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Original article

Comparative Prospective Study on Prophylactic Antibiotics *versus* Empirical Antibiotics in the Prevention of Surgical Site Infection in Libya

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Surgical Site Infections, Antimicrobial Prophylaxis, Empirical Antibiotics, Wound Infection.

ABSTRACT

Surgical site infections (SSIs) develop in or around a surgical wound after the operation depending on the type of procedure performed. One of the main strategies to prevent SSIs is the use of antimicrobial prophylaxis, which is the administration of antibiotics before, during, or after surgery to reduce the risk of wound infections. However, there is controversy about the optimal duration and regimen of antimicrobial prophylaxis. This study aims to investigate and compare the use of prophylactic antibiotics versus empirical antibiotics in preventing SSIs. A prospective observational study was conducted in secondary health center of Aljabal Alakhter in Libya from December 2020 to October 2022. A total of 96 cases were enrolled in the study. Out of whom,46 patients with a mean age of 40.59 (±13.848) years for Prophylactic group and 50 patients with a mean age 31.02 (±17.694) years for Empirical group. Prophylactic group had 17 males and 29 females, while Empirical group had 21 males and 29 females. There was statistically non-significant difference between gender distributions in the two groups. In conclusion: SSIs are one of the most common post operative complications in which a high risk of post operative morbidity and mortality, prolongs hospital stay and raises hospital cost to patients. In our study, the total incidence rate of SSI was 0.0%. While empirical use of antibiotics is of minimal benefit.

Introduction

Surgical site infections (SSIs) are infections occurring at or near the surgical incision that mostly happen within 30 days of surgery, or often between 5 and 10 days. SSIs are the most common infections, accounting for 38% of surgical patients. SSIs can prolong postoperative hospital stays, and increase costs, morbidity, and mortality [1]. SSIs is categorized into three main types according to the CDC; superficial incisional SSI is the most common type (about 42%) which affects only the skin and underlying fatty tissue, deep incisional SSIs (around 40%) are less frequent and involve infections in deeper tissues like muscle, and organ/space SSI is the least common type (around 18%), where an infection in a nearby organ spreads to the surgical incision [2, 3].

Surgical wounds are rated based on their contamination risk into four classes: Class I (clean): lowest risk (2-5% infection) - no inflammation, respiratory/digestive/urinary tracts not involved. Class II (clean-contaminated): moderate risk (5-20% infection) - involves respiratory/digestive/urinary tracts, but under controlled conditions. Class III (contaminated): higher risk (20% infection) - breach in sterile technique or leakage from digestive tract. Class IV (dirty/infected): highest risk (>40% infection) - already infected wounds or foreign object present [4].

The most common pathogens causing SSIs are the patient's own flora from the skin, mucous membranes, or hollow viscera. Aerobic gram-positive coca such as Staphylococcus aureus and coagulase-negative staphylococci are the predominant organisms, followed by gram-negative bacilli and anaerobes. The emergence of antibiotic-resistant bacteria, such as methicillin-resistant S. aureus, vancomycin-resistant enterococci, and extended-spectrum beta-lactamase-producing organisms, poses a serious challenge for the prevention and treatment of SSIs [1].

Antimicrobial prophylaxis is the use of antibiotics to prevent infections rather than to treat them. It reduces the bacterial load at the surgical site to a level that can be handled by the host's immune system, and to prevent the adherence and colonization of bacteria to foreign materials, such as prosthetic devices. The principles of antimicrobial prophylaxis include the selection of an appropriate antibiotic with a narrow spectrum of activity, covering the most likely pathogens, the administration of the antibiotic at the right time, dose, and route, and the discontinuation of the antibiotic as soon as possible to decrease the adverse effects and the development of resistance [1].

The optimal duration of antimicrobial prophylaxis is a matter of debate. The current guidelines recommend discontinuation of antimicrobial prophylaxis within 24 h after surgery, or within 48 h after cardiac surgery. However, some surgeons prefer to continue antibiotic prophylaxis until the wound is healed, especially for procedures involving

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implants or prosthetic materials, or for patients with high risk of infection. This practice is called empirical antibiotic therapy, and it is based on the assumption that prolonged antibiotic exposure can prevent or treat subclinical infections that may manifest later. However, empirical antibiotic therapy has not been proven to be superior to prophylactic antibiotic therapy, and it may increase the risk of adverse effects, such as allergic reactions, Clostridioides difficile infection, and antibiotic resistance [2]. Therefore, this study aims to compare the effectiveness and safety of short-term antibiotics (prophylactic) versus longer courses (empirical) in preventing SSIs.

Methods

The study is a prospective observational study conducted in secondary health center of Aljabal Alakhter in Libya from December 2020 to October 2022. An electronic questionnaire is used to collect the relevant data including: Patient's demographic profile, co-morbidity, stay, past surgical history, diagnosis, type of surgery, duration, the prescribed antimicrobial drugs (name, route of administration, and frequency), and outcome. Patients were classified into two groups, the prophylactic group received a single dose of antibiotic 30 min preoperatively, while the empirical group received post operative antibiotics for about 5-7 days after surgery. Inclusion criteria included: Clean contaminated cases and both genders. Exclusion criteria included: clean cases, those patients who do not consent, and contaminated cases. Written consent was obtained from participants prior to surgery. Additional approval was also obtained from the data collection site.

Results

A total of 96 cases were enrolled in the study. Out of whom,46 patients with a mean age of 40.59 (±13.848) years for Prophylactic group and 50 patients with a mean age 31.02 (±17.694) years for Empirical group. Prophylactic group had 17 males and 29 females, while Empirical group had 21 males and 29 females. There was statistically non-significant difference between gender distributions in the two groups.

Table 1. The demographic data of the two study groups.

Characteristic	Prophylactic	Empirical
Age	40.59 (±13.848)	31.02 (±17.694)
Gender		
Male	17 (37.0%)	21 (42.0%)
Female	29 (63.0%)	29 (58.0%)
Total	46 (47.9%)	50 (52.1%)

Table 2: Comparison between the two studied groups according to Co-morbidity.

Characteristics	Prophylactic	Empirical	Total
Comorbidities	11 (23.9%)	11 (22.0%)	22 (22.9%)
No comorbidities	35 (76.1%)	39 (78.0%)	74 (77.1%)
Total	46 (47.9%)	50 (52.1%)	96 (100.0%)

Table 3: Comparison between the two studied groups according to Type of surgery.

Type of Surgery	Prophylactic	Empirical	Total
Classical Appendectomy	5 (10.9%)	27 (54.0%)	32 (33.3%)
Laparoscopic Cholecystectomy	41 (89.1%)	23 (46.0%)	64 (66.7%)
Total	46 (47.9%)	50 (52.1%)	96 (100.0%)

Table 4: Comparison of patients with SSI, out of 96 patients in both groups, 0 patients (0.0%) had SSI in Prophylactic group and0 patient (0.0%) had SSI in Empirical group.

Outcome	Prophylactic	Empirical	Total
SSI	0 (0.0%)	0 (0.0%)	0 (0.0%)
Non-SSI	46 (47.9%)	50 (52.1%)	96 (100.0%)

Table 5: The hospital stay of patients in both groups (96).

Group	N	Mean (±SD)	*P*
Prophylactic	46	2.07 (±1.272)	0.410
Empirical	50	2.28 (±1.213)	

p= t-test

In the Prophylactic group 46 patients stayed in hospital about 2.07 ±3 1.272 days. In the Empirical group 50 patients stayed in hospital about 2.28 ±1.213 days. The difference was non-sgnificant (p=0.410).

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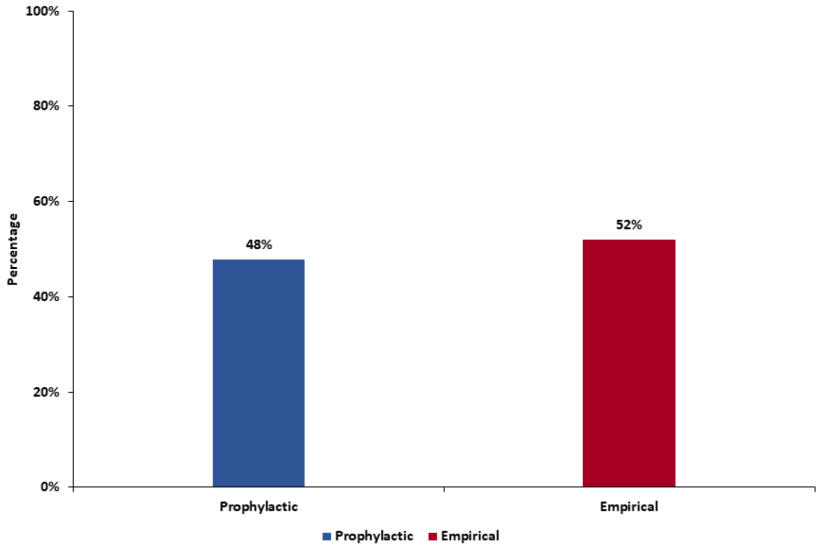

Figure1: Comparison between the two studied groups according to antibiotic use.

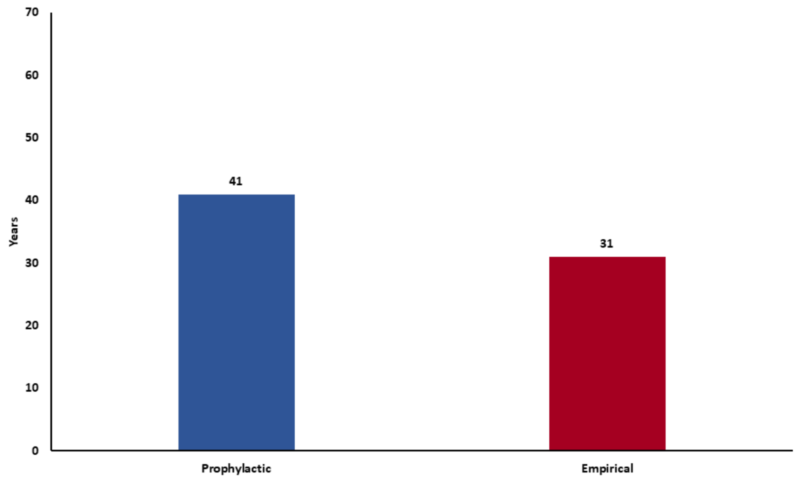

Figure 2: Comparison between the two studied groups according to age.

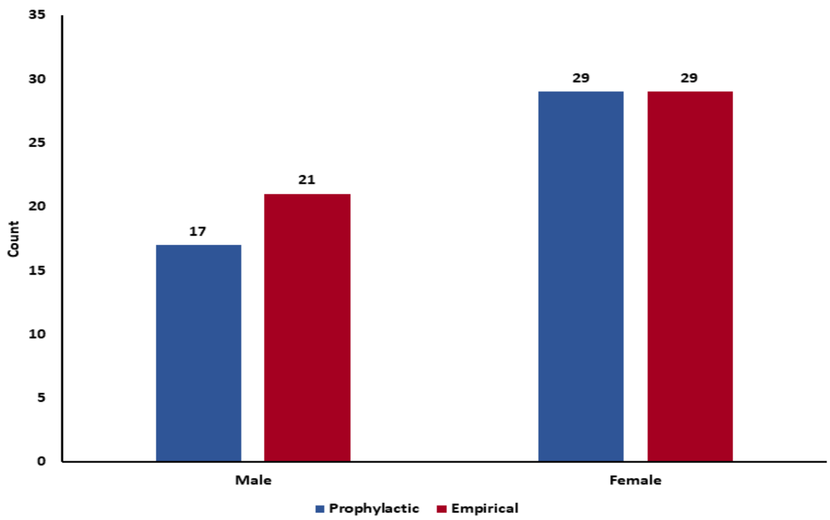

Figure 3: Comparison between the two studied groups according to gender.

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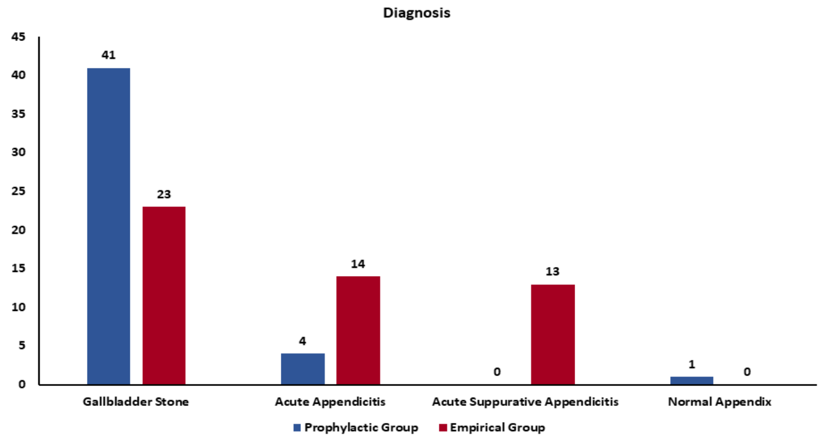

Figure 4: Comparison between the two studied groups according to Diagnosis.

Discussion

SSI is an infection that occurs after surgery in the part of the body where the surgery took place. SSIs are either superficial infections involving the skin only or more serious infections that involve tissues under the skin, organs, or implanted material. The current study aims to compare the effectiveness of a single dose of prophylactic antibiotic versus empirical post-operative antibiotic in the prevention of SSIs.

In this study, preoperative as well as postoperative antibiotics were used, and incidence of SSIs was assessed in 96 patients, of which, there were no cases of SSI in either the prophylactic or empirical groups. A systematic review and meta-analysis estimated the prevalence of SSIs following general surgery in adults and pinpoint elements that may increase the risk of infection.[5] Around 1% of general surgery patients experience an infection after 30 days. High-quality studies are crucial to improve our understanding of patient and surgery-related factors that contribute to these infections, ultimately aiming to reduce their occurrence.

According to Ratnesh et al., study, the majority of patients received antimicrobial prophylaxis. They reported that 11.1% of patients developed SSIs. Ceftriaxone was the most common antibiotic used. The study also linked a lack of preventative measures, the type of wound, and the type of surgery to a higher risk of SSIs [6] .While India (3.38%) and Brazil had higher SSI rates than reported in previous studies (3.4%), this could be due to our study including a wider range of surgeries and a larger sample size. It's important to note that even higher SSI rates were found in two Ethiopian studies (20.6% and 32%) and one Ugandan study (16.4%).[7, 8]

Most SSIs are caused Patient's own bacteria either during surgery or external contamination after surgery. These infections severely impact a patient's well-being, causing complications and longer hospital stays. Studies, like those by De Lissovoy et al., show a significant economic burden due to SSIs. Extended stays and increased treatment costs make SSIs the most expensive hospital-acquired infection. The additional financial strain comes from longer hospitalizations, emergency department visits, and readmissions [9]. The Prophylactic group 46 patients stayed in hospital about 2.07 (±1.272) days. In the Empirical group 50 patients stayed in hospital about 2.28 (±1.213) days. The difference was non-significant (p=0.410). Kirkland et al.[10] reported that hospital stays increased by 6.5 days, while Lissovoy et al. [11] reported an increase of 9.7 days. There is no significant association present for complications occurred in both study group and control group.

Conclusion

SSI is a major risk factor for post operative complications and death, prolongs hospital stay and hospital cost to patients. In our study, the total incidence rate of SSI was 0.0%. While empirical use of antibiotics is of minimal benefit, further studies are warranted with a larger sample size to evaluate post-operative benefit of antimicrobials

Acknowledgments

Not applicable

Conflicts of Interest

The authors declare no conflicts of interest.

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