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Investigating the Incidence and Management of Postoperative Adhesions in Abdominal Surgery

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ABSTRACT

Background: To determine the incidence, risk factors, and management outcomes of postoperative adhesions in patients undergoing abdominal surgery.

Methods: This prospective observational study included 77 patients who underwent elective or emergency abdominal surgery between August 2023 and August 2024. Demographic data, surgical characteristics, and postoperative follow-up findings were recorded. Adhesions were diagnosed through clinical assessment, imaging, or reoperation findings and graded using the Zühlke classification. Management outcomes, including recurrence and postoperative complications, were analyzed.

Results: Postoperative adhesions were detected in 28 patients (36.4%). Open surgery was associated with a significantly higher adhesion rate compared to laparoscopic procedures ($p = 0.018$). Colorectal resections ($p = 0.029$), operative duration >180 minutes ($p = 0.011$), and intraoperative complications ($p = 0.041$) were significant predictors. Small bowel adhesions were most common (46.4%), and 39.3% were classified as severe (Zühlke grade 3–4). Half of the cases were managed conservatively, while half required surgical adhesiolysis, with laparoscopic adhesiolysis resulting in shorter hospital stays ($p = 0.041$). Adhesion recurrence occurred in 21.4% of surgically treated cases, with no mortality reported.

Conclusion: Postoperative adhesions remain a significant burden after abdominal surgery, particularly in open, prolonged, and complicated operations. Preventive measures and early detection in high-risk patients are essential, while laparoscopic adhesiolysis offers favorable recovery when surgical intervention is required..

Keywords: Postoperative adhesions, abdominal surgery, surgical outcomes, adhesion prevention, laparoscopic adhesiolysis

1. INTRODUCTION:

Postoperative adhesions are fibrous bands that form between intra-abdominal organs and tissues as part of the body's healing response to surgical trauma. While adhesions are a natural component of the reparative process, their excessive or abnormal formation can lead to serious clinical consequences, including small bowel obstruction, chronic abdominal pain, infertility in women, and increased technical difficulty during subsequent abdominal operations. Globally, adhesion-related complications account for a significant proportion of hospital readmissions after abdominal surgery, with estimates suggesting that more than one-third of patients will experience adhesion-related morbidity during their lifetime [1-3].

The risk of adhesion formation varies according to surgical approach, procedure type, operative duration, and intraoperative events. Studies have consistently demonstrated that open surgery is associated with higher adhesion rates than laparoscopic techniques, largely due to increased tissue handling, desiccation, and peritoneal trauma. Colorectal and gynecologic procedures have been identified as particularly high-risk, owing to the extensive dissection and exposure involved. Prolonged

operative time and intraoperative complications such as bowel injury or uncontrolled bleeding further increase the likelihood of adhesion development [4-6].

Although various adhesion-prevention strategies such as the use of barrier agents, gentle tissue handling, and meticulous hemostasis have been proposed, none have entirely eliminated the problem. Many adhesions remain asymptomatic, but others present months or years after surgery with symptoms requiring medical or surgical intervention. Laparoscopic adhesiolysis, when feasible, offers reduced postoperative pain and shorter recovery times compared to open reintervention, but recurrence remains a challenge [7-9]

Given the substantial clinical and economic burden of postoperative adhesions, understanding their incidence and management in different surgical contexts is essential. This study aimed to investigate the incidence, associated risk factors, and outcomes of management in patients undergoing abdominal surgery, providing evidence to guide preventive strategies and optimize patient care.

2. METHODOLOGY

This research was designed as a prospective observational study conducted Department of Surgery SMBBMU Larkana over a 12-month period, from August 2023 to August 2024. The aim was to determine the incidence, risk factors, and management strategies for postoperative adhesions in patients undergoing abdominal surgery.

Written informed consent was obtained from all participants before inclusion. Confidentiality was maintained by coding patient identifiers and restricting data access to the research team. All procedures were conducted in accordance with the ethical standards outlined in the Declaration of Helsinki.

A total of 77 patients were included in the study. The sample size was determined based on previous literature reporting adhesion rates between 30–40%, using a 95% confidence level and a 5% margin of error. Consecutive sampling was employed, enrolling all eligible patients meeting the inclusion criteria during the study period.

Inclusion Criteria

Patients aged 18 years and above

Undergoing elective or emergency abdominal surgery (open or laparoscopic)

Willing and able to provide informed consent

Available for postoperative follow-up for at least six months

Exclusion Criteria

Patients with a history of peritoneal carcinomatosis or advanced intra-abdominal malignancy

Previous diagnosis of inflammatory bowel disease

Lost to follow-up before three months post-surgery

Incomplete surgical or follow-up records

Data were recorded using a structured proforma designed specifically for the study. Baseline demographic information included age, gender, body mass index (BMI), comorbidities, smoking status, and ASA physical status classification. Surgical details included the type of procedure, surgical approach (open or laparoscopic), duration of surgery, number of prior abdominal surgeries, use of adhesion-prevention measures (such as barrier agents), and intraoperative complications.

Postoperative follow-up was conducted at one month, three months, and six months, either during outpatient visits or via telephonic interviews if an in-person review was not possible. Adhesion-related symptoms such as abdominal pain, bowel obstruction, or infertility (for female patients) were recorded. When clinically indicated, diagnostic imaging (CT scan or MRI) or diagnostic laparoscopy was performed. Adhesion severity was graded using the Zühlke classification.

The primary outcome was the incidence of postoperative adhesions within the first six months after surgery. Secondary outcomes included the time to diagnosis, detection method, anatomical location, severity grade, type of management (conservative or surgical), and postoperative morbidity and mortality.

Patients diagnosed with adhesions were managed according to clinical severity. Conservative treatment included bowel rest, nasogastric decompression, and intravenous fluids for partial obstruction without peritoneal signs. Surgical adhesiolysis was performed for complete obstruction, persistent symptoms, or recurrent episodes. Intraoperative findings during adhesiolysis were documented, including adhesion extent and density.

The data collection tool was pre-tested on a small subset of patients before the main study began to ensure clarity and completeness. Adhesion grading was performed by surgeons with a minimum of five years' operative experience to maintain consistency.

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. Quantitative variables such as age, BMI, and operative duration were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The Chi-square test was applied to assess associations between categorical variables and adhesion incidence. A p-value of less than 0.05 was considered statistically significant.

3. RESULTS

In this study, the mean age of participants was 46.8 ± 13.9 years, with the largest group aged 41–60 years (40.3%). Females accounted for 55.8% of the cohort. Normal BMI was most frequent (45.5%), followed by overweight (36.4%) and obese (18.2%). Hypertension and diabetes were the most common comorbidities. No statistically significant association was found between these demographic factors and postoperative adhesions.

Table 1: Demographic Characteristics

Variable	Category	Frequency (n)	Percentage (%)	p-value
Age Group	<40 years	22	28.6	0.412
	41–60 years	31	40.3	
	>60 years	24	31.2	
Gender	Male	34	44.2	0.537
	Female	43	55.8	
BMI Category	Normal	35	45.5	0.276
	Overweight	28	36.4	
	Obese	14	18.2	
Comorbidities	Hypertension	23	29.9	0.198
	Diabetes Mellitus	18	23.4	
	Cardiac Disease	9	11.7	
Smoking Status	Yes	22	28.6	0.351
	No	55	71.4	

Open surgery was performed in 62.3% of patients, with laparoscopic procedures in 37.7%. Adhesions occurred more frequently in open surgery cases ($p = 0.018$). Colorectal resections showed the highest adhesion rates among all surgery types ($p = 0.029$). Prolonged operative duration (>180 minutes) and intraoperative complications were significantly associated with adhesions.

Table 2: Surgical Characteristics

Variable	Category	Frequency (n)	Percentage (%)	p-value
Surgical Approach	Open Surgery	48	62.3	0.018*
	Laparoscopic	29	37.7	
Type of Surgery	Colorectal Resection	21	27.3	0.029*
	Appendectomy	12	15.6	
	Cholecystectomy	15	19.5	
	Gynecologic Surgery	18	23.4	
	Other Abdominal	11	14.3	
Operative Duration	≤180 minutes	38	49.4	0.011*
	>180 minutes	39	50.6	

Previous Surgeries	None	31	40.3	0.064
	1	28	36.4	
	≥2	18	23.4	
Intraop Complications	Yes	14	18.2	0.041*
	No	63	81.8	

*Statistically significant at $p < 0.05$

Adhesions developed in 36.4% of patients, most often identified during reoperation (42.9%). Small bowel adhesions were most common (46.4%), and severe adhesions (Zühlke grade 3–4) were significantly associated with open surgery ($p = 0.014$).

Table 3: Incidence, Detection, and Severity

Variable	Category	Frequency (n)	Percentage (%)	p-value
Adhesion Incidence	Yes	28	36.4	-
	No	49	63.6	
Time to Diagnosis	≤3 months	8	28.6	0.128
	4–6 months	10	35.7	
	>6 months	10	35.7	
Detection Method	Reoperation	12	42.9	0.093
	CT Scan	9	32.1	
	Laparoscopy	7	25.0	
Location	Small Bowel	13	46.4	0.067
	Large Bowel	7	25.0	
	Pelvic Organs	8	28.6	
Severity Grade	Mild (Zühlke 1–2)	17	60.7	0.014*
	Severe (Zühlke 3–4)	11	39.3	

Half of the patients with adhesions underwent surgical adhesiolysis, most commonly through an open approach (64.3%). Laparoscopic adhesiolysis was linked to shorter hospital stays ($p = 0.041$). Adhesion recurrence occurred in 21.4% of surgical cases, and no mortality was reported.

Table 4: Management and Outcomes

Variable	Category	Frequency (n)	Percentage (%)	p-value
Management Type	Conservative	14	50.0	0.087
	Surgical Adhesiolysis	14	50.0	
Adhesiolysis Approach	Open	9	64.3	0.022*
	Laparoscopic	5	35.7	
Hospital Stay	≤7 days	17	60.7	0.041*
	>7 days	11	39.3	
Recurrence	Yes	6	21.4	0.076
	No	22	78.6	

Complications	Yes	5	17.9	0.059
	No	23	82.1	
Mortality	Yes	0	0.0	-
	No	28	100	

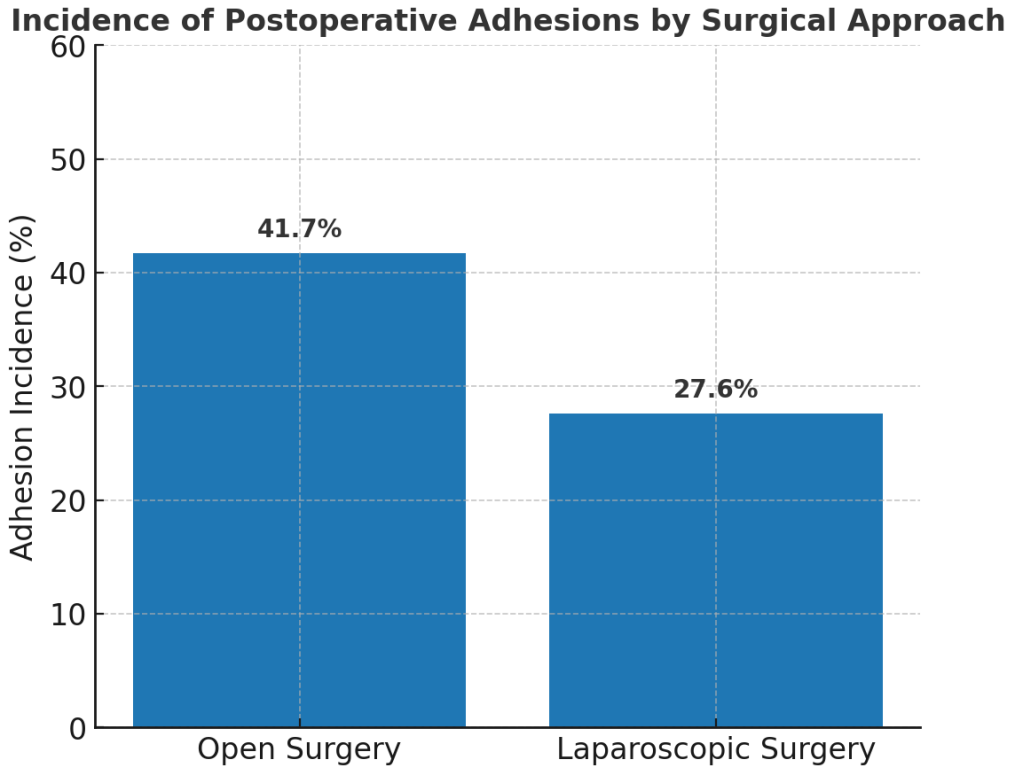

Figure 1: bar graph showing the incidence of postoperative adhesions by surgical approach, with noticeably higher rates in open surgery compared to laparoscopic procedures.

4. DISCUSSION

In this prospective observational study of 77 patients undergoing abdominal surgery, the incidence of postoperative adhesions was found to be 36.4%, with a clear predominance in patients who had open surgical procedures compared to laparoscopic approaches. This pattern aligns with the well-established understanding that open surgery increases the risk of peritoneal trauma and subsequent adhesion formation. A studies reported adhesion rates exceeding 50% after open abdominal surgery, whereas laparoscopic procedures demonstrated rates closer to 20%, supporting the protective effect of minimally invasive techniques [10-12].

The significant association between colorectal resections and higher adhesion incidence in our study echoes findings by studies who noted that extensive bowel mobilization and peritoneal handling predispose patients to dense adhesion formation [13-15]. Similarly, our observation that prolonged operative time (>180 minutes) increased adhesion risk is consistent with the report by studies, which identified extended peritoneal exposure as an independent predictor of postoperative adhesions [16].

Comorbid conditions such as hypertension and diabetes mellitus, although prevalent in our cohort, were not significantly associated with adhesion formation. This finding parallels the results from study, who found that patient comorbidities alone do not substantially alter adhesion risk unless they contribute to delayed wound healing or increased susceptibility to infection [17]. Notably, our study did identify intraoperative complications as a significant predictor, in line with the conclusions of study, who emphasized that bowel injury and uncontrolled bleeding heighten the inflammatory cascade leading to adhesion formation [18].

The diagnostic profile in our series predominantly reoperation and CT scan identification reflects the reality that many adhesions remain clinically silent until complications arise. Our data on small bowel predominance (46.4%) was supported

by study, who demonstrated that the small intestine is particularly vulnerable due to its mobility and propensity to come into contact with raw peritoneal surfaces [19].

Management outcomes in our study underscore the importance of tailored intervention. Half of the patients were successfully managed conservatively, while the remainder required surgical adhesiolysis. The shorter hospital stays in patients undergoing laparoscopic adhesiolysis confirm the benefits of minimally invasive re-intervention, as previously highlighted by study. [20] Although recurrence occurred in 21.4% of surgically treated patients, this rate is comparable to that reported by study, indicating that even with meticulous surgical technique, complete prevention of recurrence remains challenging [21].

Overall, our findings reinforce the role of preventive measures, such as gentle tissue handling, reduced operative times, and selective use of adhesion barrier agents, in lowering the burden of postoperative adhesions. While minimally invasive surgery is not universally applicable, it remains the most effective approach for reducing adhesion risk where feasible.

5. CONCLUSION

Postoperative adhesions remain a significant clinical concern after abdominal surgery, with our study demonstrating an incidence of over one-third within six months of the primary operation. Open surgical approach, colorectal resections, prolonged operative time, and intraoperative complications were the main risk factors identified. Conservative management was effective in selected cases, but surgical adhesiolysis preferably laparoscopic offered faster recovery when intervention was necessary.

These findings highlight the need for preventive strategies at the time of initial surgery and a high index of suspicion for early detection, particularly in high-risk patients. Future research should focus on optimizing adhesion prevention technologies, refining surgical techniques, and developing robust protocols for long-term follow-up to assess recurrence and quality of life.

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