Assessment of preoperative antibiotic prophylaxis in general surgery: A comparative study

Original Article

Yasser H.I. Mohammed[a,b] and Moaz Abulfaraj[c]

Department of [a]Chemistry, Faculty of Applied Science, University of Hajjah, Hajjah, Yemen, [b]Pharmacy, Faculty of Medicine and Medical Science, University of Al-Razi, Yemen, [c]Surgery, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia.

ABSTRACT

Background: Prolonged recovery is often due to surgical site infections and other complications. This study examines the impact of preoperative antibiotic prophylaxis on surgical outcomes to potentially lessen postoperative morbidity.

Patients and Methods: This study involved a prospective review of 1,000 adults scheduled for elective general surgery. Participants were divided into two groups: those who received preoperative antibiotics (group A) and those who did not (group B). The research compared demographics, surgical details, infection occurrences, wound issues, and hospital stay durations between the groups, calculating relative risks.

Results: At the outset, the two groups were comparable. Group A experienced significantly fewer surgical site infections (8% vs. 14%) and wound complications (6% vs. 10%) compared with group B, irrespective of the type of surgery performed. The analysis of relative risk ratios uniformly indicated advantages for group A. Although the average hospital stay was marginally shorter for group A (7 days vs. 8 days), this difference was statistically insignificant.

Conclusion: Administering prophylactic antibiotics before surgery substantially reduced the incidence of postoperative infections and overall morbidity among general surgery patients. Promoting the careful standardization of antibiotic practices may enhance surgical recovery by lowering complication rates and speeding up the return to health. Further research through larger, controlled trials is essential to establish the most effective antibiotic protocols.

Key Words: General surgery, preoperative antibiotic prophylaxis, surgical site infections, wound complications.

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Corresponding Author: Moaz Abulfaraj, MD, Department of Surgery, Faculty of Medicine, King Abdulaziz University, Jeddah 21589, Saudi Arabia. **Tel.:** +1 (845) 645-3870, **E-mail:** mabolafaraj@kau.edu.sa

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INTRODUCTION

Surgical site infections (SSIs) are a major cause of preventable healthcare-associated diseases worldwide, affecting 2–5% of surgeries requiring hospital stays and up to 30% of surgeries involving implants[1–3]. These infections contribute to increased rates of morbidity, mortality, healthcare costs, and litigation. In the United States, SSIs are estimated to increase hospital costs by approximately $3.5 billion each year[4,5]. Research has shown that administering prophylactic antibiotics before surgery, either as a single dose or through multiple doses for more extended procedures, significantly reduces the risk of SSIs across various surgical fields such as general, colorectal, vascular, and orthopedic surgeries[6–9]. A meta-analysis of 35 randomized controlled trials with more than 8,000 participants found that preoperative antibiotic prophylaxis reduced the incidence of SSIs by ~33%[10]. To achieve optimal tissue concentrations at the time of potential contamination, it is critical to administer the preoperative antibiotic dose within sixty minutes before making the surgical incision[11].

Although guidelines suggest the use of preoperative antibiotic prophylaxis for most surgeries classified as clean or clean-contaminated, the application in terms of correct timing, choice, and dosage is often inconsistent in medical settings[12,13]. This deviation is attributed to the absence of multidisciplinary protocols, gaps in knowledge, and lack of adherence even in advanced tertiary care centers[14,15]. Insufficient prophylaxis can lead to increased infection rates, while excessive use may contribute to the development of antimicrobial resistance[16].

In the context of the developing world, SSIs add strain to healthcare systems already facing challenges due to limited resources[17]. Therefore, the careful application of preoperative antibiotic prophylaxis, guided by evidence-based protocols, could significantly improve patient outcomes and ensure more efficient use of healthcare funds[18].

This study aims to evaluate the effectiveness of a standardized guideline for preoperative antibiotic prophylaxis in reducing the risk of SSIs and related

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morbidity following general surgical procedures. By comparing the surgical outcomes of patients who received preoperative antibiotics according to the established protocol against those who did not, the study seeks to identify areas for quality improvement[19–22].

PATIENTS AND METHODS:

Study design and participants

This study, conducted from January to December 2020 at Hospital Hajjah, included 1000 patients slated for elective general surgeries under spinal or general anesthesia in a prosepctive comparative analysis. Participants were divided into two randomized cohorts: group A (500 patients) received preoperative antibiotic prophylaxis while group B (500 patients) did not receive any antibiotic treatment.

Antibiotic prophylaxis protocol

A single dose of cefuroxime 1.5 g was administered intravenously to patients in group A as antibiotic prophylaxis, to be given within 60 min before making the surgical incision. Group B patients, on the other hand, did not receive any antibiotic prophylaxis.

Data collection

For all participants, demographic information such as age, sex, body mass index (BMI), and existing comorbid conditions were gathered. Additionally, surgical specifics including the type of procedure, its duration, and postoperative results such as the occurrence of SSIs, wound-related complications, and length of hospital stay were systematically recorded.

Outcomes assessment

The main outcomes measured were the rates of SSIs and wound complications within a 30-day postoperative period. Other factors assessed included the average length of surgical procedures and hospital admissions. SSIs were identified following the criteria established by the CDC (Centres for disease control).

Statistical analysis

Baseline characteristics were compared using χ^2 or t-tests. The incidence of outcomes between the two groups was analyzed using relative risk, with a 95% confidence interval. A *P value* of less than 0.05 was deemed indicative of a significant statistical difference.

RESULTS:

Assessment of preoperative antibiotic prophylaxis: Analysis of group characteristics

A total of 1000 patients scheduled for elective general surgery under spinal or general anesthesia were recruited and divided equally into group A (Antibiotics) and group B (No Antibiotics). Both study groups were comparable in number with 500 participants each. Age distribution was also similar with a mean of 55±10 years in group A and 54±9 years in group B. Sex proportions were evenly matched between groups with 60% males. Average BMI was within normal limits ranging from 26±2 in group B to 27±3 in group A. Prevalence of comorbidities like hypertension (40% vs. 36%), diabetes (20% vs. 18%), and obesity (30% vs. 24%) was also comparable between groups.

This comparative analysis of patients' demographic and clinical characteristics indicated homogeneity between the antibiotic and nonantibiotic prophylaxis cohorts. Baseline equivalence enhanced the validity of subsequent outcome comparisons to assess the impact of preoperative antibiotic prophylaxis (Table 1).

Table 1: Comparative group characteristics: Antibiotics versus no antibiotics - sample size, age, sex, BMI, and comorbidities

Group characteristics	Group A (Antibiotics)	Group B (No Antibiotics)
Number of Participants	500	500
Age (Mean±SD)	55±10	54±9
Sex (male/female)	300/200	280/220
BMI (Mean±SD)	27±3	26±2
Comorbidities	Hypertension: 200 Diabetes: 100 Obesity: 150	Hypertension: 180 Diabetes: 90 Obesity: 120

Impact of preoperative antibiotic prophylaxis on surgical procedures and postoperative outcomes

This study set out to assess how preoperative antibiotic prophylaxis affected surgical techniques and postoperative results. To ensure equal representation and comparability between the groups, 600 surgical operations were performed on each of group A (antibiotics) and group B (no antibiotics). Preoperative antibiotic prophylactic results can be reliably assessed due to the procedures' balanced distribution. Additionally, 100 appendectomy procedures, 150 cholecystectomy procedures, 200 hernia repair procedures, and 150 bowel resection procedures were carried out in group A. Group B saw 90 instances of appendectomy, 140 cases of cholecystectomy, 180 cases of hernia repair, and 150 cases of bowel resection. Both groups' surgical procedure distributions show a wide variety of typical general surgical operations. In addition, the average amount of time spent on surgery was 90 min in group A, with a standard deviation of 20, and 88 min in group B, with a standard variation of 18. It is doubtful that the little variation in mean length will have a major effect on the results because it is not statistically significant. The comparable duration of surgery between the groups suggests that the surgical procedures were performed under similar conditions. Similarly, in group A, 40 (8%) cases developed SSIs, while in group B, 70 (14%) cases experienced SSIs. Given that group A had a decreased incidence of SSIs, preoperative antibiotic prophylaxis may be a useful strategy for lowering postoperative infection risk. The statistically significant difference in infection rates between the groups emphasizes the possible advantage of antibiotic prophylaxis in SSI prevention. Furthermore, there were 30 (6%) instances of wound complications in group A and 50 (10%) cases in group B. The efficacy of preoperative antibiotic prophylaxis is further supported by group A's decreased frequency of wound complications. The statistical significance of the difference in the frequencies of wound complications across the groups suggests that antibiotics may have a protective effect in lowering wound-related complications following surgery. Additionally, group A's mean hospital stay lasted 7 days with a standard deviation of two, whereas group B's mean hospital stay lasted 8 days with a standard deviation of three. Given that group A's hospital stay was marginally shorter, preoperative antibiotic prophylaxis may have facilitated a quicker recovery and release from the hospital. Still, the difference in length of stay between the groups is not statistically significant, indicating that other factors may also influence the duration of hospitalization. In conclusion, these results demonstrate that preoperative antibiotic prophylaxis is associated with favorable outcomes in terms of SSIs and wound complications. These findings suggest that the administration of antibiotics before surgery may be beneficial in reducing postoperative complications. However, further analysis and statistical tests are necessary to establish a causal relationship and determine the optimal antibiotic regimen for specific surgical procedures (Table 2).

Table 2: Surgical procedures and postoperative outcomes

Surgical procedures	Group A (Antibiotics)	Group B (No Antibiotics)
Number of Procedures	600	600
Appendectomy	100	90
Cholecystectomy	150	140
Hernia Repair	200	180
Bowel Resection	150	150
Duration of Surgery (Mean±SD)	90±20	88±18
SSIs	40 (8%)	70 (14%)
Wound Complications	30 (6%)	50 (10%)
Hospital Length of Stay	7±2	8±3

Effect of preoperative antibiotic prophylaxis on SSIs and wound complications: A comparative analysis

Comparing the incidence of SSIs and wound complications between group A (antibiotics) and group B (no antibiotics) for various surgical procedures was the aim of this investigation. (Table 3) provides a detailed comparison of the number of cases with SSIs and wound complications, along with the calculated relative risk and corresponding 95% confidence intervals (CI).

In the case of appendectomies, group A saw 10 (10%) cases of SSIs compared with 20 (22%) cases in group B. This resulted in a relative risk of 0.45 (95% CI: 0.25–0.80) for group A versus group B, significantly lowering the SSI risk for group A. For cholecystectomies, SSI occurrences were 15 (10%) cases in group A against 25 (18%) cases in group B, leading to a relative risk of 0.55 (95% CI: 0.34–0.89) for group A, thereby significantly reducing SSI risk. In hernia repairs, SSIs developed in 10 (5%) cases in group A and 30 (17%) cases in group B. The relative risk for group A was 0.29 (95% CI: 0.16–0.53), significantly lowering the SSI risk. Bowel resections had 5 (3%) cases of SSIs in group A compared with 15 (10%) cases in group B, with a relative risk of 0.29 (95% CI: 0.11–0.76) for group A, significantly reducing the risk of SSIs. Across all types of surgeries, group A had a total of 40 (8%) cases of SSIs, while group B had 70 (14%) cases. The overall relative risk for group A compared with group B was 0.57 (95% CI: 0.41–0.78), indicating a significantly lower risk of SSIs in group A.

These findings underscore the beneficial impact of preoperative antibiotic prophylaxis in reducing the risk of SSIs and wound complications across a range of surgical procedures. The consistently lower rates of infections in group A compared with group B, highlighted by the significant variation in relative risk, bolster the case for employing preoperative antibiotic prophylaxis. This approach emerges as a vital strategy to improve patient safety and decrease postoperative complications, particularly concerning SSIs and wound problems, as evidenced by the data in (Table 3).

Table 3: Comparison of surgical site infections and wound complications by surgical procedure

Surgical procedure	Group A (Antibiotics) [*n* (%)]	Group B (No Antibiotics) [*n* (%)]	Relative risk (95% CI)
Appendectomy	10 (10)	20 (22)	0.45 (0.25–0.80)
Cholecystectomy	15 (10)	25 (18)	0.55 (0.34–0.89)
Hernia Repair	10 (5)	30 (17)	0.29 (0.16–0.53)
Bowel Resection	5 (3)	15 (10)	0.29 (0.11–0.76)
Overall	40 (8)	70 (14)	0.57 (0.41–0.78)

Preoperative antibiotic prophylaxis and hospital stay: Impact on recovery time

To investigate the influence of preoperative antibiotic prophylaxis on the mean length of hospital stay for various surgical procedures. (Table 4) offers a detailed comparison of the average stay lengths in group A (Antibiotics) versus group B (No Antibiotics) across various surgeries, including the standard deviations. For appendectomies, group A patients had an average hospital stay of 6±1 days, while group B patients experienced a slightly longer average stay of 7±2 days, giving an overall average stay of 6.5±1.5 days. In case of cholecystectomies, those who received antibiotics prophylactically (group A) recorded an average stay of 7±2 days, in contrast to the 8±3 days for group B, resulting in an overall average of 7.5±2.5 days. Moreover, for hernia repairs, the average stay was 7±2 days for patients in group A, against 9±3 days for those in group B, with the combined average length of stay reaching 8±2.5 days.

In the context of bowel resection, patients receiving preoperative antibiotics (group A) reported an average hospital stay of 7±2 days, compared with an 8±3 days stay for those not receiving antibiotics (group B), with the overall average stay calculated as 7.5±2.5 days. Looking at the broader dataset across all surgeries, the average stay for group A was 7±2 days, while group B's average was slightly higher at 8±3 days, leading to a combined average duration of 7.5±2.5 days for both groups. Despite not reaching statistical significance, there was a consistent trend showing a shorter average stay for patients in the antibiotic prophylaxis group (group A) across most surgical procedures when compared with those in the nonantibiotic group (group B). This trend suggests that preoperative antibiotic prophylaxis may contribute to faster recovery and potentially reduce hospital stay lengths. Nonetheless, when considering the overall impact of antibiotics on the duration of hospital stays, it is important to factor in surgical complexity and individual patient conditions. Further research is necessary to explore these relationships more comprehensively, as indicated in (Table 4).

Table 4: Comparison of mean length of stay (Days) by surgical procedure

Surgical procedure	Group A (Antibiotics)	Group B (No Antibiotics)	Mean length of stay (Days)
Appendectomy	6±1	7±2	6.5±1.5
Cholecystectomy	7±2	8±3	7.5±2.5
Hernia Repair	7±2	9±3	8±2.5
Bowel Resection	7±2	8±3	7.5±2.5
Overall	7±2	8±3	7.5±2.5

The table shows the mean length of stay (days) for different surgical procedures in two groups: group A, which received antibiotics, and group B, which did not receive antibiotics. The mean length of stay is given as the average value ± the standard deviation.

DISCUSSION

This research evaluated the impact of administering prophylactic antibiotics before surgery on the outcomes of 1,000 general surgery patients. The study provides valuable insights into the efficacy of antibiotics in enhancing surgical recovery. The initial comparison of demographic and health characteristics, as illustrated in (Table 1), shows uniformity between patients who received antibiotics and those who did not, ensuring that the outcome analysis is based on comparable and valid groups. Additionally, (Table 2) compares the types of surgeries performed and their related morbidity outcomes between the two groups, revealing that the use of antibiotics before surgery was significantly associated with a reduction in SSIs and wound issues across the board. This highlights the protective advantages of antibiotics against infection-related complications in surgery. The further breakdown of SSIs and wound issues by type of surgery in (Table 3) shows a consistently lower risk in patients who received antibiotics, underlining the effectiveness of preoperative antibiotics in minimizing postoperative infections across various surgical fields. Moreover, Table 4 details the average hospital stay lengths by surgical procedure, showing a trend towards quicker recovery times in the antibiotic group, although this difference was not statistically significant. This points to a potential positive effect of antibiotics on improving recovery outcomes. The study acknowledges limitations, such as not fully considering the nuances of surgical complexity and the variety of patient health factors that can influence recovery apart from antibiotic use. Future research that adjusts for these aspects could further clarify these findings. In summary, the results underscore the importance of preoperative antibiotic prophylaxis in reducing the incidence of postoperative infections, thereby facilitating improved surgical recovery and possibly shorter hospital stays.

CONCLUSION

In summary, this study conclusively indicates that administering antibiotics before surgery significantly enhances the outcomes and recovery process of surgical interventions. Ensuring similar demographic and health characteristics between the groups receiving antibiotics and those who did not ensure accurate comparisons. The findings reveal that pre-surgery antibiotics considerably reduce the rate of SSIs and wound complications across various types of surgeries, highlighting the effectiveness of preventive antibiotic use. The consistent decrease in infection risk ratios across the board emphasizes the protective benefits of such measures. Additionally, there was an observable trend towards shorter hospital stays for patients who received antibiotics, suggesting a possible acceleration in the recovery process.

Preoperative antibiotic prophylaxis plays a crucial role in diminishing post-surgery complications and facilitates quicker healing, endorsing its use to prevent infection-related delays. Although future studies should take into account the complexities of surgeries and diverse patient health backgrounds, the current evidence strongly supports the routine use of antibiotics before operations to lessen complications and shorten recovery durations. Establishing standardized protocols for administering preoperative antibiotics is pivotal for increasing patient safety and efficiency in healthcare provision. Ultimately, the prudent application of antibiotics, guided by principles of antimicrobial stewardship, is recommended to enhance postoperative recovery, with further research needed to refine these approaches for optimal outcomes.

CONFLICT OF INTEREST

There are no conflicts of interest.

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