

# Comparison of Post-Operative Outcome with and without Application of ERAS Protocols in Patients of Acute Appendicitis

Muhammad Saleem Iqbal<sup>1</sup>, Sajid Rashid<sup>2</sup>, Zafar Ali Choudry<sup>3</sup>, Israr Ahmad Khan<sup>4</sup>, Sajid Rehman Randhawa<sup>5</sup>, Muhammad Habib Ur Rahman<sup>6</sup>

- 1 Assistant Professor, Department of Surgery, Faisalabad Medical University, Faisalabad Pakistan  
Principal investigator, Statistical analysis, Manuscript writing
- 2 Associate Professor, Department of Surgery, Faisalabad Medical University, Faisalabad Pakistan  
Data collection
- 3 Vice Chancellor, Faisalabad Medical University, Faisalabad Pakistan  
Supervised the project
- 4 Assistant Professor, Department of Surgery, Faisalabad Medical University, Faisalabad Pakistan  
Proof reading
- 5 Associate Professor, Department of Surgery, Faisalabad Medical University, Faisalabad Pakistan  
Discussion & references
- 6 Post Graduate Resident, Department of Cardiac Surgery, Faisalabad Institute of Cardiology, Faisalabad Pakistan  
Data collection

## CORRESPONDING AUTHOR

Dr. Muhammad Saleem Iqbal  
Assistant Professor, Department of Surgery,  
Faisalabad Medical University, Faisalabad Pakistan  
Email: drsaleemiqbal@yahoo.com

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## ABSTRACT

**Background:** The application of ERAS allows for a multidisciplinary and multimodal approach to perioperative care which not only expedites recovery but maximizes patient outcomes. **Objective:** Comparison of post-operative outcome with and without application of ERAS protocols in patients of acute appendicitis. **Study Design:** Randomized controlled trial. **Settings:** Surgical Emergency, Allied Hospital, Faisalabad Pakistan. **Duration:** 01-05-2023 to 31-12-2023. **Methods:** 160 patients were included with non-probability consecutive sampling technique. All data was recorded in a predesigned proforma. **Results:** In our studies mean of Pain score in Group A was 2.45 (Sd-0.53) after 4 hrs., 2.25 (sd-0.43) after 08 hrs., 1.66(sd-0.52) after 12 hrs., 1.08 (sd-0.28) after 24 hrs. Mean of pain score in Group B was 3.42 (Sd-0.56) after 4 hrs., 3.03(sd-0.29) after 08 hrs., 2.77(sd-0.44) after 12 hrs., 2.20(sd-0.40) after 24 hrs. Mean of Activity score in Group A was 1.41 (Sd-0.58) after 4 hrs., 2.17(sd-0.59) after 08 hrs., 2.75(sd-0.56) after 12 hrs., 3.68 (sd-0.49) after 24 hrs. Mean of activity score in Group B was 0.08 (Sd-0.28) after 4 hrs., 0.86(sd-0.47) after 08 hrs., 1.62(sd-0.48) after 12 hrs., 2.25(sd-0.46) after 24 hrs. In Group A mean of rescue analgesia needed postoperatively is 0.17 (0.44) and in Group B, the mean is 2.22(sd-0.67). **Conclusion:** Patients who underwent appendectomy with ERAS protocols had less pain postoperatively, were mobile and able to perform routine activity earlier, had less need of rescue analgesia postoperatively, were oral-free earlier, less incidence of surgical site infection and were discharged from the hospital earlier

**Keywords:** Appendectomy, Laparoscopic, Enhanced recovery after surgery (ERAS protocols), Pain, Activity after surgery.

## INTRODUCTION

The concept of enhanced recovery after surgery (ERAS) was developed in the 1990s, by Henrik Kehlet, a colorectal surgeon in Denmark, to expedite a patient's recovery by reducing the profound physiologic stress response of surgery<sup>1</sup>.

It incorporates a multimodal and multidisciplinary approach to perioperative care<sup>2</sup>. Its utility within multiple surgical fields has been established in the literature and has since been published in a broad array of subspecialties such as colorectal, vascular, hepatobiliary, thoracic, as well as urology and gynecology<sup>3-8</sup>. ERAS

allows for a multidisciplinary and multimodal approach to perioperative care which not only expedites recovery but maximizes patient outcomes.

A variety of such protocols exists, but the main elements include preoperative counselling, maximization of nutrition, standardized aesthetic and analgesia regimens, and early mobilization<sup>2</sup>. Successful implementation of these protocols has translated into a decrease in hospital stay, complications, and high patient satisfaction<sup>9-10</sup>. Enhanced Recovery After Surgery (ERAS) protocols are well-documented logistic programs in elective surgery but it is still uncertain whether ERAS can benefit emergency patients, because of significant challenges

facing its application to emergency surgery. With healthcare costs rising, there has been pressure to reduce the length of hospital stays while improving the patient experience concomitantly.<sup>11</sup> ERAS protocols have demonstrated reduction of healthcare expenditures while improving overall patient satisfaction.<sup>12</sup>

Literature has also shown that ERAS can improve the 5-year survival rate, safety, and satisfaction of patients with colorectal cancer.<sup>13</sup>

Rationale of this study is to apply ERAS protocols in commonly performed emergency surgery appendectomy. Its result is convincing, and it will provide guidelines to future surgeon to apply these protocols and improve patient outcomes.

**OBJECTIVE**

Comparison of post-operative outcome with and without application of ERAS protocols in patients of acute appendicitis

**OPERATIONAL DEFINITIONS**

**Acute Appendicitis:** It is the inflammation of appendix. (Alvarado score>7)

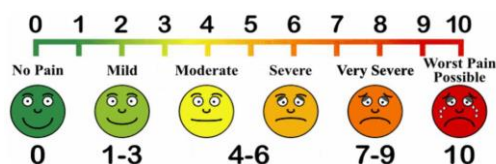
**Appendectomy:** It is the surgical removal of appendix.

**ERAS:** Enhanced recovery after surgery protocols help optimize inpatient care and minimize discomfort.

**Pre-emptive Analgesia:** Introduction of analgesic regimen before the onset of noxious stimuli.

**Primary Outcome:**

**A. Pain:** Primary outcome will be the measurement of pain (onset, severity, response rate) and demand for analgesic. Post operative Pain response will be assessed as per Visual Analogue pain score.



Pain score after surgery VAS 4 Hr.,8Hr.,12 Hr., 24 Hr.

**B. Postoperative Activity Scale:** Postoperative activity will be recorded as

0	Unable to turn, sit, or stand
1	Turn yourself in the bed
2	Sit comfortably
3	Can stand for 01 min /Shift to chair
4	Can walk comfortably

Activity score after surgery after 4 hr.,8 hr.,12 hr., 24 hr.

**Secondary Outcomes**

- A. First oral intake after surgery:** will be calculated as first oral intake score as 1: <12 hrs.,2: 12-24, 3: >24
- B. Postoperative ileus /abdominal distension:** Score of 1: Yes ,2: No
- C. Surgical site infection:** It will be calculated as the score of 1: None ,2: Mild,3: Severe
- D. Rescue analgesia:** It will be calculated as the number of rescue analgesia needed as score 0:0,1:1,2:2,3:>2
- E. Hospital Stay:** It will be labelled as the score of 1:<24 hrs., 2:24-48 hrs,3:>48hrs.

**HYPOTHESIS**

**Study Hypothesis:** ERAS protocols provide better post-operative surgical outcomes in the form of early uneventful recovery and lesser hospital stay compared to those in which ERAS protocols are not applied protocols in patients of acute appendicitis.

**Null Hypothesis:** There is no difference of post-operative outcomes with or without ERAS protocols in patients of acute appendicitis

**METHODS**

This Randomized controlled trial was conducted at Surgical Emergency, Allied Hospital, Faisalabad Pakistan. The duration of the study was from 01-05-2023 to 31-12-2023(eight months) after approval from the ethical review board NO.48 ERC/FMU/2021-22/259.

By using the WHO sample size calculator for two proportions

- Level of significance=5%
- Sample size=160 (Group1= 80, Group 2= 80)

Non-probability consecutive sampling technique was used. 15-50 years of age with clinically/radiological diagnosed acute appendicitis, Clinically or radiologically suspicious uncomplicated acute appendicitis, Normal hematologic, hepatic and renal functions and voluntary signed informed consent were included in the study.

Peri-appendiceal abscess and perforation, patients unfit for anaesthesia, allergy or hypersensitivity to bupivacaine, patient with serious comorbidities, pregnancy, consent refusal patients were excluded from the study.

The patients were provided with comprehensive information about the ERAS protocol, including the surgical approach, postoperative recovery and eventual complications. Following ERAS protocols will be followed.

**Table 1: Modified ERAS protocol for acute appendicitis**

Time	Components
<b>Preoperative</b>	<ul style="list-style-type: none"> <li>• Patient counselling session by the operating team</li> <li>• Preoperative carbohydrate loading-2 drinks 2 hours before surgery</li> <li>• Prophylactic antibiotic treatment at the time of anaesthesia induction.</li> <li>• Prophylaxis of postoperative nausea and vomiting following Apfel scale</li> <li>• Pre-emptive analgesia: Port-site infiltration with Bupivacaine 0.5%, 20 ml, before port placement</li> </ul>
<b>Intraoperative</b>	<ul style="list-style-type: none"> <li>• Diclofenac rectal suppository 100mg before the start of surgery</li> <li>• Limited intravenous fluids (1L crystalloids)</li> <li>• Active heating with thermal fluid heater and thermal blanket</li> <li>• Laparoscopic surgery by a consultant</li> </ul>
<b>Immediate and early Postoperative period</b>	<ul style="list-style-type: none"> <li>• Intravenous analgesia (NSAIDs). Avoid opioids</li> <li>• Oral fluids 6 h after surgery</li> <li>• Active mobilization 8 h after surgery</li> </ul>
<b>Postoperative Day 1 &amp; Discharge</b>	<ul style="list-style-type: none"> <li>• Start oral analgesia</li> <li>• Progression to complete diet</li> <li>• Discharge criteria: No surgical complications, no fever, pain controlled with oral analgesia, ambulating independently, tolerating a full oral diet, Passing flatus, Satisfactory support at home</li> </ul>
<b>Follow-up</b>	<ul style="list-style-type: none"> <li>• Patient is given a phone number for contacting the ward if required</li> <li>• Telephone monitoring for 48 hrs. by Nursing staff</li> <li>• Follow-up outpatient clinic visit within 07 days of discharge</li> </ul>

Note: ERAS-Enhanced Recovery After Surgery, NSAIDs- Nonsteroidal anti-inflammatory drugs, USG; Ultrasonography

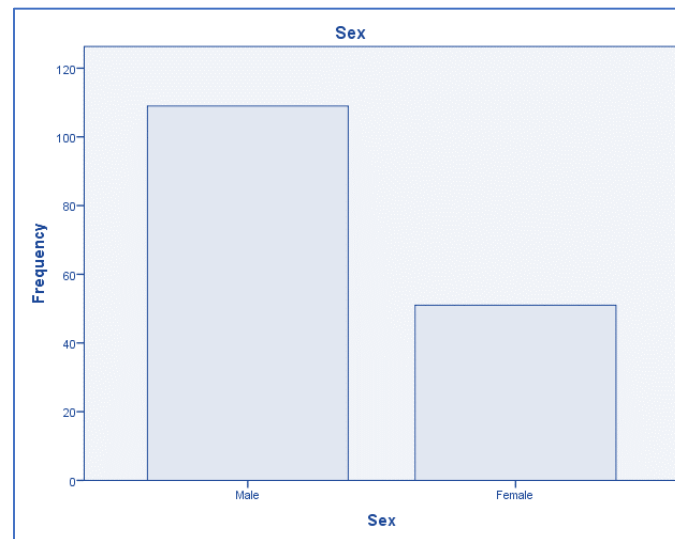
All the data will be analysed using SPSS version 24.0. Quantitative variables like the number of injectable analgesics required and VAS score was measured and compared. Effect modifiers like age, postoperative pain, use of analgesics, pain-free time, and time of first mobilization will be controlled by stratification. Independent samples t-test was used to analyse the impact of ERCs on pain after surgery, pain control and duration of hospital stay. A P-value<0.05 was considered statistically significant.

**RESULTS**

**1. Sex Distribution:** In our studies 109(68.1%) were males & 51(31.9%) were females (Table 1)

**Table 1: Sex distribution**

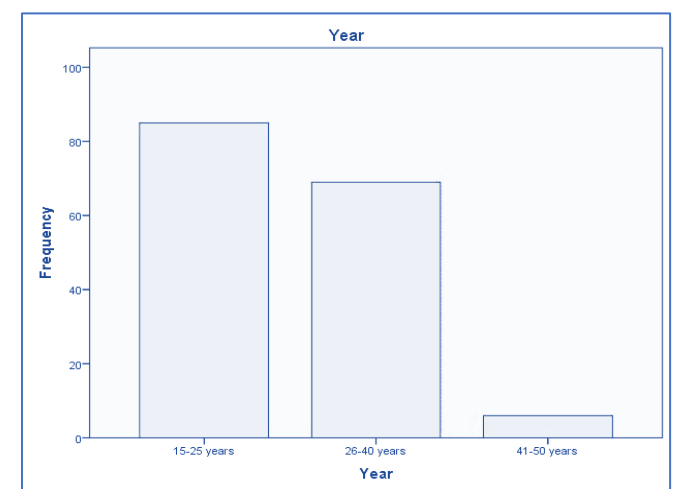
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<b>Male</b>	109	68.1	68.1	68.1
	<b>Female</b>	51	31.9	31.9	100.0
	<b>Total</b>	160	100.0	100.0	



**2. Age distribution:** In our study 85 (53.1%) patients were between 15-25 years of age, 69 (43.1%) was between 26-40 years of age and 06 (3.8%) were between 41-50 year of age.

**Table 2: Age distribution**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<b>15-25 years</b>	85	53.1	53.1	53.1
	<b>26-40 years</b>	69	43.1	43.1	96.3
	<b>41-50 years</b>	6	3.8	3.8	100.0
	<b>Total</b>	160	100.0	100.0	



**3. Primary and Secondary outcomes of study**

- **Pain score:** Mean of Pain score in **Group A** was 2.45 (Sd-0.53) after 4 hrs., 2.25(sd-0.43) after 08 hrs., 1.66(sd-0.52) after 12 hrs., 1.08 (sd-0.28) after 24 hrs. Mean of pain score in **Group B** was 3.42 (Sd-0.56) after 4 hrs., 3.03(sd-0.29) after 08 hrs., 2.77(sd-0.44) after 12 hrs., 2.20(sd-0.40) after 24 hrs.
- **Activity score:** Mean of Activity score in **Group A** was 1.41 (Sd-0.58) after 4 hrs., 2.17(sd-0.59) after 08 hrs., 2.75(sd-0.56) after 12 hrs., 3.68 (sd-0.49) after 24 hrs. Mean of activity score in **Group B** was 0.08 (Sd-0.28) after 4 hrs., 0.86(sd-0.47) after 08 hrs., 1.62(sd-0.48) after 12 hrs., 2.25(sd-0.46) after 24 hrs.
- **Rescue analgesia needed Postoperatively:** In group A mean is 0.17 (0.44) and in Group B mean is 2.22(sd-0.67).

**Table 3: Primary and Secondary outcomes of study**

	Group	Mean	Std. Deviation	Std. Error Mean
Pain Score after 04 hours	Group-A	2.4500	0.52531	0.05873
	Group-B	3.4250	0.56870	0.06358
Pain Score after 08 hours	Group-A	2.2500	0.43574	0.04872
	Group-B	3.0375	0.29527	0.03301
Pain Score after 12 hours	Group-A	1.6625	0.52636	0.05885
	Group-B	2.7750	0.44933	0.05024
Pain Score after 24 hours	Group-A	1.0875	0.28435	0.03179
	Group-B	2.2000	0.40252	0.04500
Activity score after 04 hours	Group-A	1.4125	0.58879	0.06583
	Group-B	0.0875	0.28435	0.03179
Activity score after 08 hours	Group-A	2.1750	0.59054	0.06602
	Group-B	0.8625	0.47049	0.05260
Activity score after 12 hours	Group-A	2.7500	0.56254	0.06289
	Group-B	1.6250	0.48718	0.05447
Activity score after 24 hours	Group-A	3.6875	0.49283	0.05510
	Group-B	2.2500	0.46389	0.05186
Postoperative Oral Intake in hours	Group-A	1.01250	0.111803	0.012500
	Group-B	1.38750	0.490253	0.054812
Rescue analgesia needed Postoperatively	Group-A	0.1750	0.44366	0.04960
	Group-B	2.2250	0.67458	0.07542
Postoperative hospital Stay in hours	Group-A	1.0250	0.15711	0.01757
	Group-B	1.7000	0.46115	0.05156
Surgical site infection	Group-A	1.0125	0.11180	0.01250
	Group-B	1.1750	0.41415	0.04630
Postoperative ileus	Group-A	2.0000	0.00000	0.00000
	Group-B	1.9375	0.24359	0.02723

		Group		Total
		Group-A	Group-B	
Pain Score after 04 hours	1-3	45	0	45
	4-6	34	49	83
	7-9	1	28	29
	10	0	3	3
Total		80	80	160

		Group		Total
		Group-A	Group-B	
Pain Score after 08 hours	1-3	60	2	62
	4-6	20	73	93
	7-9	0	5	5
Total		80	80	160

		Group		Total
		Group-A	Group-B	
Pain Score after 12 hours	0	29	0	29
	1-3	49	19	68
	4-6	2	60	62
	7-9	0	1	1
Total		80	80	160

		Group		Total
		Group-A	Group-B	
Pain Score after 24 hours	0	73	0	73
	1-3	7	64	71
	4-6	0	16	16
Total		80	80	160

		Group		Total
		Group-A	Group-B	
Activity score after 04 hours	0	4	73	77
	1	39	7	46
	2	37	0	37
Total		80	80	160

		Group		Total
		Group-A	Group-B	
Activity score after 08 hours	0	0	15	15
	1	8	61	69
	2	50	4	54
	3	22	0	22
Total		80	80	160

		Group		Total
		Group-A	Group-B	
Activity score after 12 hours	1	0	30	30
	2	25	50	75
	3	50	0	50
	4	5	0	5
Total		80	80	160



Activity score after 24 hours * Group Crosstabulation				
Count				
		Group		Total
		Group-A	Group-B	
Activity score after 24 hours	1	0	1	1
	2	1	58	59
	3	23	21	44
	4	56	0	56
Total		80	80	160

## DISCUSSION

This study was carried out to know the effects of ERAS protocols on [postoperative outcomes in patients undergoing appendectomy. Appendicitis is the most performed procedure in developed and developing countries. In our studies 109(68.1%) were males & 51(31.9%) were females. In our study 85 (53.1%) patients were between 15-25 years of age, 69 (43.1%) was between 26-40 years of age and 06 (3.8%) were between 41-50 years of age.

Mean of Pain score in Group A was 2.45 (Sd-0.53) after 4 hrs., 2.25(sd-0.43) after 08 hrs., 1.66(sd-0.52) after 12 hrs., 1.08 (sd-0.28) after 24 hrs. Mean of pain score in Group B was 3.42 (Sd-0.56) after 4 hrs., 3.03(sd-0.29) after 08 hrs., 2.77(sd-0.44) after 12 hrs., 2.20(sd-0.40) after 24 hrs. This shows the clear benefit of ERAS protocols by inhibiting nerve sensitization on postoperative pain. It is one of the most important outcomes of ERAS protocols. Preoperatively infiltrating the incision site with long-acting local anaesthesia causes preoperative desensitization of nerves, which causes less stimulation of pain fibres and ultimately less postoperative pain.

Mean of Activity score in Group A was 1.41 (Sd-0.58) after 4 hrs., 2.17(sd-0.59) after 08 hrs., 2.75(sd-0.56) after 12 hrs., 3.68 (sd-0.49) after 24 hrs. The mean of activity score in Group B was 0.08 (Sd-0.28) after 4 hrs., 0.86(sd-0.47) after 08 hrs., 1.62(sd-0.48) after 12 hrs., 2.25(sd-0.46) after 24 hrs. The clear difference between the two groups is because of the beneficial effects of ERAS. Patients were more comfortable in the ERAS group than in conventional groups. Due to less postoperative pain in the recovery period, patients were mobilized earlier than in the conventional group.

The need for Rescue analgesia Postoperatively in Group A, was 0.17 (0.44), and in Group B mean was 2.22(sd-0.67). This is also because of preoperative desensitization of the nerve as was done in the ERAS group.

Most patients in the ERAS group were oral-free earlier as compared to the conventional group. And the finding was in line with Massimiliano et.al, who claimed that, even with colorectal anastomosis, postoperative enteral feeding is harmless<sup>11</sup>.

The length of hospital stay was significantly less in ERAS group. The effect of ERAS protocols on length of hospital stay is one of the most significant indicators of the effectiveness of these protocols. In a single, tertiary centre experience in Korea by Kim *et al.*, the postoperative hospital stay was significantly shorter with ERAS pathways [(18.0±12.4) d] vs. conventional pathways [(24.5±14.4) d], regardless of complications.<sup>9</sup>

Robert Young *et al* have accepted and said that several writers agreed to create and adopt a complete ERAS protocol to minimize postoperative opioid use and the duration of hospital stay.<sup>10</sup> This follows on from Karen P and Paul R *et al*, which showed that implementation of ERAS has resulted in a 3.5-day decrease in the duration of hospital stay (LOS). Compliance with the ERAS

## CONCLUSION

In conclusion, ERAS has obvious advantages in patients with appendicitis after surgery over traditional surgery in promoting postoperative recovery, decrease postoperative pain, less /no requirement for rescue analgesia, early return to oral feeding, shortening the length of hospital stay. This study demonstrates that ERAS protocols appears to be a safe and feasible option for patients undergoing appendectomy.

## LIMITATIONS

The study is limited by its small sample size and single centre.

## SUGGESTIONS / RECOMMENDATIONS

It is recommended to conduct larger-scale multicenter studies to confirm and validate these findings.

## CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflict of interest.

## ACKNOWLEDGEMENTS

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