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Utilization of a specimen retrieval bag during laparoscopic appendectomy for both uncomplicated and complicated appendicitis is not associated with a decrease in postoperative surgical site infection rates

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ABSTRACT

Background: To determine whether utilization of a retrieval bag during laparoscopic appendectomy for uncomplicated and complicated appendicitis (perforation/abscess) is associated with postoperative surgical site infection rates.

Methods: We studied patients presented in the database of the 2016 Appendectomy-Targeted American College of Surgeons National Surgical Quality Improvement Program who underwent laparoscopic appendectomy for pathology-confirmed appendicitis. The primary predictor variable was intraoperative utilization of a specimen retrieval bag for removal of the appendix from the peritoneal cavity. The primary outcome variable was 30-day postoperative surgical site infection. Logistic regression analysis was used to determine the association between use of a specimen retrieval bag and postoperative surgical site infection rate after adjustment for patient- and disease-related variables.

Results: A total of 10,357 patients were included for analysis. Of these procedures, 9,585 (92.6%) included the use of a specimen bag and 772 (7.5%) did not. The 30-day incidence of postoperative surgical site infection was 4.2% in the group in which no bag was used and 3.6% in the group in which a bag was used (adjusted odds ratio of surgical site infection with no bag utilization was 1.15 [95% confidence interval 0.78–1.69; $P = .49$]). The lack of a statistically significant association between bag utilization and postoperative surgical site infection incidence was also demonstrated for a subgroup of patients with perforated appendicitis.

Conclusion: Utilization of a retrieval bag during laparoscopic appendectomy is not associated with a statistically significant decrease in postoperative surgical site infection for either uncomplicated or complicated acute appendicitis.

Introduction

As United States health care shifts slowly but inexorably toward value-based reimbursement, the financial viability of hospitals will depend increasingly on their ability to provide care that is both effective and efficient. Individual clinical service lines, in turn, will be scrutinized more closely in an effort to minimize their use of equipment or processes that add to the cost but not the measurable quality of the care that they provide. Being the most common, nonelective operative procedure performed currently in the United States, laparoscopic appendectomy represents an ideal target for efforts to improve the efficiency of surgical care.[1] Although more expensive to perform than open appendectomy, the numerous advantages of the laparoscopic approach (shorter duration of postoperative stay, a decreased rate of complications, and quicker return to normal activity) make it a cost-effective alternative to open appendectomy.[2–6]

Although laparoscopic appendectomy is now the standard of care for patients with acute uncomplicated appendicitis, it may be possible to improve the efficiency of this procedure.[7–9] In particular, little evidence is available to support or refute an outcome benefit to many of the technical adjuncts that are used routinely by many surgeons during laparoscopic appendectomy. Our study sought to determine whether the utilization of one such adjunct (the

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Table
Patient- and procedure-related characteristics of 10,357 patients undergoing laparoscopic utilization, stratified by specimen retrieval bag utilization

Characteristics		Specimen retrieval bag use		*P* value
		Yes (n = 9,585; 92.6%)	No (n = 772; 7.5%)	
Sex	Male	5,053 (93%)	379 (7%)	.05
	Female	4,532 (92%)	390 (8%)	
Age ≥65 years	No	8,760 (92.5%)	708 (7.5%)	.76
	Yes	825 (92.8%)	64 (7.2%)	
Obesity classification	Nonobese	5,655 (92.6%)	953 (7.4%)	.38
	Class I	1,576 (92.5%)	128 (7.5%)	
	Class II	695 (93.2%)	51 (6.8%)	
	Class III	475 (94.1%)	30 (5.9%)	
	Unknown	1,184 (91.5%)	110 (8.5%)	
Diabetes mellitus	No	9,128 (92.4%)	749 (7.6%)	.02
	Yes	457 (95.2%)	23 (4.8%)	
Chronic steroid use	No	9,456 (92.6%)	760 (7.4%)	.63
	Yes	129 (91.5%)	12 (8.5%)	
Bleeding disorder	No	9,439 (92.6%)	757 (7.4%)	.36
	Yes	146 (90.7%)	15 (9.3%)	
Procedure status	Nonemergency	3,148 (93.7%)	213 (6.3%)	.003
	Emergency	6,437 (92%)	559 (8%)	
Prolonged operation	No	7,257 (92.6%)	584 (7.4%)	.97
	Yes	2,328 (92.5%)	188 (7.5%)	
Perforated appendix	No	7,748 (92.6%)	621 (7.4%)	.79
	Yes	1,837 (92.4%)	151 (7.6%)	
Intra-abdominal abscess	No	8,683 (92.5%)	704 (7.5%)	.58
	Yes	902 (93%)	68 (7%)	

laparoscopic specimen retrieval bag) offers any protection against postoperative, surgical site infection (SSI) in adult patients who undergo laparoscopic appendectomy for appendicitis.

Methods

Our study utilized data from the Participant Use File of the 2016 Appendectomy-Targeted American College of Surgeons National Surgical Quality Improvement Program.[10] This data source includes 12,376 appendectomy procedures performed at 115 participating hospitals. We included patients who underwent laparoscopic appendectomy for pathology-confirmed acute appendicitis. Patients who underwent other major procedures during appendectomy were excluded from our analysis. These criteria were intended to minimize the possibility of including patients who underwent "incidental" appendectomy in our study population. Missing data were handled in one of two ways. For variables with <1% of observations missing (operative time), patients with missing information were simply excluded from the analysis. For variables with >1% of observations missing (body mass index), a missing indicator was utilized.

The primary outcome of our study was 30-day, postoperative SSI, including incisional SSI and/or organ/space SSI. The primary predictor variable for our analysis was utilization of a laparoscopic specimen retrieval bag as documented in the patient's operative report.[10] Additional predictor variables included patient sex; age (< versus ≥65 years of age); body mass index; emergency procedure status; and the presence of diabetes mellitus, chronic steroid use, bleeding disorder (including chronic anticoagulation therapy that was not reversed before operation), preoperative systemic inflammatory response syndrome or sepsis, prolonged operation (defined as an operative time >75th percentile, or 63 minutes), perforated appendicitis, and periappendiceal abscess.

Demographic, comorbid, and operative characteristics of patients with or without use of a specimen retrieval bag were compared, using Pearson's χ^2 tests. Multivariate logistic regression analysis was used to determine the independent association between utilization of a specimen retrieval bag and the primary outcome after adjustment for other demographic, comorbid, and procedure characteristics. Secondary univariate analyses were used to determine the association between use of a specimen retrieval bag and postoperative SSI rates stratified by type of appendicitis (uncomplicated versus that associated with perforation and/or abscess). A P value < .05 was considered statistically significant. Stata v 14.2 (STATACorp, College Station, TX) was used for all statistical analyses.

Results

A total of 10,357 patients were included for analysis. Specimen retrieval bags were utilized in 9,585 (92.6%) of these procedures and not utilized in 772 (7.5%). The Table presents the demographic, comorbid, and operative characteristics of these patients stratified by intraoperative utilization of a specimen retrieval bag. Specimen retrieval bags were somewhat more likely to be used in diabetic patients (95.2% use in diabetic patients vs 92.4% in nondiabetic patients; P = .02) and were less used in a similar frequency in emergency procedures (92% use in emergency procedures vs 93.7% use in nonemergency procedures). None of the other variables in our study (including presence or perforation or periappendiceal abscess) had a statistically significant association with specimen retrieval bag utilization.

Overall, 374 (3.6%) patients developed an SSI in the first 30 days after their appendectomy (89 patients with incisional SSI, 276 patients with organ/space SSI, and 9 patients with both incisional and organ/space SSI). The 30-day incidence of postoperative SSI in patients whose procedures included use of a specimen bag was 3.6%, and the rate in patients whose procedures did not include use of a specimen bag was 4.2% (P = 0.4). After adjustment for other demographic, comorbid, and procedure characteristics, we observed no association between utilization of a specimen bag and development of postoperative SSI (adjusted odds ratio of SSI [95% confidence interval] with non-use of specimen bag 1.15 [0.78,1.69]; P = .49).

When stratified by the presence or absence of complicated appendicitis (defined as intraoperative documentation of a perforated appendix and/or intra-abdominal abscess), there was no difference in postoperative SSI rates between procedures with and without use of a retrieval bag. In patients with uncomplicated appendicitis, the incidence of SSI was 1.7% (128 of 7,417 patients)

when a bag was used and 1.8% (11 of 600 patients) when no bag was used ($P = .85$). In patients with complicated appendicitis, the incidence of SSI was 10.0% (214 of 2,151 patients) when a bag was used and 12.4% (21 of 170 patients) when no bag was used ($P = .32$).

Discussion

Originally described as adjuncts for laparoscopic morcellation of large viscera and prevention of tumor seeding during laparoscopic oncologic resection, specimen retrieval bags were first recommended as a means of preventing wound infection after laparoscopic appendectomy in 2003.[11–17] To our knowledge, only one study has actually assessed the impact of protected specimen retrieval on postoperative infection rates.[18] Conducted at a single Italian center and absent statistical comparison, that study suggested that protected specimen retrieval was advantageous in cases of suppurative, gangrenous, or perforated appendicitis.

Although the potential benefit of protected specimen retrieval during laparoscopic appendectomy has not been assessed rigorously, the practice has essentially become the standard of care in most centers. In a recent survey of more than 300 members of the European Association of Endoscopic Surgery on management practices for acute appendicitis, almost all of the respondents agreed with a proposed recommendation that "extraction of the appendix should avoid direct contact of the appendix and the abdominal wall."[19] In their published report of recommended practices, the expert panel that conducted this survey conceded that the level of evidence supporting protected laparoscopic appendix retrieval was "very low." Nevertheless, because of the near-universal support from survey respondents, the European Association of Endoscopic Surgery panel graded the strength of their recommendation for protected retrieval as "strong."

More recent studies provide at least indirect evidence against dogmatic utilization of retrieval bags during laparoscopic appendectomy. In an effort to decrease the cost of the procedure at their pediatric hospital, Skorka et al[9] implemented a uniform doctor's preference card for laparoscopic appendectomy that specifically excluded adjunct devices, including retrieval bags. Such devices remained available but were used only when the operating surgeon believed were necessary. This intervention resulted in a decrease in the use of retrieval bags (from 90.7% to 60.3% of procedures), a decrease in overall device cost per procedure including several other unnecessary devices as well as the retrieval bag (from US$844.11 to US$305.32), but no increase in the incidence of postoperative complications.[9] Other investigators have shown that providing surgeons with real-time feedback of data on operating room supply costs can also produce a substantial decrease in the use of devices such as retrieval bags during laparoscopic appendectomy without increasing the rate of adverse postoperative outcomes.

To our knowledge, the current study represents the first attempt to determine the independent association between use of a specimen retrieval bag and SSI after laparoscopic appendectomy for uncomplicated and complicated acute appendicitis. We found that a large majority (92.6%) of the procedures captured in the data set of the 2016 Appendectomy-Targeted American College of Surgeons National Surgical Quality Improvement Program included use of a specimen retrieval bag, but that bag utilization provided no demonstrable benefit in terms of decreasing the rate of postoperative SSI, even for that subgroup of patients who were noted based on intraoperative findings to have complication appendicitis. Taken together, the findings of our study suggest that utilization of a specimen bag provides no detectable benefit in terms of SSI prevention for patients undergoing laparoscopic appendectomy. The vast majority of patients in our sample had uncomplicated appendicitis, and the SSI rates with and without utilization of a specimen bag in these patients was clinically equivalent. Of note, although most surgeons would agree that perforated or complicated appendicitis will still likely require bag utilization to protect an infected organ coming into contact with the wound surface, our data were insufficiently powered to suggest otherwise. It is important to note that there are other protected techniques of specimen retrieval that have been described in the literature that could be employed in these situations to decrease overall costs during this procedure, such as using the cut end of a glove finger.[20,21] We therefore conclude that either elimination of the laparoscopic specimen bag or use of a much less expensive alternative retrieval method in the uncomplicated appendicitis patient population could result in substantial aggregate savings in the cost of performing laparoscopic appendectomy.

Our study has several important limitations. First, the number of procedures in our study that were performed without retrieval bags was relatively small, creating the possibility of a type II error in the statistical comparison of postoperative SSI rates between the two groups. As a result, we cannot conclude that retrieval bags have no effect on postoperative SSI rates, only that any potential effect that they may have is either too small or clinically important to be detected, given the sample size of our study population. Second, our study does not represent a comparison of protected versus unprotected specimen retrieval during laparoscopic appendectomy, because procedures without bag utilization may have employed other "minimal cost" techniques of protected specimen retrieval that have been described in the literature.[20–22] Third, the underlying reason for use of specimen bag retrieval was not documented in the data source that we used for our study. Few of the patient-related or procedure-related variables in our analysis were associated with bag utilization, suggesting that the use of these bags is largely nonselective and founded primarily on routine. There may be specific situations, however, in which the use of a specimen retrieval bag might be reasonably perceived as necessary, such as concern for potential appendiceal malignancy or retrieval of a fragmented specimen from a morbidly obese patient. Finally, antibiotic use preoperatively, perioperatively, or postoperatively was not documented in the data source that we used for this study.

Despite these limitations, our study provides the largest analysis to date of the impact of the use of a specimen retrieval bag during laparoscopic appendectomy. Particularly in procedures that are performed for uncomplicated appendicitis, there appears to be no statistically identifiable benefit to using the laparoscopic specimen retrieval bags in terms of postoperative SSI prevention. Although the unit cost of retrieval bags (US$50.75 per device at the authors' institution) may be relatively small compared with other devices, the aggregate savings that could be realized by eliminating their routine use (approximately US$486,438 for our study population if no retrieval bags were used) would be substantial. The results of our study should prompt scrutiny of other costly devices that, although used widely, have no demonstrable efficacy relative to alternatives of lesser cost. It will be otherwise difficult to improve the value of common procedures such as laparoscopic appendectomy in an evidence-based fashion.

Disclosure

The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article. There was no funding source for this work.

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