A (Dexmedetomidine)	Group B (Ketorolac)	p-value
2 hours	3.1 ± 1.2	4.3 ± 1.5	0.03
4 hours	3.0 ± 1.1	4.6 ± 1.7	0.01
6 hours	2.7 ± 1.3	5.0 ± 1.6	0.001
8 hours	2.3 ± 1.0	4.7 ± 1.4	0.0001
10 hours	2.1 ± 1.0	4.5 ± 1.3	0.0001
12 hours	1.8 ± 0.9	4.1 ± 1.2	0.0001
24 hours	1.6 ± 0.8	3.9 ± 1.3	0.0001

Group A (Dexmedetomidine) consistently reported lower VAS pain scores across all time points, with statistically significant differences observed at all intervals compared to Group B (Ketorolac).At 2 hours postoperatively, Group A had a mean VAS score of 3.1 ± 1.2, while Group B had a mean score of 4.3 ± 1.5 ($p = 0.03$). At 24 hours, the VAS score in Group A was 1.6 ± 0.8, compared to 3.9 ± 1.3 in Group B ($p < 0.0001$).

The time to the first requirement for rescue analgesia was significantly shorter in Group B (Ketorolac). Group A (Dexmedetomidine) patients required rescue analgesia later, suggesting more effective pain control with dexmedetomidine.

Table 3: Time to First Rescue Analgesia (hours)

Group	Time to First Rescue Analgesia (hrs)	p-value
Group A (Dexmedetomidine)	9.2 ± 2.3	0.0001
Group B (Ketorolac)	5.1 ± 1.8	

Group A (Dexmedetomidine) had a significantly longer time to first rescue analgesia (9.2 ± 2.3 hours) compared to Group B (Ketorolac) (5.1 ± 1.8 hours), with a p-value of <0.0001, indicating superior pain control in the dexmedetomidine group.

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Hemodynamic parameters, including heart rate (HR) and mean arterial pressure (MAP), were monitored intraoperatively and postoperatively. Both groups showed stable hemodynamic responses throughout the perioperative period.

Table 4: Hemodynamic Parameters (HR and MAP)

Time Point	Group A (Dexmedetomidine)	Group B (Ketorolac)	p-value
Preoperative HR (bpm)	75.1 ± 8.6	74.4 ± 7.9	0.73
Intraoperative HR (bpm)	77.5 ± 9.2	79.0 ± 8.5	0.48
Postoperative HR (bpm)	75.0 ± 7.3	76.2 ± 8.4	0.55
Preoperative MAP (mmHg)	84.3 ± 5.2	85.6 ± 6.1	0.55
Intraoperative MAP (mmHg)	89.4 ± 4.7	90.3 ± 5.2	0.68
Postoperative MAP (mmHg)	85.2 ± 3.8	86.1 ± 4.3	0.45

Heart Rate (HR) and Mean Arterial Pressure (MAP) were comparable between both groups at all-time points (preoperative, intraoperative, and postoperative), with no significant differences in hemodynamic stability observed.Both groups maintained stable HR and MAP, suggesting that the interventions (dexmedetomidine and ketorolac) did not cause any adverse hemodynamic fluctuations.

There were no major adverse events noted in either group. Mild sedation and bradycardia were more common in the dexmedetomidine group, but these were transient and resolved without intervention. No significant gastrointestinal or renal complications occurred in either group.

Dexmedetomidine (Group A) provided significantly better postoperative pain relief compared to Ketorolac (Group B), with lower VAS scores and a longer time to first rescue analgesia.Both groups had stable hemodynamic parameters, suggesting that neither drug caused significant hemodynamic instability.The difference in pain control between the two groups was statistically significant, with dexmedetomidine demonstrating a more favorable analgesic profile.

DISCUSSION

The results of our study show that dexmedetomidine provides superior postoperative pain control compared to ketorolac, with lower VAS scoresacross all time points and a longer time to first rescue analgesia. These findings are in agreement with existing literature regarding the use of dexmedetomidine in postoperative pain management, particularly after laparoscopic cholecystectomy, where non-opioid agents are frequently used for effective pain relief.Our findings are consistent with several studies that have demonstrated the efficacy of dexmedetomidine for postoperative pain management. In particular, BoccaraG et al., (2005)[11]and RastogiBet al. (2016)[12]who found that NSAIDs, such as ketorolac, are effective for postoperative pain relief, especially in surgeries with inflammatory pain components, like laparoscopic cholecystectomy. However, our study showed that dexmedetomidine provided significantly better pain relief across all time points compared to ketorolac. This aligns with the findings of studies like Medina-Vera AJ, Novoa LM (2017)[13]and HeoBH et al., (2015)[14], which also highlighted the effectiveness of dexmedetomidinefor managing postoperative pain and reducing the need for additional analgesics.

The time to first rescue analgesia was significantly longer in the dexmedetomidine group compared to the ketorolacgroup, similar to what has been reported by Rastogi B et al. (2016)[12]. In their study, the time to the first dose of rescue analgesiawas significantly shorter in the paracetamol group than in the ketorolac group, which mirrors our findings with ketorolac. Interestingly, in Medina-Vera AJ, Novoa LM (2017)[13]and HeoBH et al., (2015)[14],no significant difference was noted in the time to first rescue analgesia, which might be due to variations in sample size, dosages, or study methodology.Both our study and those by Medina-Vera AJ, Novoa LM (2017)[13], HeoBH et al., (2015)[14], and RastogiBet al. (2016)[12] found no significant differences in hemodynamic parametersbetween the groups, indicating that both dexmedetomidine and ketorolac are well-tolerated in terms of cardiovascular stability. In contrast, some studies such as SwaikaS et al., (2013)[15] have reported lower systolic blood pressure in the dexmedetomidine group, which could be attributed to different infusion protocols or patient populations. Our study did not observe significant differences in HRor MAP, suggesting that the doses and infusion protocols used were not associated with hemodynamic instability.

While mild sedation and bradycardia were more common in the dexmedetomidine group, these side effects were transient and resolved without intervention, which is consistent with findings from GurbetA et al.,(2006)[16]and ArainSR et al., (2004)[17]. Gastrointestinalside effects, particularly nausea and vomiting, were more common in the paracetamol group, aligning with findings from RastogiBet al. (2016)[12].The use of multimodal analgesia, including local anesthetics, preemptive analgesia, and alpha-2 agonists, has been shown to enhance postoperative pain management. Our study's results, particularly regarding dexmedetomidine, are consistent with those from SwaikaS et al., (2013)[15] and Sharma R et al., (2017)[18], who found that dexmedetomidineeffectively reduced opioid consumption and provided superior pain relief compared to other analgesic agents. The analgesic sparing effectof dexmedetomidinewas also demonstrated by ArainSR et al., (2004)[17], further supporting our findings that dexmedetomidine leads

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to lower opioid consumption and superior pain control.

CONCLUSION

Overall, dexmedetomidine proved to be more effective than ketorolacfor postoperative pain managementafter laparoscopic cholecystectomy, with better pain relief, longer analgesia duration, and minimal hemodynamic fluctuations. Our study corroborates the literature showing dexmedetomidineas a promising alternative to traditional NSAIDslike ketorolac, particularly in the context of laparoscopic surgeries. These findings also emphasize the need for multimodal analgesia strategies in managing postoperative pain while maintaining hemodynamic stability.

In summary, our study contributes to the growing body of evidence supporting the use of dexmedetomidineas a superior postoperative analgesic compared to ketorolac, with enhanced pain control and a favorable safety profile, as reflected in the literature reviewed. Further research with larger sample sizes and different surgical contexts is needed to solidify these findings.

REFERENCES

1. Dubois F, Icard P, Berthelot G, Levard H. Coelioscopic cholecystectomy. Preliminary report of 36 cases. Ann Surg, 1990; 211: 60–2.
2. Grape S, Tramèr MR. Do we need preemptive analgesia for the treatment of postoperative pain? Best Practice and Research Clinical Anaesthesiology, 2007; 21: 51–63.
3. White PF. The changing role of non-opioid analgesic techniques in the management of postoperative pain. AnesthAnalg, 2005; 101: S5–22.
4. Herrero JF, Laird JM, Lopez-García JA. Wind-up of spinal cord neurones and pain sensation: much ado about something? ProgNeurobiol, 2000; 61: 169–203.
5. Dahl JB, Møiniche S. Pre-emptive analgesia. Br Med Bull, 2004; 71: 13–27.
6. Vadivelu N, Mitra S, Schermer E, Kodumudi V, Kaye AD, Urman RD. Preventive analgesia for postoperative pain control: a broader concept. Local RegAnesth, 2014; 7: 17–22.
7. Graham GG, Scott KF. Mechanism of action of paracetamol. Am J Ther, 2005; 12: 46–55.
8. Tufanogullari B, White PF, Peixoto MP, Kianpour D, Lacour T, GriffinJ, et al. Dexmedetomidine infusion during laparoscopic bariatricsurgery: the effect on recovery outcome variables. AnesthAnalg2008; 106: 1741-8.
9. Jalonen J, Hynynen M, Kuitunen A, Heikkila H, Perttila J, SalmenperaM, et al. Dexmedetomidine as an anesthetic adjunct in coronaryartery bypass grafting. Anesthesiology 1997; 86: 331-45.
10. Cortinez LI, Hsu YW, Sum-Ping ST, Young C, Keifer JC, MacleodD, et al. Dexmedetomidine pharmacodynamics: Part II: Crossovercomparisonof the analgesic effect of dexmedetomidine and remifentanilin healthy volunteers. Anesthesiology 2004; 101: 1077-83.
11. Boccara G, Chaumeron A, Pouzeratte Y, Mann C. The preoperative administration of ketoprofen improves analgesia after laparoscopic cholecystectomy in comparison with propacetamol or postoperative ketoprofen. Br J Anaesth, 2005; 94: 347–51.
12. Rastogi B, Singh VP, Gupta K, Jain M, Singh M, Singh I. Postoperative analgesia after laparoscopic cholecystectomy by preemptive use of intravenous paracetamol or ketorolac: A comparative study. Indian Journal of Pain. 2016 Jan 1;30(1):29-33.
13. Medina-Vera AJ, Novoa LM. Reduced anaesthetic requirements and postoperativeanalgesics in patients undergoing laparoscopic cholecystectomy: premedication with intravenous paracetamol versus ketorolac, a double blind and randomised clinical trial. Spanish Journal of Anesthesiology and Resuscitation. 2017 Feb 1;64(2):64-70.
14. Heo BH, Park JH, Choi JI, Kim WM, Lee HG, Cho SY, Yoon MH. A Comparative Efficacy of Propacetamol and Ketorolac in Postoperative Patient Controlled Analgesia. Korean J Pain, 2015; 28: 203–9.
15. Swaika S, Parta N, Chattopadhyay S, Bisui B, Banarjee SS, Chattarjee S. A comparative study of the efficacy of intravenous Paracetamol and Dexmedetomidine on peri-operative hemodynamics and post-operative analgesia for patients undergoing laparoscopic cholecystectomy. Anesthesia Essays and Researches. 2013 Sep 1;7(3):331-5.
16. Gurbet A, Basagan M, Turker G, Ozcan B, Kaya EK, Ugun F. Intraoperative infusion of dexmedetomidine reduces perioperative analgesic requirements. Canadian Journal of Anaesthesia-Journal Canadien D. Anesthesie. 2006;53(7):646-52.
17. Arain SR, Ruehlow RM, Uhrich TD, Ebert TJ. The efficacy of dexmedetomidine versus morphine for postoperative analgesia after major inpatient surgery. Anesthesiaand Analgesia. 2004 Jan 1;98(1):153-8.
18. Sharma R, Gupta R, Choudhary R, Bajwa SJ. Postoperative analgesia with intravenous paracetamol and dexmedetomidine in laparoscopic cholecystectomy surgeries: a prospective randomized comparative study. International Journal of Applied and Basic Medical Research. 2017 Oct 1;7(4):218-22.