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Midline versus McBurney Incision for Interval Appendectomy after Complicated Appendicitis: A Retrospective Cohort Study in a Resource-Limited Center

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ABSTRACT

Introduction: In settings without routine laparoscopic access, open appendectomy remains the standard approach for interval appendectomy after complicated appendicitis, but the effects of midline laparotomy versus McBurney incision on postoperative outcomes have not been directly compared.

Objectives: This study compared midline laparotomy and McBurney incision in terms of intraoperative adhesions, postoperative complications, antibiotic duration, hospital stay, and readmission in patients undergoing interval appendectomy.

Methods: In this retrospective cohort study, all patients with conservatively managed complicated appendicitis (peri-appendiceal abscess or phlegmon) who subsequently underwent interval appendectomy via midline laparotomy or McBurney incision at Pasteur Hospital, Bam, between April 2024 and March 2025 were enrolled by census sampling according to predefined inclusion and exclusion criteria. Data were extracted from surgical and follow-up records using a standardized form. Groups were compared using the chi-square and Mann-Whitney U tests in IBM SPSS version 26, with significance set at $p < 0.05$.

Results: Among 136 patients (68 per group), surgical site infection occurred in 15.4% (15 midline vs. 6 McBurney; $p = 0.058$) and postoperative bleeding in 11% (11 vs. 4; $p = 0.101$), with no significant association with incision type. Intraoperative adhesions occurred in 25% of cases (19 vs. 15; $p = 0.552$). Antibiotic duration was significantly longer in the midline group (5.60 ± 1.59 vs. 4.74 ± 1.30 days, $p = 0.002$), and hospital stay was significantly shorter in the McBurney group (1.79 ± 0.72 vs. 3.09 ± 1.27 days, $p < 0.001$). Readmission occurred in 2.9% of patients (4 cases, all midline; $p = 0.128$).

Conclusions: Both techniques appear effective and safe for interval appendectomy, and McBurney incision was associated with shorter antibiotic use and hospitalization. However, given the retrospective, non-randomized allocation of incision type, these findings should be interpreted cautiously. Larger prospective studies accounting for underlying disease severity are recommended.

Keywords: Surgery, Complicated Appendicitis, Interval Appendectomy, McBurney Incision, Midline Laparotomy.

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1. Introduction

Appendicitis is one of the most common causes of acute abdominal pain and remains a leading cause of emergency abdominal surgery worldwide, with appendectomy being the primary treatment (1). According to the 2024 Global Burden of Disease (GBD 2021) study, the global age-standardized incidence of appendicitis was 214 per 100,000 population (95% UI 174–274) in 2021, corresponding to approximately 17 million new cases, with substantial regional variation and a rate as high as 364 per 100,000 in high-income Asia-Pacific regions (2). Most cases present acutely at an early stage of disease; however, a subset of patients (approximately 3.8–7%) present with more advanced disease, in which the inflammatory response leads to the formation of a periappendiceal phlegmon or abscess (2). These cases are referred to as complicated appendicitis, defined for this study as appendicitis associated with a periappendiceal abscess or phlegmon at presentation, as distinct from uncomplicated (early-stage) appendicitis (3, 4). Complicated appendicitis is more common among very young and elderly patients and those with dementia, who may have difficulty expressing acute symptoms, as well as in settings with delayed presentation or referral (5).

Initial management of complicated appendicitis typically involves antibiotic therapy with or without percutaneous drainage of the abscess. While this conservative approach successfully resolves the abscess in up to 90% of cases, recurrence has been reported in a meaningful proportion of patients, which has tradition - nally been the rationale for interval appendectomy — delayed surgical removal of the appendix, usually performed 6 to 12 weeks after resolution of the acute episode, once the inflammatory mass has subsided (5). Interval appendectomy has also been associated with the incidental detection of neoplastic or other significant pathological findings at a higher rate than in acute appendectomy specimens (6, 7). As more patients with complicated appendicitis are managed initially with nonsurgical treatment rather than emergency appendectomy, there will be increased opportunities to consider interval appendectomy in this population; however, its routine necessity has recently been questioned, given that recurrence after successful conservative management appears to be relatively uncommon in some series (8–10).

Because interval appendectomy is performed in a surgical field already altered by a prior episode of inflammation, it is frequently complicated by extensive intra-abdominal adhesions, unlike acute appendectomy performed at initial presentation. This makes the choice of surgical incision a potentially important determinant of outcomes: the wider exposure of a midline laparotomy may facilitate safer, more controlled adhesiolysis in cases with extensive or dense adhesions, whereas the smaller, more localized McBurney incision may be preferable when disease is less extensive, potentially reducing tissue trauma, operative time, infection risk, and recovery time (11, 12). Despite this plausible rationale, to our knowledge, no prior study has directly compared these two incision types specifically within the context of interval appendectomy; most existing comparative literature instead contrasts open versus laparoscopic approaches, or examines incision type in the setting of acute (rather than interval) appendectomy.

2. Objectives

The present study compares midline laparotomy and McBurney incision in patients undergoing interval appendectomy, with a focus on intraoperative adhesions and postoperative complications, including surgical site infection, bleeding, antibiotic duration, hospital stay, and readmission. By evaluating outcomes among patients treated under comparable conditions at the same center, this study aims to inform incision selection in interval appendectomy and to help reduce postoperative complication rates and improve clinical outcomes in this specific patient population.

3. Methods

3.1 Study Design

This was a retrospective cohort study conducted to compare outcomes of two surgical incisions, midline laparotomy and McBurney, in patients undergoing interval appendectomy at Pasteur Hospital, Bam, between April 2024 and March 2025.

3.2 Participants

All patients who underwent interval appendectomy via midline laparotomy or McBurney incision at Pasteur Hospital, Bam, from April 2024 to the end of March 2025 were eligible for this study. A census sampling method was used. All eligible patients treated during the one-year study period were included, without a priori sample-size calculation, since the aim was to capture the full eligible population rather than a randomly selected subsample. This census yielded 68 patients in the midline group and 68 in the McBurney group; this equality in group size arose by coincidence from the number of eligible patients undergoing each procedure during the study period and was not the result of intentional matching or balancing.

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3.2.1. Inclusion Criteria

Patients with a history of complicated appendicitis (peri-appendiceal abscess or phlegmon) managed conservatively who subsequently underwent interval appendectomy 6–12 weeks after conservative treatment, via midline laparotomy or McBurney incision as confirmed by surgical reports, with complete documentation of preoperative, intraoperative, and postoperative findings. Patients presenting with generalized peritonitis were managed with emergency (non-interval) appendectomy at our center and were therefore not eligible for inclusion in this cohort.

3.2.2. Exclusion Criteria

Prior abdominal surgery (other than appendectomy) that could independently contribute to intra-abdominal adhesions; inflammatory bowel disease (e.g., Crohn's disease, ulcerative colitis) or gastrointestinal malignancy; incomplete medical records lacking sufficient detail on intraoperative or postoperative findings; and surgical approaches other than midline laparotomy or McBurney incision (e.g., laparoscopic appendectomy).

3.3 Outcome Measures

As this is a retrospective chart review study rather than one employing a psychometric instrument, this section (“Scales”) is adapted to describe the exposure and outcome variables assessed. The exposure variable was surgical incision type (midline laparotomy vs. McBurney). The six outcomes compared between groups were: surgical site infection, postoperative bleeding, intraoperative adhesions, readmission, antibiotic treatment duration (days), and postoperative hospital stay (days). Additional variables recorded for descriptive purposes included patient demographics (age, sex), relevant comorbidities (e.g., diabetes, hypertension), and prior surgical history.

3.4 Data Collection

Data were extracted from the hospital's surgical and follow-up records using a standardized data-extraction form covering preoperative, intraoperative, and postoperative variables. Surgical notes provided the incision type and the presence of intraoperative adhesions; postoperative records provided complications, length of hospital stay, and antibiotic duration; follow-up records provided readmission data. Postoperative antibiotic duration was not determined by a fixed institutional protocol but by the treating surgical team based on the patient's clinical course (fever curve, wound appearance, inflammatory markers), consistent with continuing therapy for the minimum duration necessary to ensure patient safety. Missing or unclear entries were resolved by further chart review or consultation with the surgical team.

3.5 Data Analysis

Descriptive statistics are presented as mean ± standard deviation or median (interquartile range, IQR) for continuous variables, and as frequency and percentage for categorical variables. Between-group comparisons (midline vs. McBurney) used the chi-square test for categorical variables and the Mann-Whitney U test for non-normally distributed continuous variables. Analyses were performed in IBM SPSS version 26. Statistical significance was set at the conventional threshold of $p < 0.05$ for all comparisons; no correction for multiple comparisons was applied.

3.6 Ethical Considerations

This study was approved by the Ethics Committee of Bam University of Medical Sciences and Health Services (ethics code IR.MUBAM.REC.1403.099) and was conducted in accordance with national and international medical ethics standards. As this was a retrospective review of existing medical records, there was no direct interaction with or intervention in patients. All identifiable information (names, medical record numbers, contact details) was removed or anonymized during data extraction, and each patient was assigned a unique study identification number.

4. Results

A total of 136 patients were included; 68 in the midline group and 68 in the McBurney group (see Section 3.2 for clarification regarding the equal group sizes). Mean age was 34.28 ± 9.79 years in the midline group and 32.85 ± 11.25 years in the McBurney group. The midline group comprised 42 males (61.8%) and 26 females (38.2%), and the McBurney group comprised 48 males (70.6%) and 20 females (29.4%); age and sex distributions did not differ significantly between groups.

A total of six postoperative outcomes were compared between the two incision groups using the conventional significance threshold of $p < 0.05$ (Table 1); no correction for multiple comparisons was applied.

Surgical site infection occurred in 21 patients (15.4%) overall, with 15 cases in the midline group and 6 in the McBurney group; there was no statistically significant association between surgical site infection and incision type (χ^2 test, $p = 0.058$) (Table 1). Postoperative bleeding was observed in 15 patients (11%) overall, comprising 11 cases in the midline group and 4 in the McBurney group; there was likewise no significant association with incision type (χ^2 test, $p = 0.101$) (Table 1).

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Intraoperative adhesions were identified in 34 patients (25%) overall (19 in the midline group and 15 in the McBurney group); there was no significant association with incision type (χ^2 test, p = 0.552) (Table 1). Readmission occurred in 4 patients (2.9%) overall, all within the midline group; there was no significant association with incision type (χ^2 test, p = 0.128) (Table 1).

The duration of postoperative antibiotic therapy did not follow a normal distribution and was compared using the Mann-Whitney U test. Antibiotic duration was significantly longer in the midline group (median [IQR]: 5.0 [4.0–7.0] vs. 5.0 [4.0–6.0] days; mean ± SD: 5.60 ± 1.59 vs. 4.74 ± 1.30 days; p = 0.002). Postoperative hospital stay, also non-normally distributed, was significantly longer in the midline group than the McBurney group (median [IQR]: 3.0 [2.0–4.0] vs. 2.0 [1.0–2.0] days; mean ± SD: 3.09 ± 1.27 vs. 1.79 ± 0.72 days; p < 0.001) (Table 1).

Table 1: Comparison of postoperative outcomes by surgical incision type (Midline vs. McBurney)

Variable	Category	Midline N (%)	McBurney N (%)	Total	p-value	Type of statistical test
Readmission	Yes	4 (5.9)	0 (0.0)	4 (2.9)	0.128	Chi-square
	No	64 (94.1)	68 (100.0)	132 (97.1)		
Intraoperative adhesions	Yes	19 (27.9)	15 (22.1)	34 (25.0)	0.552	Chi-square
	No	49 (72.1)	53 (77.9)	102 (75.0)		
Postoperative bleeding	Yes	11 (16.2)	4 (5.9)	15 (11.0)	0.101	Chi-square
	No	57 (83.8)	64 (94.1)	121 (89.0)		
Surgical site infection	Yes	15 (22.1)	6 (8.8)	21 (15.4)	0.058	Chi-square
	No	53 (77.9)	62 (91.2)	115 (84.6)		
Continuous variables — reported separately as mean ± SD and median (IQR)						
Antibiotic treatment duration (days)	Mean ± SD	5.60 ± 1.59	4.74 ± 1.30	5.17 ± 1.51	0.002	Mann-Whitney U
	Median (IQR)	5.0 (4.0–7.0)	5.0 (4.0–6.0)	NA		
Postoperative hospital stays (days)	Mean ± SD	3.09 ± 1.27	1.79 ± 0.72	2.44 ± 1.22	<0.001	Mann-Whitney U
	Median (IQR)	3.0 (2.0–4.0)	2.0 (1.0–2.0)	NA		

NA: not available at the pooled (Total) level, as non-normally distributed variables were summarized by median and IQR only within the Midline and McBurney groups; the pooled median/IQR cannot be derived from group medians without access to the underlying raw data. The chi-square test was used for categorical variables; the Mann-Whitney U test was used for the two continuous variables (antibiotic treatment duration and postoperative hospital stay)

5. Discussion

This study compared midline laparotomy and McBurney incision in patients undergoing interval appendectomy at Pasteur Hospital, Bam, focusing on intraoperative adhesions and postoperative complications.

The majority of patients were male (66.2%), consistent with the well-documented male predominance of complicated appendicitis reported across adult and pediatric populations. A large Ontario cohort of 50,369 patients found a higher perforation rate in men than women (38.7% vs. 23.5%), and pediatric studies have similarly reported higher rates of complicated appendicitis in boys than girls (18% vs. 10%) (14–16).

Surgical site infection (15.4% overall) and postoperative bleeding (11% overall) did not differ significantly by incision type (p = 0.058 and p = 0.101). Our surgical site infection rate is broadly consistent with, and somewhat lower than, rates reported for open appendectomy in resource-limited settings (pooled rate 17.9%) and for complicated/perforated appendicitis specifically (27–30%) (17–19), likely reflecting the "cooling-off" effect of interval surgery. One comparative study of midline versus transverse incisions reported a higher wound-infection rate with midline incision (33.5% vs. 22.6%); the smaller, more localized McBurney incision is generally assumed to carry lower intraoperative blood loss and fewer bleeding complications, although our data did not provide statistical evidence for a difference between incisions (20, 21).

Intraoperative adhesions were present in 25% of cases, with no significant association with incision type (p = 0.552), suggesting that adhesion formation after interval appendectomy relates more to underlying pathology than to the surgical approach itself. While no prior study has directly compared adhesion rates between these two specific incisions in interval appendectomy, the McBurney incision is generally considered to cause less tissue disruption and peritoneal exposure than midline laparotomy, and midline incisions have been linked to a higher incidence of adhesions in broader surgical literature, including a higher rate of adhesions with increasing numbers of prior midline procedures (21, 22).

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Antibiotic treatment duration was significantly longer in the midline group (5.60 ± 1.59 vs. 4.74 ± 1.30 days, p = 0.002). As antibiotic duration in this study was clinician-driven rather than protocol-based, this difference likely reflects greater underlying surgical complexity and perceived infective risk in the midline group rather than a direct effect of incision type; this should be interpreted alongside the broader limitation of non-randomized incision selection discussed below. This finding is broadly consistent with van den Boom et al., who examined antibiotic duration and time-to-discharge after appendectomy for complex appendicitis, and with World Society of Emergency Surgery guidance supporting individualized rather than fixed-protocol antibiotic dosing (23, 24).

Postoperative hospital stay was significantly longer in the midline group (3.09 ± 1.27 vs. 1.79 ± 0.72 days, p < 0.001), consistent with literature associating less invasive incisions with faster recovery; for comparison, midline laparotomy for right colectomy has been associated with a median stay of 9 days, considerably longer than less invasive approaches (23, 25). As with antibiotic duration, this association should be interpreted in light of the non-randomized selection of incision type.

Readmission occurred in only 2.9% of patients, all in the midline group, with no significant association with incision type (p = 0.128), supporting the overall safety of both techniques. Eskandarlou et al. and Javadi et al., comparing minimal-access and classic McBurney incisions for open appendectomy, similarly found no significant differences in wound infection, cellulitis, or postoperative bleeding between groups, although open surgery was associated with greater patient satisfaction and longer operating time/pain (26, 27).

Barut et al. (2024) compared laparoscopic and open surgery for complicated appendicitis and found a higher incidence of severe complications, including intra-abdominal abscess, with the laparoscopic approach, concluding that open surgery may be preferable in this setting; unlike our findings, they found no significant difference in hospital stay between approaches (28). Arshad et al. (2013) compared laparoscopic and open interval appendectomy in 100 patients with appendicular phlegmon and found lower pain scores, shorter ileus duration, shorter hospital stay, and faster return to work with the laparoscopic approach (29).

Other studies comparing interval and emergency appendectomy (Akingboye et al., Suzuki et al., Miyo et al.) reported fewer postoperative complications, shorter hospitalization, and faster recovery with interval appendectomy (30–32), whereas Al-Kurd et al. reported more intraoperative complications and organ-space infections with interval appendectomy, cautioning against its routine use (33). Leung et al. identified perforated appendicitis and midline incision as risk factors for small bowel obstruction after appendectomy, though with no significant difference between laparoscopic and open approaches overall (34); in contrast, we found no significant association between intraoperative adhesions and incision type (p = 0.552).

5.1 Limitation

This study has several limitations. First, as a retrospective chart review, it is subject to the possibility of incomplete or inaccurate records; missing or incomplete data may have affected the precision of some estimates. Second, the severity of intraoperative adhesions was not graded using a standardized scale across surgeons, which may have introduced variability; this was partly mitigated by applying stringent inclusion and exclusion criteria. Third, because a census sampling method was used, no independent a priori power calculation was performed for this study; the final sample (68 patients per group) should therefore not be interpreted as having been targeted to a pre-specified statistical power, although it represents the complete eligible population over a full year. Fourth, and most importantly, the choice of incision was not randomized but was determined by the operating surgeon based on perceived case complexity; patients with more extensive inflammatory masses, suspected malignancy, or denser adhesions were more likely to undergo midline laparotomy. This confounding by indication may account, at least in part, for the longer antibiotic duration and hospital stay observed in the midline group, independent of the incision itself. As intraoperative severity indices were not systematically recorded, we could not statistically adjust for this factor, and the observed between-group differences should be interpreted as associative rather than causal. Fifth, six postoperative outcomes were compared without adjustment for multiple comparisons, which should be considered when interpreting the statistically significant findings. Finally, although all patients underwent interval appendectomy within the pre-specified 6–12-week window, the exact interval was not analyzed as a continuous variable, precluding assessment of a possible dose-response relationship with adhesions or complications; future studies should

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record and analyze this interval systematically. Prospective, randomized, multicenter studies that account for underlying disease severity are needed to confirm these findings.

5.2 Conclusion

This study compared midline laparotomy and McBurney incision in interval appendectomy with respect to intraoperative adhesions, postoperative complications, and length of hospital stay. Both techniques appear effective and safe options for interval appendectomy. The McBurney incision was associated with a shorter duration of antibiotic therapy and reduced postoperative hospital stay; however, given the retrospective, non-randomized allocation of incision type, these associations should be interpreted with caution and should not yet be regarded as establishing the superiority of one technique over the other. The absence of statistically significant differences in infection rates, postoperative bleeding, intraoperative adhesions, and readmission rates, while not establishing equivalence, is consistent with both techniques being viable options. Surgeons should continue to base incision choice on individual assessment of comorbidities, adhesion burden, and intraoperative findings, rather than on these associative findings alone. Larger, prospective, multicenter studies with longer follow-up and adjustment for underlying disease severity are recommended to confirm these findings and to further inform incision selection in interval appendectomy.

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Statements

AI Use: We utilized AI-powered tools to check grammar and enhance the academic quality of the text, which was primarily written by the authors.

Authors' Contribution: Marziyeh Ansari Shiri designed the study and drafted the initial version of the manuscript. Leila Malekian, Amirreza Salehi, and Ehsan Moshki contributed to data analysis and interpretation of the results. Majid Nozari performed the final revision of the manuscript. All authors read and approved the final version of the manuscript.

***Conflict of Interests*:** The authors declare no competing interests.

Data Availability: The dataset analyzed during the current study is available from the corresponding author upon reasonable request.

Ethical Approval: This study was approved by the Ethics Committee of Bam University of Medical Sciences and Health Services (ethics code IR.MUBAM.REC.1403.099).

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Informed Consent: Because this retrospective study used anonymised medical records and involved no direct patient contact or intervention, the Ethics Committee of Bam University of Medical Sciences waived the requirement for individual informed consent

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