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Small bowel obstruction 4 years after open appendectomy: A case report and narrative review of the literature.

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Abstract
Background: *Adhesive small bowel obstruction after appendectomy is a concerning complication.*
Case presentation: *Herein, we report a 16-year-old male who appeared in the emergency department with a history of abdominal pain localized in the right lower quadrant and vomiting. The patient reported an open appendectomy four years ago in our hospital. Clinical examination did not reveal peritonism (rebound tenderness, guarding). Computed tomography corroborated small bowel obstruction diagnosis without signs of bowel ischemia, strangulation, or peritonitis. Initially, the patient was treated conservatively, but the following day a diagnostic laparoscopy was performed due to excruciating pain. The laparoscopy converted to exploratory laparotomy for technical reasons. An adhesion band compressing the terminal ileum was found, ligated, and divided.*
Conclusion: *The true incidence of small bowel obstruction following laparoscopic and open appendectomy remains unclear. Generally, adhesive small bowel obstruction following laparoscopic and open appendectomy changed based on the severity of appendicitis and the type of the study.*
Keywords: *appendectomy; laparoscopy; postoperative adhesions; small bowel obstruction.*

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I. Introduction

Appendicitis is a common surgical emergency, with a lifetime risk of 8-9% in western countries. Perforation is more frequent in youths or individuals older than 50 years, and it is linked with higher mortality and morbidity. Although open appendectomy is the cornerstone of surgical intervention for acute appendicitis, laparoscopic appendectomy has gained much popularity and become the preferred approach for uncomplicated and complicated appendicitis (1).

Postoperative adhesions are the leading cause of small bowel obstruction, accounting for 60% of all cases (2). Appendectomy displays an increased risk for small bowel obstruction 200-fold at one year after the operation, reducing to 6-fold at 30 years compared to the control population (3).

The impact of laparoscopic appendectomy on adhesive small bowel obstruction compared to open appendectomy remains unclear. Generally, adhesive small bowel obstruction following laparoscopic and open appendectomy changed based on the type of studies and the severity of appendicitis. Here we describe the case of a 16-year-old patient who developed small bowel obstruction 4 years after an open appendectomy.

II. Case Presentation

A 16-year-old male visited the emergency department with a two-day history of abdominal pain localized in the right lower quadrant. The pain was described as colicky, and it was associated with vomiting. There was no history of fever, chills, and diarrhea. The patient reported an open appendectomy four years ago.

Physical examination disclosed a soft, distended abdomen and tenderness in the right lower quadrant without rebound tenderness or muscle guarding. Bowel sounds were hypoactive.

Laboratory studies revealed elevated white blood cells (14.87 K/UI) without any other inflammatory marker (neutrophils 65%, erythrocyte sedimentation rate 8 mm/hr, and C-reactive protein 2 mg/L), and elevated LDH (315 U/L). A contrast-enhanced computed tomography of the abdomen was performed and showed distended jejunal and ileum loops with a transition point in the right iliac fossa, at the level of the L5, after which ileal loops, as well as the large bowel, were collapsed. A small amount of free fluid in the abdomen was also observed (Figure 1).

Initially, the patient treated conservatively. The following day, the patient experienced excruciating pain that led to the decision to carry out a diagnostic laparoscopy. Distended small bowel loops with swelling and hyperemic change of the bowel wall were noted. No signs of bowel ischemia, strangulation or peritonitis were present. An adhesion band compressing the terminal ileum was found, but unfortunately, it was not well visualized due to the distended bowel loops. Therefore, the laparoscopy converted to exploratory laparotomy through a midline infraumbilical incision. The adhesion band obstructed the terminal ileum was identified, ligated, and divided. The patient recovered uneventfully, and he was discharged on the third postoperative day.

III. Discussion

Appendicitis is a common cause of abdominal pain and a leading cause of surgical emergencies. Its incidence varies from 5.7 to 50 patients per 100,000 individuals per year, with a peak incidence between the second and third decade of life. The USA and Europe display the highest lifetime risk for acute appendicitis (9% and 8%, respectively), whereas, in Africa, the risk is lower (2%). The perforation rate ranges between 16% and 40%. Youths and individuals older than 50 years exhibit a higher risk for perforation (40-57% and 55-70%, respectively). Perforation is correlated with higher mortality and morbidity compared to non-perforated appendicitis. Acute appendicitis's mortality risk is 0.1%, while the risk increases to 0.6% in gangrenous and 5% in perforated appendicitis (1).

Although open appendectomy is the cornerstone of surgical intervention for appendicitis, laparoscopic appendectomy has gained much popularity and become the preferred approach for uncomplicated and complicated appendicitis (1). Advantages of laparoscopic appendectomy encompass a shorter length of hospital stay, earlier return to normal activities, less postoperative pain, an earlier start of oral intake, and lower wound infections. When it comes to intra-abdominal abscesses, most meta-analyses demonstrated no difference between laparoscopic and open appendectomy (4-9).

One of the most familiar problems in abdominal surgery is adhesions, which might lead to mechanical small bowel obstruction with potentially devastating consequences. The commonest etiology of small bowel obstruction is adhesions, which account for 60% of all cases. It is estimated that the mean length of hospitalization for adhesive small bowel obstruction is eight days, with a mortality rate of 3% per episode. Colorectal, oncological gynecology, and pediatric surgery displayed the highest risk for adhesive small bowel obstruction. Almost one in ten patients after colectomy will develop small bowel obstruction in the following three years. Moreover, 4.2-12.6% of patients after pediatric surgery and 3.2% of colorectal patients require reoperation for adhesive small bowel obstruction (2). Compared to the control population, appendectomy exhibits an increased risk for small bowel obstruction 200-fold at one year after the operation, reducing to 6-fold at 30 years (3).

Whether laparoscopic appendectomy decreases the incidence of adhesive small bowel obstruction has been widely investigated in the literature. The true incidence of postoperative ileus following laparoscopic and open appendectomy remains unclear. According to our knowledge, eight meta-analyses have been conducted to examine this topic (Table 1). The results of meta-analyses as regards this issue are somehow confusing.

Considering both randomized control trials (RCTs) and comparative studies (CSs), small bowel obstruction incidence after laparoscopic appendectomy is 1.3% and after open appendectomy 2.8%. But, if we consider only CSs, the incidence rises to 2.2% for laparoscopic appendectomy and 3.2% for open appendectomy (10). The incidence varies from 1.78-2.9% for laparoscopic appendectomy and 1.96-3.4% for open appendectomy on RCTs (7, 10).

Meta-analysis of both RCTs and CSs revealed that the incidence of post-appendectomy bowel obstruction was significantly lower after laparoscopic than an open appendectomy, as did an analysis of comparative studies (10, 11-13). Similarly, the incidence of postoperative ileus was significantly decreased after laparoscopic than open appendectomy following perforated appendicitis (12, 14). Moreover, the incidence of adhesive bowel obstruction in studies with a long follow-up period of over three years or that required surgery was significantly reduced after laparoscopic than open appendectomy (13). On the contrary, meta-analyses of RCTs failed to demonstrate any significant difference in postoperative ileus incidence between laparoscopic and open appendectomy (10, 5-7, 12).

All these results should be interpreted with caution as there are some limitations in the above meta-analyses. Different defining criteria for postoperative ileus, heterogeneity between the included studies, non-blinding allocation concealment and assessment of outcomes, underreported confounding factors and potential

selection bias are observed in these meta-analyses (10, 5-7, 12-14). Moreover, four meta-analyses included RCTs and CSs, three meta-analyses only RCTs, and one meta-analysis only CSs. Additionally, four studies were focused on the description of post-appendectomy bowel obstruction in the pediatric population (10, 11, 12, 14), whereas two studies included only adults (5, 6) and another two both adults and children (7, 13).

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5. Margariti P: Analysis and interpretation of data.
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Figure 1: Computed tomography of the abdomen in a 16-year-old male with small bowel obstruction. (A) Transition point in the right iliac fossa (arrow), and (B) Distended (arrow) and collapsed bowel loops (arrowheads).

Table1. Type of studies, patients, severity of appendicitis and results of meta-analysis

Author	Type of studies	Type of patients	Severity of appendicitis	Incidence of postoperative ileus
Aziz et al. 2006	3 RCTs + 6 CSs	C	UA + CA	Combined meta-analysis: Lower after LA (1.3% vs 2.8%) Meta-analysis of CSs: Lower after LA (2.2% vs 3.2%) Meta-analysis of RCTs: No difference between LA and OA (2.9% vs 3.4%)
Li et al. 2010	18 RCTs	A + C	UA + CA	No difference between LA and OA (1.78% vs 1.96%)
Liu et al. 2010	16 RCTs	A	UA + CA	No difference between LA and OA
Wei et al. 2010	23 RCTs	A	UA + CA	No difference between LA and OA
Markar et al. 2012	1 RCTs + 5 CSs	C	UA + CA	UA: No difference between LA and OA (0.25% vs 0.23%) CA: Lower after LA (1.23% vs 1.48%)
Espozito et al. 2012	8 CSs	C	UA + CA	Lower after LA
Markar et al. 2014	2 RCTs + 27 CSs	A + C	UA + CA	Combined meta-analysis: Lower after LA Meta-analysis of studies with children/perforated appendicitis/long follow-up period of over 3 years/postoperative ileus that required surgery: Lower after LA
Low et al. 2019	3 RCTs + 21 CSs	C	CA	Combined meta-analysis: Lower after LA (3.5% vs 7.32%) Meta-analysis of RCTs: No difference between LA and OA

A: Adults, C: Children, CA: Complicated Appendicitis, CSs: Comparative Studies, LA: Laparoscopic Appendectomy, OA: Open Appendectomy, RCTs: Randomized Control Trials, UA: Uncomplicated Appendicitis

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