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Original Article

Comparative Efficacy of Rectal Diclofenac, Rectal Paracetamol, and Their Combination for Postoperative Analgesia in Pediatric Elective Surgery: A Randomized Double-Blind Controlled Study

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ABSTRACT

Postoperative pain remains a significant concern in pediatric surgery, and effective opioid-sparing analgesic strategies are essential for improving recovery. This randomized, double-blind, controlled study evaluated the comparative efficacy of rectal paracetamol, rectal diclofenac, and their combination for postoperative analgesia in 90 children (2–14 years) undergoing elective surgery. Patients were randomly allocated to receive rectal paracetamol (40 mg/kg), rectal diclofenac (1 mg/kg), or a combination of both. Postoperative pain was assessed using the Objective Pain Scale (OPS) for 6 hours, and rescue analgesia was administered when required. Baseline demographic and perioperative characteristics were comparable among the three groups. The combination therapy produced significantly lower OPS scores throughout the postoperative period compared with either rectal paracetamol or rectal diclofenac alone ($P < 0.05$). Although the combination group showed a lower rescue analgesic requirement and a longer time to first rescue analgesia, these differences were not statistically significant. The findings suggest that the combination of rectal paracetamol and rectal diclofenac provides more effective postoperative pain control than either drug alone and may be considered an effective multimodal analgesic strategy in pediatric elective surgery.

Keywords: Pediatric surgery; postoperative analgesia; rectal paracetamol; rectal diclofenac; multimodal analgesia; Objective Pain Scale; randomized controlled trial.

INTRODUCTION

Postoperative pain remains a major concern in pediatric surgical practice and is an important determinant of recovery after surgery. Unlike adults, children may have difficulty communicating the intensity and nature of their pain, and pain-related behaviors may be expressed through crying, irritability, restlessness, or changes in activity. Inadequately controlled postoperative pain can produce significant physiological and psychological stress and may adversely affect respiratory, cardiovascular, neuroendocrine, gastrointestinal, metabolic, and immune functions. Effective perioperative pain management is therefore an essential component of high-quality pediatric surgical care.[1]

Historically, postoperative pain in children was often undertreated because of misconceptions regarding their ability to perceive and remember painful experiences. Current understanding clearly recognizes that children experience clinically significant pain and that poorly managed acute pain may influence postoperative behavior, recovery, and subsequent responses to medical procedures. Consequently, the prevention and treatment of postoperative pain should begin early in the perioperative period and should be tailored to the specific needs of the pediatric patient.[1]

Several pharmacological and regional techniques are available for postoperative analgesia in children, including opioids, non-opioid analgesics, peripheral nerve blocks, and caudal analgesia. Although opioids remain effective for moderate-to-severe postoperative pain, their use may be associated with adverse effects such as sedation, nausea, vomiting, and respiratory depression. Regional techniques can provide effective analgesia but require technical expertise and may not be appropriate or practical for every surgical procedure. These considerations have led to increasing interest in multimodal analgesic strategies that combine drugs with different mechanisms of action while minimizing opioid exposure.[5],[6]

Paracetamol and diclofenac are widely used non-opioid analgesic agents, but their pharmacological actions differ. Paracetamol is primarily considered a centrally acting analgesic with limited peripheral anti-inflammatory activity, whereas diclofenac is a non-steroidal anti-inflammatory drug that exerts analgesic and anti-inflammatory effects predominantly through inhibition of cyclooxygenase-mediated prostaglandin synthesis. The differing mechanisms of these two drugs provide a rational basis for their combined use as part of a multimodal analgesic regimen.[24]

The concept of **preemptive analgesia** is based on administering analgesic treatment before surgical tissue injury and nociceptive stimulation occur, with the aim of reducing the development and intensity of postoperative pain. Preoperative administration of analgesics may attenuate the peripheral and central sensitization associated with surgical trauma and may thereby improve postoperative pain control and reduce the requirement for rescue analgesics.[5] Studies evaluating preoperative administration of rectal diclofenac and paracetamol have demonstrated the potential value of this approach in pediatric surgical patients.[4],[28]

The route of administration is particularly important in children. Oral medications may be difficult to administer in the perioperative period because of poor tolerance, unpleasant taste, or preoperative fasting, while intramuscular injections can cause additional pain and anxiety. Rectal administration provides a practical alternative and is particularly useful when oral administration is not feasible. Rectal suppositories of both diclofenac and paracetamol have been used in pediatric patients and may offer an effective and acceptable method of preoperative analgesic delivery.[6],[28]

Evidence supporting the use of rectal diclofenac in children has been reported in several surgical settings. Studies in pediatric tonsillectomy and other elective procedures have shown that rectal diclofenac can provide effective postoperative analgesia and may reduce the requirement for opioid rescue medication.[20],[21],[27] In children undergoing inguinal herniotomy, rectal diclofenac has also been evaluated as an alternative to caudal bupivacaine, demonstrating clinically useful postoperative analgesia after surgery.[6] The use of rectal diclofenac in combination with regional analgesic techniques has further been investigated, suggesting a possible role for diclofenac as an adjunct within multimodal pediatric analgesia.[23],[29]

Rectal paracetamol is another commonly used option for pediatric postoperative pain management. Pharmacokinetic studies indicate that rectal administration can achieve systemic analgesic exposure and may be particularly useful when oral administration is not suitable. Research on paracetamol pharmacokinetics in children has also emphasized the importance of appropriate timing of administration in relation to anticipated painful stimuli.[51],[52],[53]

An additional area of interest is the combination of paracetamol and diclofenac. Because these drugs have different pharmacological profiles, their concurrent administration may provide additive or complementary analgesic effects. In a study of children receiving patient-controlled morphine after surgery, diclofenac was associated with improved analgesia and reduced morphine consumption, although an additional benefit from paracetamol was not consistently demonstrated at the doses studied.[24] Conversely, other investigations have reported that combining rectal diclofenac with paracetamol may provide better postoperative pain control than either agent alone.[28],[49] These findings suggest that the efficacy of combination therapy may depend on factors such as dose, timing, type of surgery, and characteristics of the patient population.

The safety of NSAIDs in children, particularly with regard to postoperative bleeding, has also been an important consideration. Concerns regarding platelet function and bleeding risk have historically limited the use of diclofenac in some pediatric surgical settings. However, clinical investigations have reported effective analgesia without clinically significant increases in postoperative bleeding in selected pediatric populations, and studies assessing perioperative clot strength have not demonstrated a clinically important adverse effect following preoperative rectal diclofenac

administration.[30,32] These findings support the need for continued evaluation of the efficacy and safety of diclofenac in carefully selected pediatric surgical patients.

Despite the growing emphasis on multimodal and opioid-sparing analgesia, the comparative effectiveness of **preoperative rectal diclofenac, rectal paracetamol, and their combination** remains clinically relevant. Available studies have produced variable findings regarding the relative efficacy of these approaches, and evidence from different surgical populations cannot always be directly generalized to children undergoing elective surgery. A direct comparison of these three regimens may therefore help determine whether combination therapy provides superior postoperative analgesia, reduces rescue analgesic requirements, and offers an acceptable safety profile compared with either drug used alone.[24,28,49]

The present study was therefore designed to compare the postoperative analgesic efficacy of preoperative rectal diclofenac, rectal paracetamol, and their combination in pediatric patients undergoing elective surgery. The study also evaluates postoperative analgesic requirements and the occurrence of adverse effects, with the aim of identifying an effective and clinically practical opioid-sparing strategy for pediatric perioperative pain management.

MATERIALS AND METHODS

Study Design and Study Setting

This randomized, double-blind, controlled clinical study was conducted in the Department of Anaesthesia, Navodaya Medical College, Hospital and Research Centre, Raichur, India. The study was carried out over a period of two years, from June 2012 to June 2014. After obtaining approval from the institutional ethics committee and written informed consent from the parents or legal guardians, a total of 90 children scheduled for elective surgery were enrolled. All participants were between 2 and 14 years of age and belonged to American Society of Anesthesiologists (ASA) physical status I or II. The study was designed to compare the postoperative analgesic efficacy of rectal diclofenac, rectal paracetamol, and their combination in pediatric patients undergoing elective surgery.

Patient Selection

Children of either sex aged 2–14 years who were scheduled for elective surgical procedures and classified as ASA physical status I or II were considered eligible for inclusion. Patients with ASA physical status III or IV, a history of bronchial asthma, age greater than 15 years, known renal or hepatic disease, prolonged bleeding or clotting time, documented allergy to the study medications, or anorectal abnormalities were excluded from participation.

Preanesthetic Evaluation

All eligible patients underwent a detailed preanesthetic evaluation one day before surgery. Patients were assessed for underlying systemic illness, and relevant laboratory investigations were recorded. The proposed anesthetic technique and study procedures were explained to the parents or legal guardians, and written informed consent was obtained before enrollment.

Patients were instructed to follow the prescribed preoperative fasting regimen and received oral triclofos at a dose of 100 mg/kg as premedication in the preoperative holding area.

Randomization and Study Groups

Following completion of the preanesthetic assessment, the study participants were randomly allocated into three equal groups, with 30 patients in each group:

Group D (n = 30): Patients received rectal diclofenac suppository at a dose of 1 mg/kg.
Group P (n = 30): Patients received rectal paracetamol suppository at a dose of 40 mg/kg.
Group PD (n = 30): Patients received a combination of rectal diclofenac 1 mg/kg and rectal paracetamol 40 mg/kg.

The randomized, double-blind study design was selected to minimize allocation and observer bias during assessment of postoperative analgesic efficacy. The choice of diclofenac and paracetamol as study interventions was based on their established use as non-opioid analgesic agents and on previous studies evaluating rectal administration in pediatric surgical patients.[18,20,21,24,28,33]

Anesthetic Management

The anesthetic technique was standardized for all patients in order to reduce variations in intraoperative management that could influence postoperative pain outcomes. Patients were premedicated with intravenous glycopyrrolate at a dose of 0.004 mg/kg and intravenous ondansetron at a dose of 0.1 mg/kg.

General anesthesia was induced using intravenous tramadol at a dose of 2 mg/kg and intravenous propofol at 1–2.5 mg/kg, titrated until loss of consciousness. Neuromuscular blockade was achieved using intravenous atracurium at 0.5

mg/kg, followed by endotracheal intubation. Anesthesia was maintained using a combination of halothane, nitrous oxide, and oxygen, with intermittent administration of atracurium as required. Intraoperative analgesia was supplemented with intravenous tramadol, titrated according to hemodynamic response. Standardized anesthetic management was adopted to maintain consistency across the three study groups.[18],[19]

Administration of Study Medication
Following induction of general anesthesia and endotracheal intubation, the assigned study medication was administered according to the randomized group allocation. Patients in Group D received rectal diclofenac 1 mg/kg, patients in Group P received rectal paracetamol 40 mg/kg, and patients in Group PD received both rectal diclofenac 1 mg/kg and rectal paracetamol 40 mg/kg.

The use of rectal diclofenac in pediatric patients has been evaluated in several surgical settings, including tonsillectomy and inguinal herniotomy, with evidence of clinically useful postoperative analgesia and potential opioid-sparing effects.[20],[21],[27] Rectal paracetamol has also been investigated as a pediatric perioperative analgesic, while direct comparisons between paracetamol, diclofenac, and their combination have suggested that the combination may provide enhanced analgesic efficacy in selected surgical populations.[24],[28],[49] The present study therefore compared these three regimens to determine their relative effects on postoperative pain control.

Intraoperative Monitoring
Throughout the surgical procedure, standard intraoperative monitoring was performed. Non-invasive blood pressure (NIBP), continuous electrocardiography (ECG), peripheral oxygen saturation (SpO_2), and end-tidal carbon dioxide ($EtCO_2$) were monitored routinely. All patients were managed according to the standardized anesthetic protocol, and intraoperative analgesia was supplemented with intravenous tramadol as clinically required.

Postoperative Pain Assessment
Following completion of surgery, patients were transferred to the recovery room for postoperative monitoring and pain assessment. Pulse rate, peripheral oxygen saturation, and blood pressure were recorded every 30 minutes during the first 90 minutes following surgery.

Postoperative pain was evaluated using the Objective Pain Scale (OPS) by an anesthesiology postgraduate and a nurse trained in pediatric pain assessment. The individual performing the pain assessment was blinded to the patient's treatment allocation. The OPS score was recorded immediately on admission to the post-anesthesia care unit (PACU), every 30 minutes for the first 90 minutes, and subsequently at hourly intervals for up to 6 hours after surgery.

The use of an objective behavioral pain assessment tool was particularly appropriate for the pediatric population, in whom pain may be expressed through behavioral and physiological changes rather than reliable verbal reporting. Similar objective approaches have been used in previous investigations of postoperative analgesia in children.[20],[24],[28]

Objective Pain Scale
Postoperative pain intensity was assessed using the Objective Pain Scale, which consists of five parameters: blood pressure, crying, movement, agitation, and posture. Each parameter was assigned a score from 0 to 2, resulting in a total score ranging from 0 to 10. A higher total score indicated greater postoperative pain intensity.

The scoring system was applied as follows:

Parameter	Score 0	Score 1	Score 2
Blood pressure	Within ±10% of preoperative value	>20% above preoperative value	>30% above preoperative value
Crying	Not crying	Crying but responds to comforting	Crying and does not respond to comforting
Movement	No movement	Restless	Thrashing
Agitation	Asleep or calm	Mild agitation	Hysterical
Posture	No special posture	Flexing legs and thighs	Holding scrotum or groin

The individual scores were summed to obtain a total OPS score ranging from 0 to 10. The OPS score was used to compare the degree and duration of postoperative analgesia between the three treatment groups.

Rescue Analgesia
Rescue analgesia was administered when additional postoperative pain relief was clinically indicated. Intravenous tramadol at a dose of 1 mg/kg was given when the OPS score exceeded 5 and the patient required or requested additional analgesia.

The requirement for rescue analgesia was recorded during the postoperative observation period and was used as an indicator of the effectiveness and duration of the analgesic regimen. Previous pediatric studies have used opioid consumption and rescue analgesic requirements as clinically relevant measures when comparing non-opioid analgesic strategies. [24,27,28]

Study Outcomes

The primary outcome measure was the comparative postoperative analgesic efficacy of rectal diclofenac, rectal paracetamol, and their combination in pediatric patients undergoing elective surgery. The postoperative OPS score recorded at predefined time points was used to evaluate the intensity and duration of pain control in each treatment group.

The secondary outcome was the requirement for rescue analgesia during the postoperative follow-up period. The number of patients requiring rescue analgesia and the timing of rescue medication were considered measures of the adequacy and duration of postoperative analgesia.

The study was designed to determine whether the combination of rectal diclofenac and rectal paracetamol provided superior postoperative pain relief compared with either drug administered individually. Earlier studies have reported varying results regarding the benefit of combining these agents, making direct comparison in pediatric elective surgery clinically relevant.[24,28,36]

Sample Size Calculation

The sample size was initially calculated using the results of a previously conducted study and the following formula:

$$\mathbf{n = 2\,(Z\alpha + Z\beta)^2\,(S_1^2 + S_2^2) / (X_1 - X_2)^2}$$

where $Z\alpha = 1.65$, $Z\beta = 0.84$, and the statistical power was set at 80%. S_1 represented the standard deviation of the diclofenac group, S_2 represented the standard deviation of the comparator group, X_1 represented the mean of the diclofenac group, and X_2 represented the mean of the conventional or placebo group.

The initial calculation yielded a sample size of 10 patients per group. However, a total of 90 children were included in the final analysis, with 30 participants allocated to each of the three treatment groups.

Statistical Analysis

Statistical analysis was performed using descriptive and inferential statistical methods. Continuous variables were summarized using mean ± standard deviation (SD), together with minimum and maximum values where appropriate. Categorical variables were presented as frequencies and percentages.

Analysis of variance (ANOVA) was used to assess differences in continuous study parameters among the three treatment groups. Student's *t*-test was used for appropriate comparisons between groups. The statistical analysis was based on the assumptions that dependent variables were normally distributed, observations were independent, and the samples were randomly selected. Levene's test was used to assess equality of variances.

Statistical significance was assessed at the 5% level, and a *P* value of <0.05 was considered statistically significant. Statistical analysis was performed using SPSS version 19.0. Microsoft Word and Microsoft Excel were used for data organization and preparation of tables and graphical representations.

RESULT

A total of 90 pediatric patients undergoing elective surgery were included in the study and allocated equally into three groups of 30 patients each. Group P received rectal paracetamol, Group D received rectal diclofenac, and Group PD received a combination of rectal paracetamol and rectal diclofenac.

1. Age distribution of patients:

The mean age was 7.33 ± 3.45 years in Group P, 7.53 ± 3.52 years in Group D, and 7.43 ± 3.75 years in Group PD, with no statistically significant difference between groups (*P* = 0.97). Shown in table 2 and figure 1:

Table 1: Age distribution of patients studied

	Group P		Group D		Group PD	
Age in years	No	%	No	%	No	%
2 to 4	7	23.33	7	23.33	7	26.67
4 to 6	6	20	5	16.66	2	16.67

6 to 8	7	23.33	6	20	1	20
8 to 10	4	13.33	5	16.6	2	10
10 to 12	4	13.33	5	16.7	1	13.33
12 to 14	2	6.68	2	6.66	2	13.33
Total	30	100	30	100	30	100
Mean ±SD	7.33±3.45		7.53±3.52		7.43±3.75	

The study population in the three arms of the study was found to have comparable age distribution.

Age	**MEAN**	**SD**	**F**	**P**	**df**	**INF**
Group P	7.33	3.45				
GroupD	7.53	3.75				
Group PD	7.43	3.52	0.02	0.97	2	NS

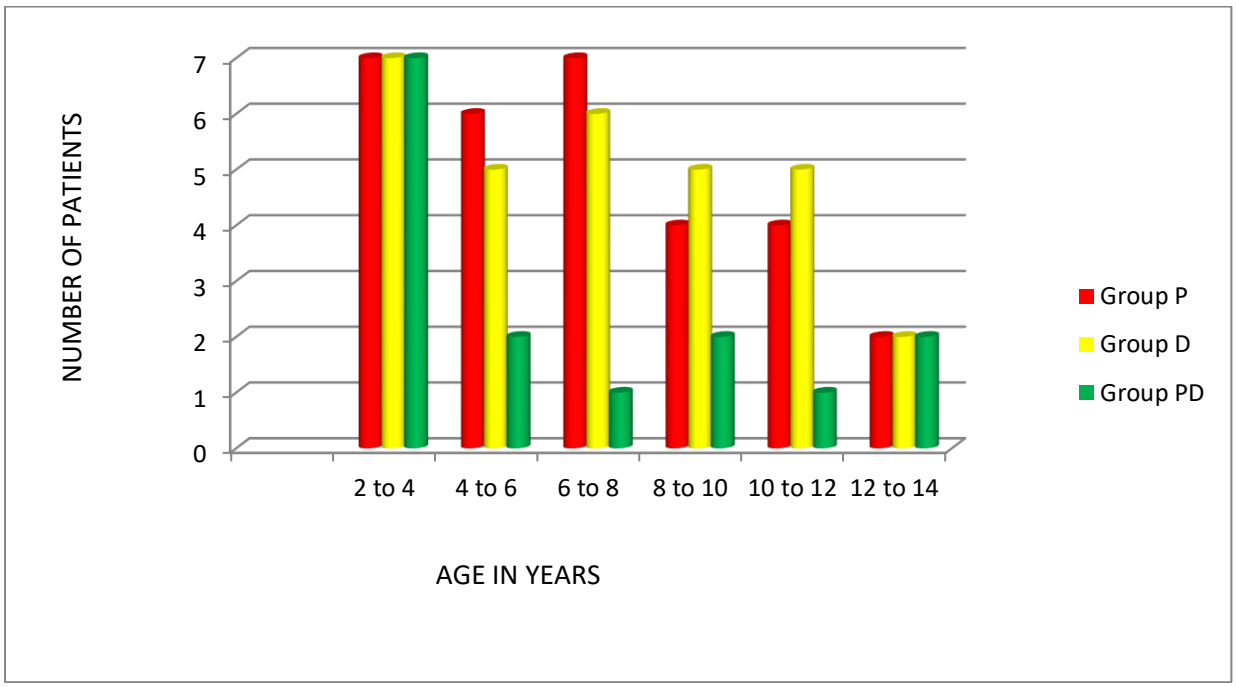

Fig1: Age distribution of patients studied

2. ASA-PS distribution of patients studied:

The patients in the three arms of this study were distributed similarly between ASA-PS classes I and II.

Table 2: ASA-PS distribution of patients studied

ASA-PS	**Group P**		**Group D**		**Group PD**	
	No	**%**	**No**	**%**	**No**	**%**
I	13	43.3	14	46.7	14	46.7
II	17	56.7	16	53.3	16	53.3
Total	30	100.0	30	100.0	30	100.0

ASA-PS distribution was statistically similar in two groups with P=0.956

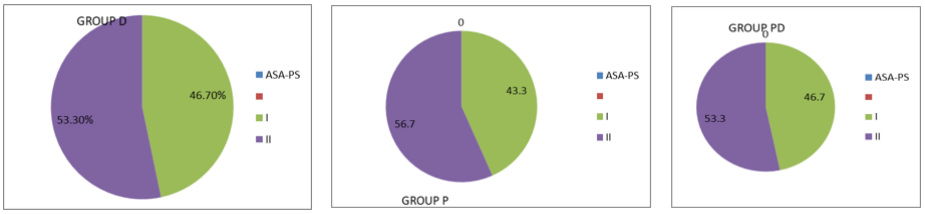

Figure 2: ASA-PS distribution of patients studied

3. Weight distribution of patients studied:

The mean body weight was 21.87 ± 7.92 kg in Group P, 22.17 ± 7.66 kg in Group D, and 21.87 ± 8.41 kg in Group PD, with no significant intergroup difference (P = 0.98).

Table 3: Weight distribution of patients studied

Weight (kg)	Group P		Group D		Group PD	
	No	%	No	%	No	%
10 TO 20	15	50	15	50	14	47
21 TO 30	10	34	11	34	9	30
31 TO 40	5	16	4	16	7	23
Total	30	100	30	100	30	100
Mean ±SD	21.87±7.92		22.17±7.66		21.87±8,41	

Samples were weight matched with p=0.98

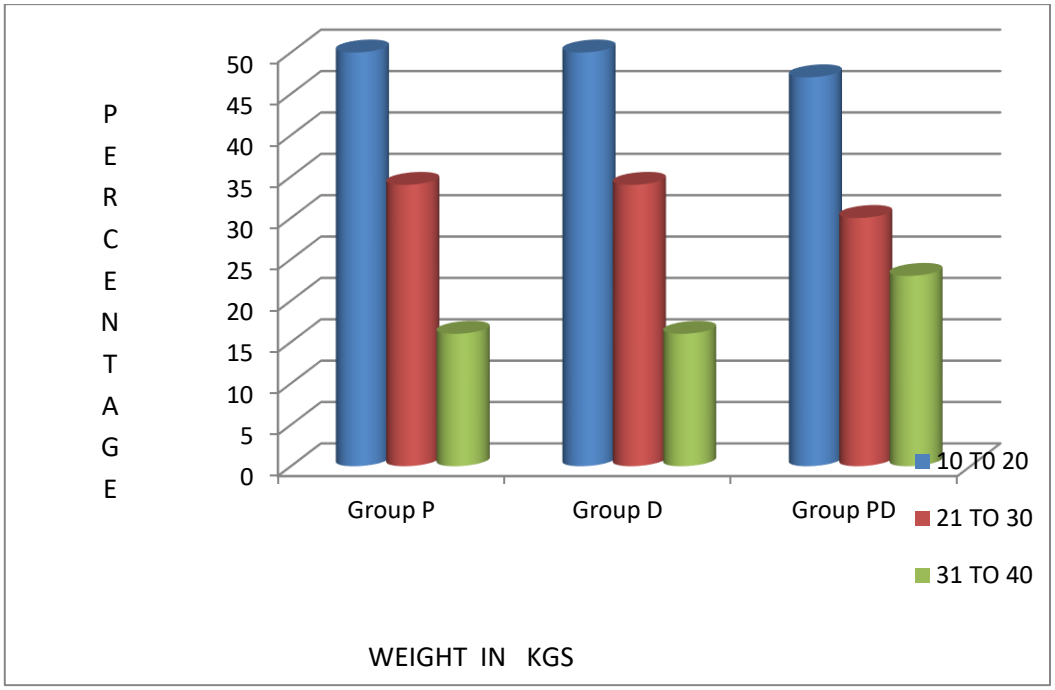

Figure 3: Weight distribution of patients studied

Duration of surgery (minutes):

The duration of surgery was also comparable, with mean operative times of 102.77 ± 26.41 minutes, 92.57 ± 21.29 minutes, and 100.40 ± 32.86 minutes in Groups P, D, and PD, respectively (P = 0.321).

Table 4: Duration of surgery (minutes)

Duration of surgery (min)	Group P		Group D		Group PD	
	No	%	No	%	No	%
45-60	1	3.3	3	10.0	3	10.0
60-90	10	33.3	10	33.3	10	33.3
90-120	16	53.3	16	53.3	14	46.7
>120	3	10.0	1	3.3	3	10.0
Total	30	100.0	30	100.0	30	100.0
Mean ±SD	102.77±26.41		92.57±21.29		100.40±32.86	

Duration of surgery was statistically similar between three groups of patients with p=0.321

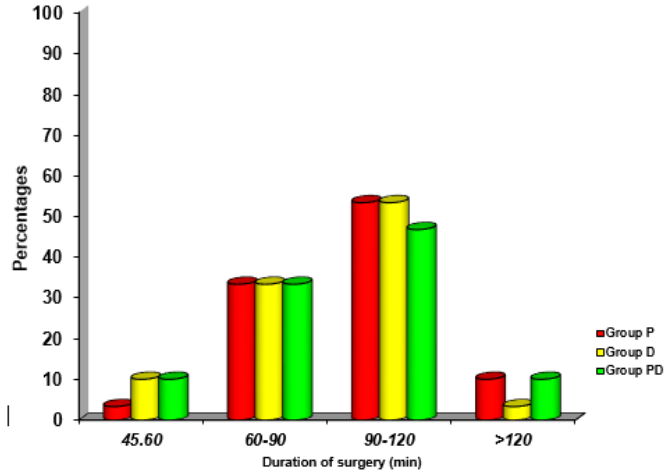

Fig 4: Duration of surgery (minutes)

4. Comparative evaluation of OPS score in three groups of patients:

In this study, the mean OPS score was 2.67 ± 0.92 in Group P, 2.83 ± 0.78 in Group D, and 1.63 ± 1.27 in Group PD, with a statistically significant difference among the groups ($P < 0.001$). At 30 minutes, the corresponding scores were 3.83 ± 1.14, 3.07 ± 0.78, and 2.57 ± 1.19, respectively ($P < 0.001$). At 60 minutes, the mean OPS scores were 3.53 ± 0.90, 3.23 ± 1.47, and 2.60 ± 1.07 in Groups P, D, and PD, respectively ($P = 0.009$).

Table 5: Comparative evaluation of OPS score in three groups of patients:

OPS SCORE0	MEAN	SD	F	P	df	INF
Group P	2.67	0.92	12.01	0.0001	2	HS
Group D	2.83	0.78				
Group PD	1.63	1.27				
OPS SCORE 30MIN	MEAN	SD	F	P	df	INF
Group P	3.83	1.14	10.9	0.0001	2	HS
Group D	3.07	0.78				
Group PD	2.57	1.19				
OPS SCORE60MINS	MEAN	SD	F	P	df	INF
Group P	3.53	0.9	4.93	0.009	2	SIG
Group D	3.23	1.47				
Group PD	2.6	1.07				
OPS SCORE 90 MIN	MEAN	SD	F	P	df	INF
Group P	4.6	2.02	11.51	0.0001	2	HS
Group D	3.47	1.22				
Group PD	2.73	1.14				
OPS SCORE2 HR	MEAN	SD	F	P	df	INF
Group P	3.93	1.61	7.97	0.001	2	SIG
Group D	3.63	1.29				
Group PD	2.6	1.1				
OPS SCORE 3 HR	MEAN	SD	F	P	df	INF
Group P	3.7	1.14	6.03	0.004	2	SIG
Group D	3.53	1.35				
Group PD	2.7	1.05				
OPS SCORE 4 HR	MEAN	SD	F	P	df	INF
Group P	3.21	0.76	6	0.004	2	SIG
Group D	3.2	0.99				
Group PD	2.4	1.27				
OPS SCORE 5 HR	MEAN	SD	F	P	df	INF
Group P	3	0.83	9.01	0.0001	2	SIG
Group D	2.93	0.82				
Group PD	2.13	0.97				
OPS SCORE 6 HR	MEAN	SD	F	P	df	INF

Group P	2.87	0.56				
Group D	2.57	1.13				
Group PD	1.7	1.05	12.1	0.0001	2	HS

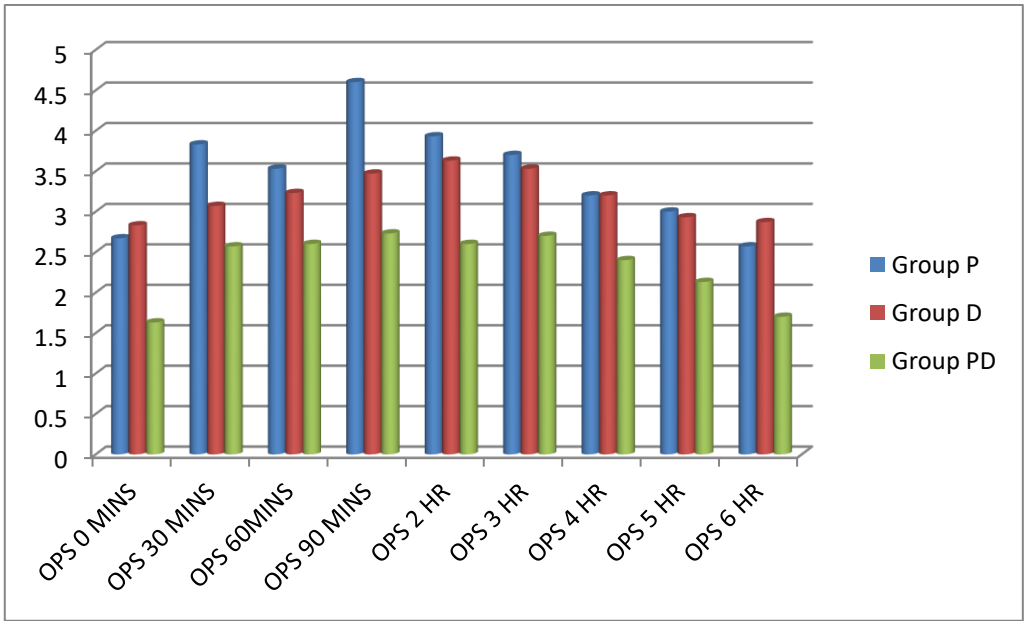

Figure 5: Comparative evaluation of OPS score in three groups of patients

Comparative postoperative analgesic requirement:

The requirement for rescue analgesia was also evaluated as a secondary measure of postoperative analgesic efficacy. The mean total dose of rescue analgesic was 52.75 ± 22.79 mg in Group P, 46.33 ± 13.65 mg in Group D, and 45.00 ± 21.37 mg in Group PD. Although the mean rescue analgesic requirement was numerically lower in the combination group, the difference among the three groups was not statistically significant (P = 0.61).

The time to administration of the first rescue analgesic was 132.86 ± 54.38 minutes in Group P, 157.14 ± 122.57 minutes in Group D, and 210.00 ± 77.46 minutes in Group PD. The combination group therefore showed a numerically longer duration before the first rescue analgesic was required; however, this difference did not reach statistical significance (P = 0.606).

Table 6: Comparative Dose of Rescue analgesic in mg

Dose of Rescue analgesia (mg)	**Group P (n=30)**	**Group D (n=30)**	**Group PD (n=30)**	**p value**
Total Dose of Rescue analgesic(in mg)	52.75±22.79	46.33±13.65	45±21.37	0.61
Time to first dose of Rescue Analgesic (in minutes from extubation)	132.86±54.38	157.14±122.57	210±77.46	0.606

Dose of Rescue analgesia (mg)	**Group P (n=30)**	**Group D (n=30)**	**Group PD (n=30)**	**p value**
Total Dose of Rescue analgesic(in mg)	52.75±22.79	46.33±13.65	45±21.37	0.568

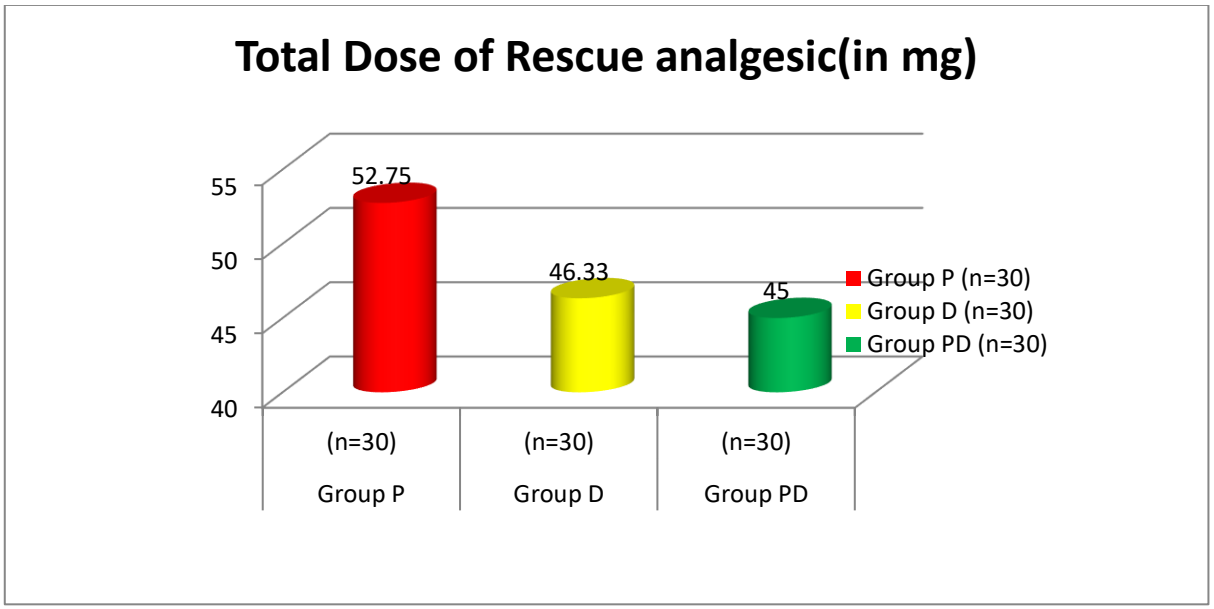

Fig 6: Total Dose of Rescue analgesic (in mg)

Table 7: Time to first dose of Rescue analgesic

FIRST RA	MEAN	SD	F	P	df	INF
Group P	132.86	54.38				
Group D	157.14	122.57				
Group PD	210	77.46	0.9	0.42	2	NS

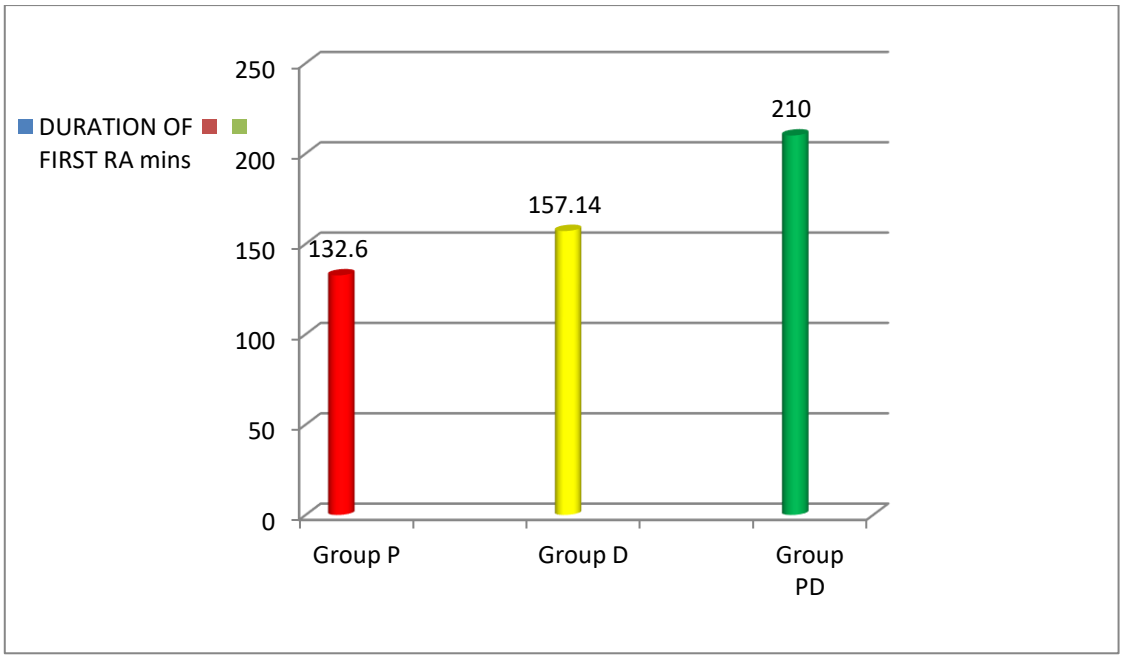

Figure 7: Time to first dose of Rescue analgesic

DISCUSSION

Effective postoperative pain management is an essential part of pediatric perioperative care. In children, inadequate analgesia may result not only in unnecessary discomfort but also in anxiety, distress, delayed recovery, and unfavorable postoperative experiences. The present study was undertaken to compare the analgesic efficacy of rectal paracetamol, rectal diclofenac, and their combination in children undergoing elective surgery, with particular emphasis on postoperative pain scores and the requirement for rescue analgesia.

The three treatment groups were comparable with respect to age, sex, body weight, ASA physical status, and duration of surgery. No statistically significant differences were observed in these baseline and perioperative characteristics. This

comparability is important because differences in demographic or operative factors could otherwise influence the severity of postoperative pain and complicate interpretation of the analgesic outcomes. The similarity of the groups therefore strengthens the likelihood that the observed differences in postoperative pain scores were primarily related to the analgesic regimens used.

The most important finding of the present study was the consistently lower Objective Pain Scale (OPS) scores observed in patients who received the combination of rectal paracetamol and rectal diclofenac. The combination group demonstrated lower mean OPS scores than both the paracetamol-only and diclofenac-only groups at every postoperative assessment point, and the overall differences among the three groups were statistically significant from the immediate postoperative assessment through 6 hours after surgery. This finding suggests that the combined regimen provided more effective postoperative pain control than either drug administered alone.

The observed benefit of combination therapy is pharmacologically plausible. Paracetamol and diclofenac exert their analgesic effects through different, potentially complementary mechanisms. Diclofenac provides analgesic and anti-inflammatory effects through inhibition of cyclooxygenase-mediated prostaglandin synthesis, whereas paracetamol has a predominantly central analgesic action. The use of agents with different mechanisms may therefore provide broader modulation of postoperative nociceptive processing. This concept provides a rational basis for multimodal analgesia and may explain why the combination group consistently demonstrated lower pain scores in the present study.[24,28,36]

Our findings are in agreement with the results reported by Mireskandari and Makarem, who evaluated rectal diclofenac and acetaminophen alone and in combination in children undergoing cleft palate repair. In that study, the combination regimen was reported to provide the most effective pain control, while diclofenac was more effective than acetaminophen when the individual agents were compared. The similarity between these findings and the present results supports the potential value of combining a non-steroidal anti-inflammatory drug with paracetamol for pediatric postoperative pain management.[36]

The present findings are also consistent with previous observations that diclofenac may provide more effective analgesia than paracetamol alone in certain pediatric surgical settings. Studies evaluating rectal diclofenac in children undergoing tonsillectomy and other procedures have demonstrated useful postoperative analgesia and an opioid-sparing effect.[20,21,27] In the current study, the diclofenac group generally showed lower OPS scores than the paracetamol group during the postoperative observation period, although the strongest and most consistent analgesic effect was seen with the combination regimen. This suggests that the anti-inflammatory component of diclofenac may be particularly relevant when postoperative pain is driven by tissue injury and inflammatory mediator release.

An important aspect of the present study is the pattern of OPS scores over time. The combination group maintained the lowest mean pain scores throughout the 6-hour observation period, indicating not only improved early postoperative analgesia but also persistence of the analgesic effect. The higher scores observed in the paracetamol group, particularly during the early and intermediate postoperative assessments, may indicate that rectal paracetamol alone was less effective for the surgical pain experienced by this study population. At the same time, the differences between the paracetamol and diclofenac groups were less pronounced at some later time points, suggesting that the relative contribution of each agent may change over the postoperative course. The consistently lower scores in the combination group, however, suggest that complementary analgesic mechanisms may provide a more sustained overall effect than either agent alone.

The immediate postoperative findings require some contextual interpretation. At the initial assessment, the mean OPS score was already lower in the combination group than in the two single-drug groups. Because all patients received intraoperative tramadol as part of the standardized anesthetic protocol, the early postoperative pain scores may have been influenced by residual effects of intraoperative analgesia. This possibility is relevant when interpreting the immediate postoperative findings and may partly explain why the absolute differences in pain scores changed over subsequent observation intervals. Nevertheless, the persistence of statistically significant differences throughout the 6-hour assessment period suggests that the observed benefit of combination therapy was not limited to the immediate effects of intraoperative analgesia.

The findings also have relevance in the context of preemptive and multimodal analgesia. The rationale for administering analgesic agents around the time of surgery is to reduce nociceptive input and potentially limit the development of sensitization following tissue injury. Previous work has suggested that analgesics administered before or around surgical stimulation may reduce postoperative pain intensity and subsequent analgesic requirements.[5] In the present study, the combined administration of diclofenac and paracetamol resulted in consistently lower postoperative OPS scores, supporting the concept that complementary analgesic mechanisms may be beneficial when incorporated into a perioperative analgesic strategy.

Although the combination group demonstrated the best pain scores, the findings for rescue analgesic consumption were less definitive. The mean total rescue analgesic dose was numerically lowest in the combination group (45.00 ± 21.37 mg), followed by the diclofenac group (46.33 ± 13.65 mg) and the paracetamol group (52.75 ± 22.79 mg). However, the difference among the groups was not statistically significant (P = 0.61). Thus, while the numerical trend favored combination therapy, the present study does not provide sufficient statistical evidence to conclude that the combination significantly reduced the total amount of rescue analgesic required.

A similar pattern was observed for the time to first rescue analgesia. Patients in the combination group had the longest mean interval before requiring rescue medication (210.00 ± 77.46 minutes), compared with 157.14 ± 122.57 minutes in the diclofenac group and 132.86 ± 54.38 minutes in the paracetamol group. Although this numerical difference suggests a potentially longer duration of analgesia with the combination regimen, the difference was not statistically significant (P = 0.606). Therefore, the rescue analgesic findings should be interpreted as supportive of a possible clinical advantage of combination therapy rather than as definitive evidence of a statistically significant reduction in rescue medication requirements.

The discrepancy between the statistically significant OPS findings and the non-significant rescue analgesic outcomes is clinically important. Pain scores are measured repeatedly across the postoperative period and may capture differences in analgesic effectiveness that are not necessarily reflected by rescue medication use. In addition, the administration of rescue tramadol was based on a predefined clinical threshold and patient requirement, which may have introduced variability in the timing and total dose of rescue medication. It is therefore possible for one treatment group to demonstrate significantly better pain scores while showing only a numerical, rather than statistically significant, reduction in rescue analgesic use.

The present findings are broadly consistent with previous work examining combinations of paracetamol and diclofenac, although the literature is not entirely uniform. Montgomery et al. reported that morphine consumption was greatest among patients receiving paracetamol alone and lowest in those receiving the combination of paracetamol and diclofenac, supporting a potential opioid-sparing effect of combination therapy.[63] Similarly, previous studies have described reductions in postoperative opioid requirements when non-opioid analgesics with complementary mechanisms are combined.[34,35] In contrast, Morton and O'Brien did not demonstrate an additional analgesic benefit from paracetamol when added to diclofenac in children receiving morphine after appendicectomy, while other studies have also reported limited or inconsistent evidence for superiority of combination therapy.[37,38,39] These differences may be related to variations in surgical procedure, dosing regimen, timing of administration, route of administration, background analgesia, and methods used to assess postoperative pain.

The present study therefore adds to the existing literature by demonstrating a clear advantage of combination therapy in terms of repeated postoperative pain scores, even though the corresponding reduction in rescue analgesic use did not achieve statistical significance. This distinction is important because it suggests that the primary benefit of the combined regimen in this study may be improved quality of analgesia rather than a measurable reduction in the total amount of rescue medication administered.

The findings also support the practical role of rectal administration in pediatric perioperative analgesia. In children, oral administration may be difficult during the perioperative period, while injectable analgesics may cause additional discomfort or anxiety. Rectal preparations provide an alternative route that can be incorporated into a multimodal analgesic regimen. Previous studies have demonstrated the usefulness of rectal diclofenac and paracetamol in pediatric surgical patients, and the present findings suggest that their combination may provide more consistent postoperative pain control than either agent alone.[6,20,24,28,33]

From a clinical perspective, the results indicate that the combination of rectal paracetamol and rectal diclofenac may be particularly useful when the primary aim is to achieve better postoperative pain control during the early postoperative period. The advantage was evident across all measured OPS time points, suggesting a sustained effect throughout the 6-hour observation period. However, the lack of statistically significant differences in total rescue analgesic dose and time to first rescue analgesia indicates that the superiority of the combination should not be overstated in terms of opioid-sparing efficacy. The strongest evidence from this study relates to the quality and consistency of postoperative analgesia as reflected by OPS scores.

The study has several limitations that should be acknowledged. First, the postoperative observation period was limited to 6 hours, and therefore the findings primarily reflect early postoperative analgesia. Second, the study included children undergoing elective surgery as a broad category, and differences in the type and extent of individual surgical procedures may have influenced pain intensity. Third, although OPS provides a practical approach to pediatric pain assessment, it is an observer-based measure and may not fully capture the subjective experience of pain in older children. Finally, the

study was designed primarily to evaluate early postoperative analgesia, and the sample size may have limited the ability to detect statistically significant differences in rescue analgesic requirements.

Overall, the present study demonstrates that combined rectal paracetamol and rectal diclofenac provided superior postoperative analgesia, as reflected by consistently lower OPS scores throughout the 6-hour postoperative observation period, compared with either rectal paracetamol or rectal diclofenac alone. Although the combination group also showed a numerically lower total rescue analgesic requirement and a longer time to first rescue analgesia, these differences did not reach statistical significance. The findings therefore support the use of combined rectal paracetamol and diclofenac as a potentially effective multimodal strategy for improving the quality of postoperative analgesia in children undergoing elective surgery, while recognizing that its effect on overall rescue analgesic consumption requires further evaluation in larger, adequately powered studies.

CONCLUSION

In this randomized, double-blind comparative study, the combination of rectal paracetamol and rectal diclofenac provided superior postoperative analgesia compared with rectal paracetamol or rectal diclofenac administered alone in children undergoing elective surgery. Patients receiving the combination therapy demonstrated consistently lower postoperative Objective Pain Scale (OPS) scores throughout the 6-hour observation period, indicating improved postoperative pain control. Although the combination group also showed a lower mean rescue analgesic requirement and a longer time to first rescue analgesia, these differences were not statistically significant.

The findings support the use of multimodal non-opioid analgesia by combining rectal paracetamol and rectal diclofenac to improve the quality of postoperative pain management in pediatric patients undergoing elective surgery. This approach may offer more effective postoperative analgesia than either agent alone while contributing to an opioid-sparing perioperative strategy. Further multicenter studies with larger sample sizes and longer follow-up are warranted to confirm these findings and to evaluate the long-term clinical benefits of combination therapy across different pediatric surgical procedures. This conclusion is consistent with the original study's overall interpretation while omitting the safety findings, as requested.

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Data Availability: Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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