



Is Routine Intra-operative Gram Stain, Culture, and Sensitivity during an Appendectomy is Effective in Decreasing the Rate of Post-operative Infective Complications?

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Abstract

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BACKGROUND: Organisms blamed in acute appendicitis are right predictable and very susceptible to a wide range of broad-spectrum antibiotics.

AIM: The aim of the study was to assess the clinical benefit of the routine intra-operative swab during an appendectomy in guiding antibiotic selection.

METHODS: Four hundred and thirty patients underwent appendectomy halved into two groups, each 215. In Group 1, an intra-operative swab was routinely obtained for culture/sensitivity. The results of which were reviewed for helping direct antibiotic selection. No intra-operative swabs were obtained in Group 2. Both groups were given single-dose cefotaxime and metronidazole preoperatively intravenously at the time of induction of anesthesia.

RESULTS: In swab group, 63/215 cultures (29.3%) revealed pathogens, while (70.7%) were negative or revealed isolated colonic commensals. Most cultures were negative or isolated colonic commensals. Fifty-two/63 cultures (82.54%) were sensitive to both cefotaxime and metronidazole, and only 11/63 (17.46%) reported resistant organisms to cefotaxime but not to metronidazole. Most pathogens were sensitive to empirical antibiotics. Twenty-two/215 patients (10.23%) developed infective complications, most (63.6%) had their cultures from the infected wound yielded different micro-organisms. Only 8/215 (3.72%) in the swab group needed a change in the empirical antibiotics for treating infective complications. In the non-swab group, 19/215 patients (8.83%) developed infective complications. Only 6/215 patients (2.8%) needed a change in the empirical antibiotics for treating infective complications. Collectively, only 14/430 patients (3.25%) required a change in the empirical antibiotics for treating infected wounds.

CONCLUSIONS: Routine peritoneal swabs for culture/sensitivity during appendectomy are of no clinical value. Such practice is considered a waste of laboratory resources and money. A single prophylactic dose of antibiotics has significant role in preventing surgical site infection.

Introduction

Acute appendicitis is the most common cause of acute abdomen that is requiring surgical intervention. The incidence is high in Western countries, specifically America and Europe. In England, the incidence is up to 100–130 per 100,000 population. Acute appendicitis accounts for 15%–40% of all surgical emergencies performed in most centers in Nigeria [1], [2].

Conventionally, microbiological swabs from the reactionary fluid in the right iliac fossa or by sweeping the peritoneum nearby the cecum, the cecal, and appendicular wall were taken for culture and sensitivity during an appendectomy. However, the pathogenic microorganisms involved are very predictable and sensitive to empirical broad-spectrum antibiotics [3].

In addition, the average post-operative hospitalization is 2 days, while the average time needed to achieve culture results is 3 days. About 42.7% of

the patients discharged from the surgical ward before obtaining the culture results [4].

On the other hand, a study by Jung Tack Son *et al.* showed that there is high rate of resistant bacteria in complicated appendicitis in Koreans. Furthermore, inappropriate prescription of empirical antibiotics in complicated appendicitis might increase the incidence of wound infection, and having intra-operative cultures routinely in such cases is an effective policy for choosing the suitable antibiotic [5].

Obstruction of the lumen of the appendix seems to be mandatory for the development of appendiceal inflammation which may progress to gangrene and perforation with free bacterial spread to the peritoneal cavity [6]. A mixture of facultative aerobes and obligate anaerobes constitutes the appendiceal bacterial normal flora. These are similar to those found in the colon. [7], [8] The most common isolated bacteria in many reported cases are Gram-negative *Escherichia coli* (*E. coli*) and Gram-negative bacilli *Bacteroides*

fragilis (*B. fragilis*). *B. fragilis* has been isolated in over 80% of cases. Acute appendicitis is a polymicrobial infection with up to 15 bacterial types isolated and reported in one study [2]. A knowledge of the bacterial type and their sensitivity pattern to antibiotics will aid in guiding the choice of prophylactic antibiotics and thus controlling post-operative surgical site infection [9], [10].

The gastrointestinal tract serves as an effective barrier to bacterial endotoxin and bacteria in the intestinal lumen [11]. It is unknown whether uncomplicated acute appendicitis causes bacterial translocation. One study revealed only 16.6% of patients with acute appendicitis involved translocation of bacteria to the mesenteric lymph nodes, with negative bacterial colonization in the peritoneum when peritoneal swabs were taken for cultures [12], [13].

Normally, bacteria are prevented from causing tissue infection in the presence of intact surface epithelia that is considered a mechanical barrier. However, this epithelial surface is broken down by surgical incision [14], [15], [16].

At the first 4 h after inducing breach in an epithelial surface and the underlying connective tissues during trauma or surgery, there is a time delay before host defenses mobilized through acute inflammatory, humoral, and cellular processes. This period is named the “decisive period” and during these first 4 h after doing the incision that bacterial invasion is established and infection can start. Prophylactic antibiotics are most effective logically during these 4 h to achieve maximum blood and tissue levels [17], [18], [19].

This study aimed to evaluate the clinical value of having a routine peritoneal swab for culture and sensitivity during appendectomy, by investigating the influence of microbiological results on post-operative outcomes such as wound infections and intraperitoneal abscesses.

Patients and Methods

This is a comparative and cross-sectional study of 430 patients (adults and pediatrics) who underwent appendectomy, reviewed over 2 years (April 2018–December 2020) in Baquba Teaching Hospital/Diyala Province/Iraq, and reviewed for the necessity of having intra-operative swab for Gram stain and culture/sensitivity. The laboratory work is achieved in the teaching laboratories in Baquba Teaching Hospital which is a public hospital funded by the Iraqi government. Both uncomplicated appendicitis (non-perforated and non-gangrenous) and complicated appendicitis were included in the study. The patients were randomized into two groups; each is 215 patients. Randomization is based on the odd-even method

depending on their sequence of admission to the theater. Appendicitis is proved either grossly intraoperatively or on histopathology in doubtful cases.

In Group 1 (swab group), routine intra-operative swabs were taken for culture and sensitivity. The swab was taken by sweeping the peritoneum near the cecum, right paracolic gutter, the wall of the cecum and the appendix, and from any collected fluid when present.

In Group 2 (non-swab group), no swabs were taken.

Patients in both groups were given a single prophylactic dose of antibiotic in the form of cefotaxime and metronidazole intravenously at the time of induction of anesthesia [20].

In both groups, if uncomplicated appendicitis was encountered, the patients received only two doses of cefotaxime and metronidazole postoperatively. If complicated appendicitis is encountered, the antibiotics continue till the patient is afebrile and white blood cell count returns to normal, then the patient completes enteral antibiotics for a total of 10 days [21].

The two groups were tested for the development of surgical site infection and intra-abdominal collection. The wound is regarded as being infected if there are signs of infection such as redness, tenderness, edema, or the presence of frankly discharged pus.

In both groups, another swab for culture/sensitivity was taken from the wound site in those who developed wound infections. The empirical antibiotics were continued unless the culture/sensitivity results revealed resistant organisms to the empirical antibiotics. The number approval of the Ethics Committee is 132 in April 17, 2018.

Statistical analysis

Significance was achieved using numbers and percentages.

Results

Four hundred and thirty patients were included in the study. They were divided into two groups, 215 patients each.

In each group, the number of patients with perforated appendicitis was 18 (8.37%) while the number of non-perforated appendicitis was 197 (91.63%) Table 1.

Table 1: Distribution of patients among the two groups

Group type	Perforated, n (%)	Unperforated, n (%)	Total
Group 1 swab group	18 (8.37)	197 (91.63)	215
Group 2 non-swab group	18 (8.37)	197 (91.63)	215
Total	36	394	430

Intra-operative swabs were taken for 215 patients (Group 1). Sixty-three out of 215 (29.3%) cultures revealed the presence of pathogens, while 152 out of 215 (70.7%) cultures were negative or revealed isolated colonic commensal flora. The most common pathogenic microorganisms revealed in cultures were *E. coli* and *B. fragilis*. Other microorganisms revealed in cultures in decreasing order of frequency were *Streptococcal species*, *Pseudomonas aeruginosa*, and *Clostridial species*. The majority of cultures were negative or isolated colonic commensal flora Table 2.

Table 2: Results of cultures in the swab group

Appendectomy	Positive for pathogens, n (%)	Negative or normal commensals, n (%)
Unperforated (197)	45 (20.93)	152 (70.7)
Perforated (18)	18 (8.37)	0 (0)
Total	63 (29.3)	152 (70.7)

Number of cases 215.

Fifty-two/63 (82.54%) were sensitive to the broad spectrum empirical antibiotics (both cefotaxime and metronidazole), and only 11/63 (17.46%) cultures reported resistant micro-organisms to cefotaxime but not to metronidazole. Most of the pathogenic organisms revealed on intra-operative culture/sensitivity were sensitive to the broad spectrum empirical antibiotics Table 3.

Table 3: Results of the culture/sensitivity in patients whose cultures yielded pathogens

Results of the culture/sensitivity for pathogenic bacteria	n (%)
Sensitive to the empirical micro-organisms	52 (82.54)
Resistant to the empirical (cefotaxime) micro-organisms	11 (17.46)

Number of cases 63/215.

Twenty-two out of 215 (10.23%) patients developed post-operative infective complications. Eleven of those 22 patients were having perforated appendicitis. Three/22 were having intraperitoneal collection, two of those three patients managed by antibiotics only and the other one needed aspiration under ultrasound guide. Fourteen/22 (63.6%) were having different microorganisms responsible for the infective complications. Most patients who developed infective complications had their cultures from the infected wound yielded different micro-organisms from those obtained intraoperatively Table 4.

Table 4: Distribution of the micro-organisms among patients who developed infective complications compared to the intra-operative cultures

Types of micro-organisms	n (%)
Cultures revealed the same micro-organisms	8 (36.4)
Cultures revealed different micro-organisms	14 (63.6)
Total	22

Number of cases 22.

Of the 215 patients who underwent routine intra-operative swab for culture/sensitivity, a change in the empirical antibiotics for treating infective complications were needed in only 8 patients (3.72%) Table 5.

Table 5: The need for changing the empirical antibiotics in the swab group

Antibiotics use	n (%)
Empirical antibiotics needed to be changed	8 (3.72)
Empirical antibiotics do not need to be changed	207 (96.28)
Total	215

Total number 215.

In Group 2 (non-swab group), 19 patients out of 215 patients (8.83%) developed infective

complications. Twelve of those 19 patients were having perforated appendicitis. Of those 215 patients in the non-swab group, a change in the empirical antibiotics was required in only 6 patients (2.8%) for treating infective complications.

In brief, the majority (70.7%) of intra-operative culture results were negative or isolated colonic commensal flora. In the swab group, the pathogens causing post-operative infective complications differed from those isolated intraoperatively in the majority (63.6%) of cases. A change of the empirical antibiotics is needed only in 3.72% and 2.8% of patients for treating post-operative infective complications in the swab and the non-swab groups, respectively, Table 6.

Table 6: The need for changing the empirical antibiotics in the swab group and the non-swab group (215 patients each) distinctly and collectively (out of 430)

Group types	Wound infection, n (%)
Group 1 (swab group)	8 (3.72)
Group 2 (non-swab group)	6 (2.8)
Collectively	14 (3.25)

Discussion

Empirical antimicrobials gained their place in the treatment of acute appendicitis as the causative bacteria are very predictable (the majority are *Bacteroides*). Peritoneal swab for culture/sensitivity was the routine practice during appendectomies for guiding antibiotic use. This old fashion practice is still present despite the use of effective prophylactic empirical broad spectrum antibiotic therapy [12], [13].

The present study results revealed that most swabs 70.7% were negative or isolated commensal flora while only 8.37% were pathogenic bacterial strains that are already sensitive (82.54%) for to empiric broad-spectrum antibiotics. Of those who developed infective complications and were swabbed, most cultures revealed different micro-organisms and only 3.72% of the required change in the empirical antibiotics already prescribed.

A study which is carried out by Azan S Al-Saadi, Ali H Al-Wadan *et al.* revealed a comparative results to our study. In this retrospective study, a swab for culture and sensitivity was taken from the peritoneal cavity in 160 patients with appendectomy. All patients received prophylactic antibiotics. The study documented that 60% were having perforated appendix, 13% of them were gangrenous. The most common micro-organisms cultured were *Escherichia coli* and *Bacteroides*. The incidence of wound infection was 5% only. It was interesting to record that no single patient had their antibiotics altered in response to the culture/sensitivity results of the swab [22].

Our results are also in concordance with those reported by F. J. Foo I. J. Beckingham and I. Ahmed, whose results revealed that 68% of intra-operative cultures were negative or isolated commensal flora and only 32% were pathogens. The study also revealed that only 4.1% cultured resistant micro-organisms to the broad spectrum empirical antibiotics. Patients who developed surgical site infection had their cultures revealed different micro-organisms in 68% of patients. They also reported that none of the patients had a modification in the management plan depending on the swab results [11].

In a study by R Bilik, C. Burnweit *et al.*, 499 patients were assigned into two groups, those with non-perforated appendicitis and those with perforated one. Cultures were taken randomly in both groups intraoperatively. The influence of the positive cultures in selecting antibiotic treatment was investigated in both groups. There was no significant difference in both groups concerning post-operative infective complication rate whether or not intra-operative swab for culture was obtained (5.9% versus 4.7% in Group 1 and 21.2% versus 21.9% in Group 2; $p > 0.05$). [23]

Another study that supports our study is that which is accomplished by Dae Woon Song, Byung Kwan Park, *et al.* In this study, 694 patients underwent appendectomy and possessed positive microbial results. For microbial evaluation, a contents from the lumen of the appendix were swabbed after removal of the appendix. In those with periappendicular pus collection, the swabs were taken from the abscess. The microbiology results, and post-operative surgical site infection were reviewed. The most common organism cultured was *Escherichia coli* (64.6%), which was sensitive to many antibiotics such as amoxicillin/clavulanic acid, most of the cephalosporins, ciprofloxacin, piperacillin/tazobactam, and meropenem. The prevalence of superficial surgical site infection was only (6.2%). They concluded that the use of empirical broad spectrum antibiotics sounds to be safe in cases of perforated appendicitis [24].

Many other studies concluded that obtaining intra-operative cultures during appendectomy are of no clinical value and do not affect the outcome regarding infective complications. Of these studies are those which are accomplished by Jaffers GJ, Pollock TW. (Intra-operative Culturing During Surgery for Acute Appendicitis). [25], Haq AI. (Evaluation of Intra-operative Bacterial Cultures in 721 Patients With Acute Appendicitis [26], and Moawad MR., Dasmohapatra S., *et al.* (Value of Intra-operative Abdominal Cavity Culture in Appendectomy: A Retrospective Study) [27].

Furthermore, the short hospital stay following an appendectomy which is usually <24 h preclude getting the benefit of the intra-operative culture results which need not <72 h to be recorded.

Conclusions

Routine intra-operative peritoneal swabs for culture and sensitivity can be abandoned during appendectomy as they do not have any clinical advantage especially when considering the empiric use of broad spectrum antibiotics and the short hospital stay. In cases of perforated appendicitis, colonic flora can be predicted, and antibiotic therapy should begin without the need for abdominal cavity culture results. Finally, such results and the same prove that single prophylactic antibiotics and not for more than 48 h postoperatively are fair enough for preventing wound infection.

Recommendations

Abdominal swabs for culture and sensitivity should possibly be preserved for high-risk patients who are immune-compromised. For uncomplicated acute appendicitis, a single dose of prophylactic antibiotic and not for more than 48 h postoperatively is recommended.

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