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Research Article

Comparative Analgesic Efficacy of Intravenous Ibuprofen versus Intravenous Paracetamol Following Laparoscopic Cholecystectomy

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ABSTRACT
Aim: To compare the Analgesic Efficacy of Intravenous Ibuprofen versus Intravenous Paracetamol Following Laparoscopic Cholecystectomy.
Materials and Methods: The prospective comparative study was conducted in the Department of Anesthesia. Total 100 patients were enrolled for the study, divided into two groups. Group A received IV ibuprofen 400 mg and Group B received IV paracetamol 1 g, both administered over 30 minutes. The study comprised patients scheduled for elective laparoscopic cholecystectomy. All patients received instruction on how to use the Visual Analogue Scale (VAS) for pain assessment during the preoperative evaluation. Convenience sampling was used for participant recruitment, after which participants were assigned into two groups using a computer-generated allocation sequence.
Results: The two groups were comparable at baseline, with no significant differences in age, gender, weight, height, or BMI ($p > 0.05$). Postoperative pain scores were significantly lower in the ibuprofen group at 0, 2, 4, and 6 hours, with the greatest difference at 6 hours ($p < 0.05$). Rescue analgesic requirement was also lower with ibuprofen, particularly at 4 and 6 hours. Heart rate and systolic blood pressure were generally lower in the ibuprofen group, while no consistent significant difference was observed in diastolic blood pressure.
Conclusion: Intravenous ibuprofen provided better postoperative analgesia than intravenous paracetamol, with lower pain scores, delayed rescue analgesia, and reduced overall rescue analgesic use.

Keywords: Analgesic Efficacy, Intravenous Ibuprofen, Intravenous Paracetamol, Laparoscopic Cholecystectomy.

INTRODUCTION

Laparoscopic cholecystectomy is the preferred surgical treatment for symptomatic gallstone disease and is considered the standard of care because of its minimally invasive approach, shorter hospital stay, faster recovery, lower postoperative morbidity, and improved patient satisfaction compared with open cholecystectomy.[1] Despite these advantages, postoperative pain remains a common clinical challenge, particularly during the first 24 hours after surgery. The pain is multifactorial in origin and results from trocar-site incisions, gallbladder dissection, peritoneal stretching caused by pneumoperitoneum, diaphragmatic irritation, and residual carbon dioxide within the abdominal cavity.[2] Inadequately controlled postoperative pain delays mobilisation, impairs recovery, prolongs hospitalisation, and adversely affects patient satisfaction and quality of recovery. Therefore, effective postoperative analgesia is a key component of perioperative care and Enhanced Recovery after Surgery (ERAS) protocols.[3]

Opioids have traditionally been the cornerstone of postoperative pain management because of their potent analgesic effects. However, opioid administration is frequently associated with adverse effects such as postoperative nausea and vomiting, respiratory depression, excessive sedation, ileus, urinary retention, delayed mobilisation, and the potential for tolerance and dependence. These limitations have encouraged the adoption of opioid-sparing multimodal analgesic strategies, which combine analgesics with different mechanisms of action to improve pain control while minimizing opioid consumption and opioid-related adverse effects.[4]

Among the non-opioid analgesics used in multimodal analgesia, intravenous paracetamol and intravenous ibuprofen are widely

recommended because of their rapid onset of action, proven analgesic efficacy, and favourable safety profiles.[5] Intravenous paracetamol exerts its analgesic effect primarily through central inhibition of prostaglandin synthesis and modulation of serotonergic pathways, while having minimal effects on platelet function and renal perfusion. Intravenous ibuprofen, a non-selective cyclooxygenase (COX)-1 and COX-2 inhibitor, provides both analgesic and anti-inflammatory effects by suppressing peripheral prostaglandin synthesis, thereby reducing postoperative pain and inflammatory responses following surgery.[6] Studies in the past demonstrated that perioperative intravenous ibuprofen significantly reduces postoperative pain intensity, opioid consumption, and postoperative fever while maintaining an acceptable safety profile. Likewise, perioperative intravenous acetaminophen (paracetamol) has been shown to provide effective analgesia and contribute to opioid-sparing multimodal analgesia.[6]

Although both intravenous paracetamol and intravenous ibuprofen are recommended as components of multimodal analgesia, direct comparative evidence evaluating these two agents in patients undergoing laparoscopic cholecystectomy remains limited.

Therefore, the present study was designed to compare the analgesic efficacy of Intravenous Ibuprofen versus Intravenous Paracetamol following Laparoscopic Cholecystectomy.

MATERIALS AND METHODS

After obtaining clearance from institutional ethical committee, this prospective comparative study was conducted in the Department of Anesthesia. Total 100 patients were enrolled for the study, divided into two groups. The study comprised patients scheduled for elective laparoscopic cholecystectomy. All patients received instruction on how to use the Visual Analogue Scale (VAS) for pain assessment during the preoperative evaluation. Convenience sampling was used for participant recruitment, after which participants were assigned into two groups using a computer-generated allocation sequence.

Inclusion Criteria

- Patients aged 25–50 years.
- Male or female patients.
- Patients scheduled for elective laparoscopic cholecystectomy.
- Patients classified as ASA Grade I or II.
- Patients willing to participate and provide informed consent.

Exclusion Criteria

- Current use of NSAIDs for concomitant illnesses.
- Known allergy or hypersensitivity to NSAIDs or paracetamol.
- Conversion from laparoscopic to open cholecystectomy.
- History of mental illness.
- Morbid obesity.
- Asthma or COPD.
- Presence of bleeding disorders.

METHODOLOGY

Standard monitoring with ECG, pulse oximetry, non-invasive blood pressure, heart rate, and end-tidal CO_2 was used. Anaesthesia was induced with IV propofol (1.5–2.5 mg/kg), nalbuphine (0.1 mg/kg), and atracurium (0.5 mg/kg), and maintained with isoflurane (0.9–1.5 MAC) and oxygen. Following pneumoperitoneum, Group A received IV ibuprofen 400 mg and Group B received IV paracetamol 1 g, both administered over 30 minutes. Tramadol and ondansetron were given at skin closure. After standardized surgery, neuromuscular blockade was reversed with neostigmine and glycopyrrolate, and patients were transferred to the PACU. Postoperative pain (VAS), heart rate, and blood pressure were assessed at 0, 2, 4, and 6 hours, with IV tramadol administered as rescue analgesia when required.

The Visual Analogue Scale (VAS), a standardized one-dimensional technique for evaluating pain following surgery, was employed to quantify the level of pain. In accordance with the classification used in prior postoperative pain medication studies[7,8] patients were required to rate their level of pain using a 10-cm line scale, where 0 = no pain, 1-3 = mild pain, 4-6 = moderate pain, and 7-10 = severe pain. A scheduled procedure known as an elective laparoscopic cholecystectomy was done. Rescue analgesia, in this case, referred to any additional postoperative pain medication that was used after the patient's request or when VAS > 4.[9] The analgesia was delivered following standardized protocols in order to guarantee ethical pain treatment, and documentation of such was considered as evidence of effectiveness, given its well-known use as an outcome measure in the study of post-operative pain. Patients were divided into groups according to the physical state

classification system of the American Society of Anesthesiologists (ASA) prior to surgery.[10]

Statistical Analysis

SPSS version 23 was used to analyze the data. Categorical variables were reported as frequency and percentage, and continuous variables as mean ± SD. Before parametric testing, normality was evaluated. The Chisquare test was used for categorical variables and the independent samples t-test for group comparisons. After adjusting for age, gender, and BMI, post-stratification t-tests were used. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

There was no statistically significant difference between the two groups with respect to age, gender, weight, height, or BMI ($p > 0.05$ for all variables). The groups were therefore comparable at baseline, with similar demographic and anthropometric characteristics, allowing a fair comparison of the analgesic efficacy of intravenous ibuprofen and paracetamol (Table 1).

Pain scores were consistently lower in the ibuprofen group than in the paracetamol group at all postoperative time points. The difference was statistically significant at 0, 2, 4, and 6 hours ($p < 0.05$), with the greatest difference observed at 6 hours (Table 2).

Rescue analgesia was required by fewer patients in the ibuprofen group compared with the paracetamol group, particularly at 4 and 6 hours. The total rescue analgesic requirement was also lower with ibuprofen, suggesting better postoperative analgesic efficacy and an opioid-sparing effect (Table 3).

Heart rate and systolic blood pressure were generally lower in the ibuprofen group, with statistically significant differences at most postoperative time points, whereas DBP showed no consistent significant difference between groups (Table 4).

Table 1: Baseline Characteristics of Study Participants

Variable	Group A: Ibuprofen (n=50)	Group B: Paracetamol (n=50)	p-value
Age (years), mean ± SD	40.52 ± 7.84	38.76 ± 8.12	0.270
Gender, n (%)			
• Male	11 (22%)	12 (24%)	0.813
• Female	39 (78%)	38 (76%)	
Weight (kg), mean ± SD	67.84 ± 7.52	69.12 ± 7.46	0.397
Height (m), mean ± SD	1.62 ± 0.08	1.63 ± 0.07	0.519
BMI (kg/m²), mean ± SD	25.91 ± 3.41	26.18 ± 2.58	0.651

Table 2: Comparison of VAS Pain Scores between Groups

Time	Group A – Ibuprofen (n=50) Mean ± SD	Group B – Paracetamol (n=50) Mean ± SD	p-value
0 hour	0.24 ± 0.43	0.49 ± 0.50	0.010
2 hours	0.38 ± 0.49	0.71 ± 0.46	<0.001
4 hours	1.28 ± 0.68	1.98 ± 0.65	<0.001
6 hours	1.76 ± 0.81	2.84 ± 0.76	<0.001

Table 3: Rescue Analgesia Requirement and Total Analgesia Consumption

Parameter	Group A – Ibuprofen (n=50)	Group B – Paracetamol (n=50)	p-value
Rescue analgesia required, n (%)			
• 0 hour	0 (0%)	0 (0%)	NA
• 2 hours	0 (0%)	0 (0%)	NA
• 4 hours	1 (2.0%)	8 (16.0%)	0.014
• 6 hours	4 (8.0%)	12 (24.0%)	0.022
Total rescue analgesia consumed (mg)			
• Mean ± SD (among those requiring analgesia)	104.5 ± 9.6 (n=5)	151.8 ± 45.7 (n=20)	0.032

Time to first rescue analgesia			
• At 4 hours	1 (2.0%)	8 (16.0%)	0.014
• At 6 hours	4 (8.0%)	12 (24.0%)	0.022

Table 4: Comparison of Hemodynamic Parameters (HR, SBP, DBP) Between Intravenous Ibuprofen and Paracetamol Groups at 0, 2, 4, and 6 Hours Postoperatively

Time	**Parameter**	**Ibuprofen (n=50) Mean ± SD**	**Paracetamol (n=50) Mean ± SD**	**p-value**
0 h	HR (bpm)	98.1 ± 15.8	106.2 ± 17.6	0.019
	SBP (mmHg)	132.5 ± 16.8	142.4 ± 14.2	0.002
	DBP (mmHg)	82.1 ± 11.4	88.5 ± 10.9	0.005
2 h	HR (bpm)	88.6 ± 13.2	100.5 ± 14.1	<0.001
	SBP (mmHg)	126.1 ± 13.7	139.2 ± 17.5	<0.001
	DBP (mmHg)	79.8 ± 15.2	87.9 ± 11.5	0.003
4 h	HR (bpm)	81.0 ± 9.0	87.8 ± 9.5	<0.001
	SBP (mmHg)	121.9 ± 12.4	129.4 ± 13.5	0.005
	DBP (mmHg)	76.5 ± 9.1	78.4 ± 11.8	0.374
6 h	HR (bpm)	80.2 ± 8.8	85.1 ± 9.7	0.009
	SBP (mmHg)	120.8 ± 11.5	127.2 ± 12.5	0.009
	DBP (mmHg)	75.6 ± 8.7	77.5 ± 10.8	0.328

DISCUSSION

Laparoscopic cholecystectomy is a commonly performed abdominal procedure in affluent nations. Effective postoperative pain management facilitates early mobilization, shorter hospital stays, reduced costs, and greater patient satisfaction. Preemptive analgesia is an important strategy in this context. Ibuprofen, a widely used NSAID in oral form for over 40 years, became available intravenously in the US in 2009.[11] Its analgesic effect is mediated through cyclooxygenase (COX) inhibition: COX-2 inhibition provides analgesic, antipyretic, and anti-inflammatory benefits, while COX1 inhibition can produce adverse effects. Although opioids are potent analgesics, they are associated with nausea, vomiting, respiratory depression, urinary retention, and gastrointestinal dysfunction. Multimodal analgesia is increasingly preferred due to improved efficacy and reduced adverse effects.[12] The lower postoperative heart rate and blood pressure values observed in the ibuprofen group may reflect improved postoperative analgesia and reduced sympathetic response to pain.

A study comparing IV ibuprofen and IV paracetamol after laparoscopic cholecystectomy reported significantly lower postoperative VAS scores in the ibuprofen group. Patients received 800 mg IV ibuprofen intraoperatively, followed by 400 mg every 6 hours, unlike the single 400 mg dose in our study. At awakening, VAS scores were 0.45 ± 0.94 (ibuprofen) versus 2.6 ± 1.96 (paracetamol). Total tramadol consumption was 136 ± 83.61 mg (ibuprofen) versus 144 ± 93.91 mg (paracetamol), not statistically significant. Although total rescue analgesic consumption was lower in the ibuprofen group, the difference did not reach statistical significance. Total rescue analgesic requirement was lower in the ibuprofen group (25%) compared to paracetamol (75%).[13]

Another study demonstrated that IV ibuprofen (800 mg) resulted in lower pain scores and opioid consumption compared to IV

acetaminophen (1000 mg) over 24 hours post-laparoscopic cholecystectomy. Recovery VAS scores were 1.93 ± 1.74 (ibuprofen), 4.90 ± 1.12 (acetaminophen), and 6.96 ± 1.29 (control); at 2 hours, 1.73 ± 1.48, 4.06 ± 0.78, and 4.53 ± 0.81, respectively. Total fentanyl usage was 215.66 ± 97.26 mg (ibuprofen), 342.33 ± 65.59 mg (acetaminophen), and 566.33 ± 126.33 mg (control). Rescue analgesic requirement was 1%, 30%, and 67%, respectively, with significantly fewer opioid-related adverse effects in the ibuprofen group.[14]

Another study comparing IV ibuprofen (800 mg) and acetaminophen (1000 mg) found no significant difference in NRS pain scores, although cumulative tramadol use was lower in the ibuprofen group (70 [0–180] mg) versus acetaminophen (110 [0–300] mg) over 24 hours.[15]

Celik et al. found IV ibuprofen (800 mg) more effective than IV paracetamol (1000 mg) in septorhinoplasty surgery, with lower VAS scores at 1st and 6th postoperative hours and reduced opioid consumption compared to paracetamol and control groups.[16] Similarly, in laparoscopic sleeve gastrectomy, IV ibuprofen (800 mg) led to lower VAS scores and opioid use than IV paracetamol or saline control at multiple postoperative time points ($p < 0.05$). Lee et al. compared the effectiveness of IV NSAIDs (ibuprofen versus ketorolac) in postoperative pain control in patients undergoing laparoscopic cholecystectomy. The main drawbacks were the lack of randomization in NSAID selection and short-term follow-up, which precluded evaluation of postoperative pain outcomes.[17]

Our findings suggest that a single dose of IV ibuprofen may provide improved early postoperative analgesia compared with IV paracetamol following laparoscopic cholecystectomy. Patients receiving IV ibuprofen demonstrated lower postoperative pain scores and delayed requirement for rescue analgesia. Although total rescue analgesic consumption was lower in the ibuprofen group, the difference did not achieve statistical significance.

The study had several limitations. Only a single 400 mg dose of IV ibuprofen was used, with follow-up limited to 6 hours. The relatively small sample size and single-center design may also limit the generalizability of the findings. Standardized protocols and validated pain scores were used to minimize assessment bias.

CONCLUSION

Following laparoscopic cholecystectomy, intravenous ibuprofen showed reduced postoperative pain scores and a delayed need for rescue analgesia when compared to intravenous paracetamol. The ibuprofen group used fewer rescue analgesics overall, although the difference was not statistically significant. A multi modal approach to managing postoperative pain may include IV ibuprofen.

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