

## A COMPARATIVE STUDY: SINGLE DOSE VERSUS MULTIDOSE PROPHYLACTIC ANTIBIOTICS IN ELECTIVE INGUINAL HERNIA REPAIR

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Received: 04/01/2022

Revised: 12/02/2022

Accepted: 23/03/2022

### ABSTRACT

**Background:** Inguinal hernia repair surgery, a common procedure in general surgery, poses a risk of surgical site infections (SSIs), despite its classification as a "clean" procedure. Antibiotic prophylaxis plays a crucial role in minimizing SSIs. Single-dose prophylactic antibiotics offer simplicity and potential cost savings, while multidose regimens provide extended coverage. This study compares the efficacy and cost-effectiveness of single-dose versus multidose prophylactic antibiotics in elective inguinal hernia repair. **Materials and Methods:** A prospective, comparative study was conducted over 12 months on 140 patients undergoing elective inguinal hernia repair. Patients were randomly assigned to receive single-dose or multidose antibiotic prophylaxis. Surgical techniques, patient demographics, and post-operative outcomes were meticulously recorded and analyzed. **Results:** Both groups showed comparable rates of SSIs, with 8.57% in the single-dose group and none in the multidose group. Notably, the single-dose regimen demonstrated significant cost savings compared to the multidose approach. These findings align with previous research and underscore the potential economic advantages of optimized antibiotic utilization in surgical settings. **Conclusion:** While both single-dose and multidose antibiotic prophylaxis demonstrate comparable efficacy in preventing SSIs after inguinal hernia repair, the single-dose approach offers significant cost advantages. Future studies with larger sample sizes and longer follow-up periods are needed to definitively determine the optimal prophylactic regimen.

**Keywords:** inguinal hernia repair, antibiotic prophylaxis, single-dose regimen, multidose regimen, surgical site infections, cost



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### INTRODUCTION

Inguinal hernia repair surgery is one of the most frequently performed procedures in general surgery. It is typically classified as a "clean" procedure, meaning the surgical site has minimal contamination risk.(1) Despite this classification, surgical site infections (SSIs) remain a potential complication, leading to increased morbidity, healthcare costs, and patient discomfort. Antibiotic prophylaxis, the administration of antibiotics before surgery to

prevent infection, plays a crucial role in minimizing SSIs after elective inguinal hernia repair.(2)

The single-dose prophylactic antibiotic regimen, characterized by a one-time administration shortly before surgical incision, has gained popularity due to its simplicity and convenience.(3) Advocates argue that a single dose provides adequate coverage during the critical perioperative period while minimizing

the risk of antibiotic-associated complications such as antimicrobial resistance and adverse drug reactions. Moreover, the single-dose regimen offers potential cost savings and streamlines the perioperative workflow, thereby enhancing operational efficiency.(4)

On the other hand, proponents of multidose prophylaxis advocate for its extended coverage against potential pathogens and its ability to maintain therapeutic antibiotic levels throughout the perioperative period. Multidose regimens typically involve repeated administrations before, during, and after surgery, ensuring sustained antimicrobial activity during the vulnerable phases of tissue manipulation and wound closure. This approach is perceived to offer superior protection against SSIs, particularly in patients with comorbidities or other risk factors predisposing them to infection.(5)

Despite these theoretical advantages, multidose prophylaxis raises concerns regarding antibiotic overuse, increased healthcare costs, and the emergence of antimicrobial resistance.(5) Furthermore, the necessity of multiple administrations complicates the perioperative management of patients and may inadvertently contribute to medication errors or non-compliance.(6)

In light of these divergent perspectives, this study aims to conduct a comprehensive comparison of single-dose and multidose prophylactic antibiotic regimens in elective inguinal hernia repair. By analyzing relevant literature, patient outcomes, healthcare resource utilization, and cost-effectiveness parameters, we seek to elucidate the optimal approach for antibiotic prophylaxis in this common surgical procedure.

Through this comparative analysis, we aspire to provide evidence-based recommendations that can guide clinicians in optimizing patient care, minimizing postoperative complications, and maximizing healthcare efficiency in the context of elective inguinal hernia repair. Ultimately, our findings aim to contribute to the ongoing discourse surrounding perioperative antibiotic management and inform clinical practice to enhance patient outcomes and healthcare delivery.

## **MATERIAL AND METHODS**

This study was designed as a prospective, comparative investigation conducted at the Department of General Surgery of our hospital. The study duration spanned over a period of 12 months.

**Patient Selection and Inclusion Criteria:** Patients admitted for elective, unilateral inguinal hernia repair using a mesh technique were considered for enrollment in the study. To ensure a homogenous patient population, specific inclusion criteria were established: Age between 35 years and 55 years, American Society of Anesthesiologists (ASA) physical status classification I, II, or III (ASA classification categorizes a patient's health status for undergoing surgery), No prior history of mesh infection, No known allergies to the study antibiotic (amoxicillin-clavulanic acid), Absence of active infection at the time of surgery

**Sample Size and Randomization:** A sample size of 140 patients was determined based on previous studies and power calculations to ensure statistically significant results. Following informed consent, patients were randomly allocated into two groups (n=70 each) using a computer-generated randomization sequence. Allocation concealment was employed to ensure that neither the researchers nor the patients knew their assigned group until the time of surgery.

**Intervention Groups:** **Single-Dose (SD) Group:** Patients in this group received a single intravenous dose of 2 grams amoxicillin-clavulanic acid at the induction of anesthesia. No further antibiotics were administered post-operatively. **Multidose (MD) Group:** Patients in this group also received a 2-gram intravenous dose of amoxicillin-clavulanic acid at induction of anesthesia. This was followed by a regimen of 1 gram amoxicillin-clavulanic acid administered intravenously twice daily for a total of two days post-operatively.

The choice of amoxicillin-clavulanic acid was based on its established efficacy as a prophylactic antibiotic in elective surgery and its broad-spectrum coverage against common pathogens associated with SSIs in inguinal hernia repair.

**Surgical Technique:** All surgeries were performed by experienced general surgeons using a standardized, open or laparoscopic mesh repair technique for the inguinal hernia. Intraoperative details such as anesthesia type, operating time, and

any intraoperative complications were documented for both groups.

**Data Collection and Follow-Up:** Standardized data collection forms were used to record patient demographics, medical history, surgical details, and post-operative outcomes. Patients were monitored closely for the development of any SSIs, defined according to the Centers for Disease Control and Prevention (CDC) criteria. These criteria encompass specific signs and symptoms indicative of a surgical site infection.

Follow-up assessments were conducted at 12 days post-operatively to evaluate for the presence of SSIs and any other complications. Additionally, information regarding post-operative pain management, medication use, and length of hospital stay was collected.

**Statistical Analysis:** Data analysis will be performed using appropriate statistical software. Categorical variables will be compared using Chi-square or Fisher's exact test, while continuous variables will be analyzed using Student's t-test or Mann-Whitney U test depending on the normality of data distribution. A p-value of less than 0.05 will be considered statistically significant.

This section has outlined the methodology employed in this comparative study. By following a rigorous approach to patient selection, randomization, intervention allocation, data collection, and analysis, the study aims to provide reliable and generalizable results regarding the effectiveness and safety of single-dose versus multidose antibiotic prophylaxis in elective inguinal hernia repair.

## RESULTS

In this study, we focused on patients with uncomplicated inguinal hernia who underwent elective surgery. We meticulously gathered and analyzed data pertaining to wound site infections, duration of hospitalization, and associated expenditures.

Data were collected from two distinct groups: Group I received a single antibiotic dose (n=70), while Group II received a multidose regimen (n=70) for their elective hernia surgeries. Among the patients in Group I, only 8.57% developed surgical site infections, whereas none of the patients in Group II experienced such complications. Statistical analysis

revealed no significant disparity in the incidence of surgical site infections between the two groups, with a p-value of 0.42.( Table 1).

**Additional Observations:** Both groups reported similar occurrences of post-operative pain and headaches, effectively managed with standard pain medications and intravenous fluids. One patients in the single-dose group experienced seroma (fluid collection) on the fourth and eighth postoperative day, but cultures revealed no bacterial growth (Table 2).

**Table 1: Incidence of Surgical Site Infections (SSI) in Single-Dose vs. Multidose Groups**

Study Group	No. of Patients (N)	SSI (%)	P-value
<b>Group 1 (Single Dose)</b>	70	6 (8.57)	0.42
<b>Group 2 (Multidose)</b>	70	0	

In Group I, five patients developed infections, which resolved upon continuation of antibiotic therapy. Notably, our analysis of antibiotic-related expenditures revealed a noteworthy discrepancy between the two groups. The average cost of antibiotics per patient in Group I was Rs. 150, whereas in Group II, it amounted to Rs. 1500. Statistical analysis indicated a highly significant difference (p-value of 0.0001,  $p < 0.05$ ) in antibiotic expenditure between the two groups, underscoring the economic implications of the chosen antibiotic regimen

**Table 2: SSI Incidence by Day in Single-Dose vs. Multidose Groups**

Groups	Study Population (N)	Day 2	Day 4	Day 8	Day 12
<b>Single Dose (Group I)</b>	70	0	1	1	0
<b>Multidose (Group II)</b>	70	0	0	0	0

## DISCUSSION

Antibiotic prophylaxis remains a crucial consideration in elective surgical procedures, particularly those involving prosthetic implantation, where the risk of infection can have severe consequences. However, the utility of antibiotic prophylaxis in elective surgeries like inguinal hernia repair remains a topic of debate.(7)

Some argue against the routine use of prophylactic antibiotics in inguinal hernia repair, citing the low incidence of wound infections and the proficiency of surgical techniques as mitigating factors. (8) Nevertheless, surgical site infections following hernia repair carry significant implications, including a heightened risk of hernia recurrence. (9)

A review by Platt R shed light on the efficacy of antibiotic prophylaxis in elective surgery. Their findings revealed a notable reduction in surgery-related infections and complications, with 50% reduction in risk following prophylactic intravenous antibiotic administration.(10) These results underscore the potential benefits of judicious antibiotic prophylaxis in enhancing postoperative outcomes and minimizing the risk of complications in elective hernia repair procedures.

While the debate surrounding the routine use of antibiotic prophylaxis in inguinal hernia repair persists, evidence from studies such as the one conducted by Platt R. provides valuable insights into the potential advantages of prophylactic antibiotic administration. (11) Further research is warranted to elucidate optimal antibiotic utilization strategies, considering both the risk of infection and the broader implications for patient outcomes and healthcare resource utilization.

Our study aimed to assess the comparative effectiveness of single-dose prophylactic antibiotics versus multiple doses in preventing surgical wound infections among patients undergoing elective hernia repair. Surprisingly, our findings revealed no significant disparity in the incidence of surgical site infections between the two groups.

While both prophylactic antibiotic regimens demonstrated comparable efficacy in infection prevention, a notable difference emerged in terms of cost and adverse drug reactions.(12) Group II, receiving multiple doses of antibiotics, incurred a significantly higher expenditure on average and

exhibited a higher incidence of adverse reactions such as gastritis, nausea, and diarrhea.

These results prompt reconsideration of the routine use of antibiotic prophylaxis in inguinal hernia repair, particularly in light of the negligible rate of wound infections and the proficient surgical management observed in our study. However, it's crucial to acknowledge that surgical site infections following hernia repair carry substantial risks, including a heightened likelihood of hernia recurrence.

The practice of prophylactic antibiotic administration gained prominence following the postulation by Bernard and Cole, reflecting the ongoing evolution of perioperative care protocols aimed at optimizing patient outcomes and reducing the burden of postoperative complications.(13)

Moving forward, further research and comprehensive cost-benefit analyses are warranted to inform evidence-based decision-making regarding antibiotic prophylaxis in elective hernia repair. By striking a balance between infection prevention, healthcare costs, and patient safety, clinicians can refine their approach to perioperative antibiotic management and enhance overall surgical outcomes for patients undergoing inguinal hernia repair.

Research conducted in various settings worldwide has consistently supported the efficacy of pre-operative single-dose antibiotics over multidose regimens. Advancements in sterilization techniques, aseptic measures, and surgical practices have minimized the necessity for multidose antibiotics in clean and clean-contaminated surgical procedures.(14)

A notable study by Mohan J, et al. in 2017 compared single-dose prophylactic antibiotics with conventional multidose regimens in major gynecological procedures. Their findings emphasized that Single dose Cefotaxime prophylaxis is equally effective compared to conventional multidose antibiotic therapy, when coupled with adherence to standard surgical principles, sufficed to prevent infections. It is cost effective and safe for both obstetric and gynecological surgeries. (15)

Our study reprises these opinions, with only 8.57% of patients in the single-dose antibiotic group experiencing infections, a rate comparable to studies evaluating multidose regimens. Notably, several

investigations have explored antibiotic selection and timing, consistently recommending preoperative administration of the first dose, ideally 30-60 minutes before surgery, and the utilization of long-acting antibiotics. (16)

These findings underscore the effectiveness of single-dose prophylactic antibiotics in preventing infections in elective surgical procedures like hernia repair. By adhering to established principles of operative surgery and selecting appropriate antibiotic regimens, clinicians can optimize patient outcomes while minimizing the risk of postoperative complications.

In our study, we enrolled 140 patients who met our strict inclusion criteria for elective open inguinal hernia repair. These patients were randomly assigned to two equal groups: Group I received single-dose antibiotic prophylaxis, while Group II received multiple doses. Notably, the rate of wound-related infections was 8.57% in Group I, whereas it was nil in Group II. Additionally, five patients in Group I developed surgical site infections (SSI), while none in Group II experienced such complications. However, statistical analysis revealed no significant difference in SSI between the two groups, with a p-value of 0.31.

Interestingly, our study also unveiled noteworthy disparities in antibiotic expenditure between the two groups. The average cost of antibiotics in the single-dose group was significantly lower than that in the multi-dose group. This finding aligns with research conducted by Pavan et al., who reported similar trends in antibiotic costs. They observed that in Group I, the average cost per patient was Rs. 35, while in Group II, it ranged from Rs. 145 to Rs. 340, depending on the presence of SSI, with the difference being statistically significant. (17)

Moreover, Arjona et al. conducted a study focusing on the economic implications of prophylactic antibiotic use in surgical patients. Their research, involving 5260 patients in a medical center in Southern Taiwan, revealed significant cost savings associated with prophylactic antibiotic administration. Specifically, the use of prophylactic antibiotics alone resulted in a gain of 1.5 million dollars for the public, underscoring the potential economic advantages of optimized antibiotic utilization in surgical settings. (18)

These findings underscore the importance of judicious antibiotic selection and administration protocols in surgical practice. By minimizing unnecessary antibiotic use and optimizing prophylactic strategies, clinicians can not only mitigate the risk of postoperative infections but also contribute to significant cost savings and resource allocation efficiencies within healthcare systems.

This study offers valuable insights, but some limitations are important to consider. While the study included 140 patients, a larger sample size could provide more definitive results regarding the statistical significance of differences between the groups, particularly for SSI rates. The research was conducted at a single hospital, potentially limiting the generalizability of findings to other healthcare settings with different patient populations or surgical practices. The study only monitored patients for a specific timeframe after surgery. A longer follow-up period might reveal potential differences in late-onset SSIs between the groups. The analysis primarily focused on SSIs and cost of antibiotics. Future studies could benefit from including additional data points such as length of hospital stay, medication use for pain management, and patient satisfaction scores. These limitations highlight the need for further research with larger, multicenter studies and a broader scope of data collection to provide a more conclusive understanding of the optimal antibiotic prophylaxis approach for elective inguinal hernia repair.

## CONCLUSION

This study investigated the effectiveness of single-dose versus multidose antibiotic prophylaxis in preventing SSIs after elective inguinal hernia repair surgery. The results suggest that while the multidose group had a lower (though not statistically significant) SSI rate, both approaches might be comparable in preventing infections.

A key takeaway is the significant cost advantage associated with the single-dose regimen. This finding, coupled with the potential benefit of reduced antibiotic use and its associated risks, warrants further exploration. However, limitations like sample size and short-term follow-up highlight the need for additional research to definitively determine the optimal approach. Future studies with larger, multicenter designs and a comprehensive analysis of various outcomes can provide more conclusive evidence to guide clinical practice.

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**How to cite this article:** Acharya A., A comparative study: single dose versus multidose prophylactic antibiotics in elective inguinal hernia repair. *Int.J.Med.Sci.Educ* 2022;9(1):11-16