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# Using antimicrobial solution for irrigation in appendicitis to lower surgical site infection rates

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Irrigation;
Perforated appendix;
Surgical complication;
Surgical site infection;
Wound infection;
Abdominal abscess

**Abstract**

**BACKGROUND:** The use of antimicrobial solutions for irrigation in appendicitis is controversial. Numerous antiseptic and antibiotic solutions have been suggested for use as an intraoperative irrigant. We sought to determine whether there was a difference in postoperative surgical site infections (SSIs) comparing normal saline (.9%), antiseptic solution (Dakin's, .25%), and an antibiotic solution (imipenem 1 mg/mL).

**METHODS:** We performed a retrospective study of adult appendectomies from January 1997 through November 2007 at a single institution The data were evaluated by multivariate logistic regression analysis and chi-square test. The incidences of postoperative overall SSI, wound infection, and abdominal abscess were compared.

**RESULTS:** A total of 1,063 cases were identified. Saline (n = 661) had an SSI rate of 9.8% (65/661), a wound infection rate of 7.3% (48/661), and an abdominal abscess rate of 4.2% (28/661). Dakin's (n = 208) had an SSI rate of 20.7% (43/208), a wound infection rate of 15.9% (33/208), and an abdominal abscess rate of 9.1% (19/208). Imipenem (n = 194) irrigation had an SSI rate of .5% (1/194), a wound infection rate of .5% (1/194), and an abdominal abscess rate of .5% (1/194).

**CONCLUSIONS:** These results suggest that abdominal irrigation with an antibiotic solution (imipenem 1 mg/mL) is superior to both normal saline and Dakin's solution.


Appendectomy remains one of the most common abdominal operations in the United States. However, relative to other frequent abdominal operations such as cholecystectomy and hysterectomy, it has a high rate of postoperative infectious complications, and therefore it is an excellent model to investigate surgical site infections (SSIs) in abdominal operations.

An area of debate regarding postoperative SSIs has been the use of intra-abdominal irrigation. There are more than 5 decades of literature on the subject. Numerous antibiotic solutions have been compared with antiseptic solutions and saline. At our institution over the past decade, 3 solutions have been used for intra-abdominal irrigation: saline (.9% normal saline), Dakin's solution (.25% NaOCL), and imipenem (1.0 mg/mL). We performed a chart review of the previous 10 years to see if there was a significant difference in postoperative infection rates.

## Methods

The charts of all adult patients (≥18 years of age) treated for appendicitis from January 1997 to November of 2007

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**Table 1** Variables included in the analysis

| |
|---|
| Age |
| Temperature |
| Sex |
| Weight |
| Date and time of hospital admission and operation |
| Cardiovascular disease |
| Respiratory disease |
| Liver disease |
| Diabetes |
| Cancer |
| Immunosuppression; |
| Pregnancy |
| Neuropsychiatric illness |
| Current medications |
| White blood cell count |
| Hemoglobin |
| Abumin |
| Allergies |
| Computed tomography findings |
| Ultrasound findings |
| Time from the emergency room to the operating room |
| Preoperative antibiotics |
| Open vs laparoscopic procedure |
| Perforation |
| Peritoneal cultures |
| Peritoneal irrigation |
| Method of wound closure |
| Incidence of infectious complications |
| Length of stay |
| Additional complications |
| Hospital charges |

were reviewed. There were no exclusion criteria. The data recorded for each patient are listed in Table 1.

Past medical history was broken down into the presence of the following subcategories: cardiovascular disease, respiratory disease, liver disease, diabetes, cancer, immunosuppression, pregnancy, neurological disease, and neuropsychiatric illness. Albumin was looked at as an indicator of preoperative nutritional status. Computed tomography findings and ultrasound findings were categorized as being positive or negative for the presence of appendicitis. Three types of peritoneal irrigation were used over the period of study based on attending surgeon preferences: saline, Dakin's solution (.25%), or imipenem (1 mg/mL). Wound closure was categorized as being either primary closure or delayed primary closure. A perforated appendix was defined by operative evidence of a hole in the appendix, or an abscess cavity noted during surgery. Positive peritoneal cultures were counted as being an indication of perforation. The selection of preoperative antibiotic, type of operation (open vs laparoscopic), type of abdominal irrigation, and method of wound closure were based on surgeon preference.

Infectious complications were divided into surgical wound infections, intra-abdominal abscess, or both. A surgical wound infection was defined as purulent drainage from the wound, cellulitis requiring antibiotics, or the opening of a closed wound. An intra-abdominal abscess was defined as an intra-abdominal fluid collection that contained purulent material.

## Statistics

All values are expressed as means ± SEM or percentages. Each of the variables was tested for differences between patients with and without wound infections or abdominal abscess by univariate statistical methodology with significance accepted at $P < .05$ (chi-square). Data were evaluated using a combination of chi-square analysis and logistic regression analysis. A pooled cross-sectional multivariate logistic regression analysis was used to test the hypotheses that the 3 irrigation solutions affect the probability of the presence of wound infection or abdominal abscess. This was performed using the Statistical Analysis System package (SAS, Cary, NC). For this analysis, the dependent variable was the presence of either a wound infection or abdominal abscess.

Specifically, the model estimated was Log(pi/1-pi) = log Oi = alpha + Bi(I)+ Bi(E)+ C + E Where log Oi is the log odds of either a wound infection or abdominal abscess, Bi(I)is the vector of the irrigation solutions, Bi(I2)is the vector of the irrigation solution 2, Bi(I3)is the vector of the irrigation solution 3, Bi(E) is the vector of pre-existing conditions, C is the control (potential confounding) variable, and E is the error term. To determine significance of each variable, the chi-square probability (p) value, which within multiple logistic regression corresponds to a standard probability value, was calculated for all variables in an analysis within their assigned category, and significance was accepted at .05. This chi-square probability value is reported in the tables for each independent variable in addition to the probability value from standard univariate analyses. In conjunction with the above models, nested models based on sequential addition of significant variables along each additional time course were determined. This was performed by adding significant independent variables to subsequent models. Further analyses lead to models containing only the significant variables described in the regression equations. When variables were colinear, the strongest reasonable variable was retained. Variables that lost significance in progression equations were eliminated.

## Results

A total of 1,063 patients underwent appendectomy by 22 attending surgeons during the period studied; 42 procedures were performed laparoscopically—all were in the saline group. There was no difference in age, weight, temperature, white blood cell count, or preoperative albumin in the saline, Dakin's, or imipenem irrigation groups (Table 2).

One hundred nine patients had postoperative infectious complications. Of these infectious complications, 82 were surgical wound infections, 48 were abdominal abscess, and