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Timing and duration of antibiotic usage in appendectomies and its relation with surgical site infection

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Abstract

Background: Sepsis in modern surgery continues to be a significant problem for healthcare practitioners across the world. The proper use of resources is a critical challenge for health services. The optimal time for administration of preoperative doses is within 60 minutes before surgical incision. Short postoperative course of antimicrobials involving a single dose or continuation for less than 24 hours is the recommendation. *Objectives:* To evaluate the current timing practice and duration of antibiotic prophylaxis in patients underwent appendectomy. *Patients and methods:* A cohort study conducted in Omdurman teaching hospital (November 2011 to August 2012). It included all consecutive patients with appendicitis managed by appendectomy. Patients were followed up for one month and wound was assessed using ASEPSIS classification for presence of wound infection. The collected data was managed statistically using SPSS computer program version 21. *Results:* The study included 255 patients (192 (75.3%) males, 63 (24.7%) females) with male to female ratio of 3.1:1. Their mean age was 21.6 years (range 7 to 42 years). ASA I was recorded in 98.4%. Mean operative time was 42 minutes. Only 38.04% of patients received precisely timed prophylactic antibiotics. Incidence of surgical site infection (SSI) was 12.2%. According to ASEPSIS classification infection was minor, moderate, and severe in 19 (7.45%), 10 (3.92%) and 2.0 (0.78%) respectively. SSIs were developed in one to two weeks postoperatively in 93.5% of patients. Risk factors were such as smoking, diabetes mellitus or hypertension were studied and found to be statistically not significant $p > 0.05$. A higher incidence and statistically significant proportion of wound infections were developed in the group of patients that received antibiotics in either intra or postoperatively, $p = 0.001$.*Conclusion:* The most common violation of protocol is poor timing of the preoperative dose and prolonged duration of the prophylaxis.

Keywords

Acute Appendicitis, Appendectomy, Postoperative Antibiotics, Prophylactic Antibiotics, Surgical Site Infections (SSIs)

1. Introduction

Surgical site infection (SSI) is the most common source of morbidity after appendectomy. Rates of postoperative SSI vary between 6 to 50% based primarily on antibiotic coverage and perforated versus nonperforated appendicitis. Prior to the use of antibiotics, postoperative SSI following

appendectomy for perforated appendicitis was as high as 70% [1].

SSIs are defined as infections occurring within 30 days of the procedure and involving the operative area. Where implants have been placed, this time period is extended to one year if the infection appears to relate to the procedure [2]. SSIs are one of the most frequent adverse events that could occur in operated patients. It is the third most common nosocomial infection. Surgical site infections represent a substantial burden of disease for patients and health services [3].

We aimed to study the current timing practice and duration of antibiotic prophylaxis in patients underwent appendectomy at Omdurman teaching hospital.

2. Patients and Methods

A cohort study was conducted in Omdurman teaching hospital during the period from November 2011 to August 2012. It included all consecutive patients with appendicitis managed by appendectomy after acceptance of the informed consent. Some patients presented with classical features, otherwise confirmatory tests were done in the form of total white blood count and its differential, C reactive protein, urinalysis and ultrasound assessment. Patients were admitted from emergency room and the operation was performed upon their admission. All patients were operated in the emergency theatre at our hospital but by different grade and experiences of operators. Preoperative surgical site shaving was not routinely applied practice in our hospital. Patient skin antisepsis and surgical scrub were done with 5-10% povidone-iodine and or spirit. Most of the patients were operated through right grid iron incision but those with peritonitis or suspicious of perforation were approached through right lower paramedian laparotomy incision. After surgery, incisions were left covered with sterile dressings for at least 48 hours. Patients were followed up for one month. Wound was assessed for presence of wound infection. The collected data were analyzed using SPSS version 21.0 for Windows. All quantitative data were presented as mean values ± standard deviation (SD). Pearson's Chi-square test was used to compare the differences between groups with CI level of 95% and p value <0.05 considered to be significant.

3. Results

The study included 255 patients (192 (75.3%) males, 63 (24.7%) females) with male to female ratio of 3.1:1. Their mean age ± SD was 21.6 ± 14.8 (range 7 to 42 years).

The anaesthetic score was calculated in all patients. ASA I was recorded in 251 (98.4%) and ASA II in 4 (1.6%) of patients. All patients were treated by appendectomy performed through grid iron or right paramedian incisions. The mean operative time was 42 minutes (SD ± 17.6 minutes), 62.4% of the appendectomies were carried out in less than 1 hour, but two cases of perforated appendix took longer than two hours (Table 1), and no intraoperative second dose of prophylactic antibiotic was given. It was non perforated in 217 (85.1%) and perforated in the reminder 38 (14.9%) patients.

Table 1: *Operative time in study group (n=255)*

Operative time	Frequency	Percent
< 1 hour	159	62.4
1-2 hour	94	36.9
>2 hours	02	0.7
Total	**255**	**100.0**

All patients received injectable antibiotics in the form of cefuroxime 750 mg and metronidazole 500 mg infusion with different starting time as in 123 (48.2%) it was received within 30 minutes prior to induction of anaesthesia, and in 37 (14.5%) it was received postoperatively, of them 253 (99.2%) received oral antibiotics for 5 or more days. The study stated that only 38.04% of patients received precisely timed prophylactic antibiotics for 24 hours or less. Of note, there was antibiotic miss use in the current study as there was no fixed rule in our hospital, (Table 2).

Table 2: *Timing, route and duration of antibiotics in study group (n=255)*

Timing of antibiotics		**Frequency**	**Percent (%)**
Preoperative <30 min		123	48.2
Intraoperative		95	37.3
Postoperative		37	14.5
Total		**255**	**100.0**
Duration of Antibiotic		**Frequency**	**Percent (%)**
	≤24 Hours	97	38.04
Injectable	48 Hours	25	9.80
	>48 hours	133	52.16
	Total	255	100
Oral	≥ 5 day	253	99.2

Mean hospital stay was 3.5 (SD ± 2.1) days. The incidence of SSI in this study was 12.2%.It developed in 17/217 (7.8%) non perforated appendicitis and 3/38 (7.9%) perforated appendicitis, and the difference was statistically not significant (p>0.05). All patients were classified according to ASEPSIS classification, infection was minor, moderate, and severe in 19 (7.45%), 10 (3.92%) and 2.0 (0.78%) respectively (Table 3)

Table 3: *ASEPSIS classification in study group (n=255)*

Category of infection	Total score	No. of patients
Satisfactory healing	0-10	209 (81.97%)
Disturbance of healing	11-20	15 (5.88%)
Minor infection	21-30	19 (7.45%)
Moderate infection	31-40	10 (3.92%)
Severe infection	> 40	2.0 (0.78%)
Total	**—**	**255 (100%)**

The operations were performed by surgical registrars, medical officers and surgical specialists in 160 (62.7%), 87 (34.1%), and 8 (3.2%) respectively. The development of SSI is not affected by operator status as p = 0.09. The incidence of SSI was higher in patients operated by medical officers (7.1%) than operated by the surgical specialists (0.4%) (Table 4).

Table 4: *Correlation between operator status and development of SSI in study group (n=255)*

Operator	SSI						Total
	Yes			NO			
	No.	Incidence %	Rate %	No.	Incidence %	Rate %	
Surgeon	01	0.4	12.5	07	02.7	87.5	**08 (3.14%)**
Registrar	12	04.7	07.5	148	58.0	92.5	**160 (62.74%)**
Medical officer	18	07.1	20.7	69	27.1	79.3	**87 (34.12%)**
Total	**31**	**12.2**	**-----**	**224**	**87.8**	**----**	**255 (100%)**

On classifying the SSI in our 31 patients; 27 (87.1%) involved the skin and subcutaneous tissues 'superficial incisional SSI', three patients (9.7%) involved the deep soft tissues as fascia or muscle layers of the incision 'deep Incisional SSI' and in one patient (3.2%) purulent drainage from a drain that is placed into the pelvic cavity was noted 'Organ/Space SSI'. The study revealed that 29/31 patients (93.5%) of SSIs occur between one to two weeks postoperatively.

Complications secondary to surgical site infection were developed in three patients (1.2%) in form of septicemia and enterocutaneous fistula in 2 (0.8%) and 1 (0.4%) respectively. Risk factors were observed in 20 (7.8%) in a form of smoking, diabetes mellitus, hypertension in 17 (6.7%), 2 (0.7%) and 1 (0.4%) respectively. These factors were studied and found to be statistically not significant p > 0.05.

A higher incidence and statistically significant proportion of wound infections were developed in the group of patients that received antibiotics in either intra or postoperatively in comparison to that received antibiotic in the preoperative period p = 0.001.

4. Discussion

Acute appendicitis is the most common surgical emergency encountered compared with other non-traumatic acute abdomens. Omdurman Teaching Hospital recorded there were 255 cases of acute appendicitis during the period from November 2011 to August 2012. The study obtained that the majority of acute appendicitis patients (85.1%) were nonperforated and only 14.9% were perforated.

The incidence of postoperative SSIs after appendectomy in patients with appendicitis has been reported to range from 0% to 11% [4]. In our study the incidence is slightly higher 12.2%.

The efficacy of pre-operative antibiotics in reducing the risk of SSI following appendectomy has been well established in the literature [5, 6].

Antibiotic prophylaxis is administered before, during and after surgery is effective to prevent postoperative infection. Antibiotic prophylaxis reduces SSI to 1-5%. It is recommended to administer prophylactic antibiotic routinely in appendectomy [7]. However, the role of postoperative antibiotics in these patients has not been clearly defined [4]. Only few studies have evaluated specifically the clinical benefits and the disadvantages of administering postoperative antibiotics in addition to adequate pre-operative antibiotics prophylaxis [8-11].

The most common violation of protocol is poor timing of the preoperative dose and prolonged duration of the prophylaxis [3]. During prolonged operation, antibiotic prophylaxis should be re-administered every 3 hours, but the duration should not exceed 24 hours [8, 9, 12] as more than 24 hours prophylaxis is not justified for any surgery[3]. In daily practice, additional 2-3 doses of antibiotics after surgery and some even administered up to five days after surgery are often found [8, 9, 12].

The stage of the disease process at the time of operation and the use of appropriate prophylactic antibiotics significantly affects the risk for postoperative SSIs in addition to patient's factors [8, 9]. In contrast in the current study there were no difference in incidence of SSI in both perforated and nonperforated appendicitis (p>0.05).This possibly might result from the exudative fluid coming in contact with the subcutaneous tissue of the incision wound during the process of surgery. Although culturing of this fluid is not usually done in our practice as it will not add to the management.

In the surgical practice, the supplementary postoperative antibiotics have been used increasingly, because of the fear of developing postoperative SSIs. Postoperative antibiotics cannot be the substitute of good surgical and aseptic techniques. The overuse of antibiotics is associated with the increase risk of antibiotic related complications, bacterial antibiotic resistance and cost of care [8-11]. In our study 253 (99.2%) received antibiotic for five days or more, if the genuine 38 cases of perforated appendix, who received it as

treatment were excluded, this makes 215 (84.3%) with non-perforated appendix unnecessarily had additional prolong oral antibiotics for five days. Our study showed a higher incidence of SSI in the group of patients that received antibiotics in either intra or postoperatively in comparison to that received antibiotic in the preoperative period. For these reasons, the benefits and side effects of antibiotics therapy have to be carefully evaluated. Moreover, our results are further strengthened by the recent studies showing that the prolong use of antibiotics even in patients with complicated appendicitis does not reduce the postoperative infectious complications [4, 13, 14].

In our study all patients were received injectable antibiotics with different starting time and duration, only 38.04% of patients received precisely timed prophylactic antibiotics. This observed variation in antibiotic use because there is no fixed rule of antibiotic prophylaxis in our hospital. In other studies when used a proper antibiotic prophylaxis in appendectomy the rate of postoperative infections were reduce from 22.6% to 4.6% [15]. The choice of antibiotic, the dose, the timing and the duration of prophylaxis are important, but it is even more important that the intended prophylaxis regime is actually accomplished [16].

In the current study the risk factors such as diabetes mellitus, found to be statistically not significant $p > 0.05$. The contribution of diabetes to SSI risk is controversial, because the independent contribution of diabetes to SSI risk has not typically been assessed after controlling for potential confounding factors [17].

The main limitation of the current study is that our patients underwent operation by several doctors with varying degrees of surgical skills.

To remove such limitation, well-designed randomized studies with a larger number of patients should be carried out. However, such trials would be practically infeasible in our set because the emergency departments usually covered by surgical registrars and medical officers.

5. Conclusion

A prolonged duration of operation was associated with increased risk of SSI among appendectomy patients, while antibiotic prophylaxis was associated with decreased risk. Postoperative antibiotics did not add an appreciable clinical benefit in these patients. Therefore, surgeons need to update their practice of antibiotic prophylaxis according to the standard guidelines and evidence based medicine. The most common violation of protocol is poor timing of the preoperative dose and prolonged duration of the prophylaxis.

Competing Interests

The authors declare that they have no competing interests.

Abbreviations

ASEPSIS
A: Additional treatment, S: Serious discharge, E: Erythema, P: Purulent exudates, S: Separation of deep tissue, I: Isolation of bacteria, S: Stay as inpatient

ASA	American Society of Anesthesiologists
CI	Confidence intervals
SD	Standard deviation
SSI	Surgical site infection

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