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Comparative Efficacy of Single-Dose versus Multiple-Dose Antibiotic Prophylaxis in Reducing Postoperative Infections in Elective Cesarean Deliveries

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ABSTRACT

Cesarean Sections (CS) were common surgeries that may lead to complications like endometritis and Surgical Site Infections (SSIs). While prophylactic antibiotics reduce these risks, the ideal dosing regimen remains debated. **Objective:** To evaluates whether a single or multiple-dose antibiotic regimen offers better protection against infections in patients undergoing planned cesarean sections. **Methods:** A six-month quasi-experimental study was conducted from October 1, 2020, to March 30, 2021, at Lady Reading Hospital in Peshawar. Eighty-two women scheduled for elective CS were assigned into two groups: one received a single 1g dose of intravenous cefazolin before surgery, and the other received the same initial dose followed by two additional doses every eight hours. Primary outcomes assessed were the incidence of endometritis and SSIs within 30 days post-surgery. **Results:** Postpartum infections were significantly lower in the multiple-dose group (4.9%) compared to the single-dose group (19.5%, p = 0.039). The multiple-dose group also had fewer SSIs (4.9% vs. 14.6%, p = 0.140) and no cases of endometritis (0% vs. 4.9%, p = 0.154), though these differences were not statistically significant. There were no significant differences in adverse drug reactions, hospital stay duration, or antibiotic resistance development between the groups. **Conclusions:** Multiple-dose antibiotic regimens may reduce infection rates in planned CS without increasing adverse effects or antibiotic resistance. Further studies were needed to confirm these findings and optimize prophylactic strategies.

INTRODUCTION

With a major share of all deliveries, Cesarean Sections (CS) are among the most often carried out surgical operations globally. Though it is somewhat common, cesarean birth has some hazards, especially in relation to postoperative infections [1]. Among the most important problems linked to cesarean births are Surgical Site Infections (SSIs) and endometritis, which raise mother morbidity, extend hospital stays, drive greater healthcare expenditures, and, in some cases, result in major long-term health implications [2]. Thus, a major emphasis in obstetric treatment is on preventing these infections. The main intervention in lowering the risk of postoperative infections in women undergoing cesarean sections is antibiotic prophylaxis [3]. Given before surgery, antibiotics are supposed to reduce the number of germs introduced during operation, therefore lowering the risk of endometritis and SSIs. Still under inquiry and discussion, however, is the ideal antibiotic prophylactic schedule especially in terms of dosage count [4]. Antibiotics given single doses before to surgery were the accepted method of treatment for infections historically. This method is based on the theory that maintaining the appropriate level

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of antibiotics in the body during the most probable period for an infection to develop usually during surgery and for a few hours following is sufficient to prevent infections from starting [5]. Because they are less likely to produce antibiotic resistance, simpler to administer, and less expensive, single dose preventive medications are superior. Conversely, new research indicates that delivering multiple doses of antibiotics over an extended period of time might help prevent endometritis and SSIs even more [6-8]. This lengthier schedule is required to provide continuous antibiotic therapy throughout the period after surgery. After the initial dosage loses part of its efficacy, this may help cure infections that can develop thereafter. Those who are overweight, diabetic, or have another illness that increases their susceptibility to infections might find this method particularly beneficial. Furthermore, some data point to multiple-dose strategies perhaps being more effective in preventing diseases brought on by less sensitive single-dose preventative bacteria [9-11]. The purpose of this research is to ascertain if it is safe and effective for women having planned cesarean sections to receive a single dose of antibiotic prophylaxis. The incidence of endometritis and SSIs were compared between the single and multiple-dose groups, and secondary outcomes such hospital stays, side effects, and antibiotic resistance were also examined.

The aim was to provide insightful information to help doctors manage pre- and post-cesarean care. To more effectively customize antibiotic usage, variables such as patient age, Body Mass Index (BMI), kind and timing of antibiotics, and pre-existing medical issues were taken into account. In order to enable a more individualized and efficient strategy to antibiotic administration in cesarean births, the results are anticipated to have an impact on clinical practice by assisting doctors in striking a balance between infection prevention and avoiding side effects and drug resistance.

METHODS

This quasi-experimental study was conducted at Lady Reading Hospital in Peshawar. The research spanned six months, from October 1, 2020, to March 30, 2021. The major objective of the trial was to determine if for women scheduled for a planned cesarean section, single or repeated doses of antibiotics were more safe and effective. Previous research showing variations in infection rates between single and multiple-dose antibiotic prophylaxis helped to determine the sample size. A minimum of 82 individuals were projected to be needed to find a clinically meaningful difference between the two groups using a significance threshold of 0.05 and a power of 0.80. For the single-dose group, this computation projected an expected infection rate of 20%; for the multiple-dose group, it projected 5% [12]. The research included 82 women booked for elective cesarean sections at Lady Reading Hospital. Simple random sampling let participants be chosen. Women between the ages of 18 and 40, who had a singleton pregnancy, and without any known antibiotics allergy were among the inclusion criteria. Women with past infections, immunocompromised states, or those who had taken antibiotics within 14 days before the cesarean delivery were excluded. One of two groups the single-dose or the multiple-dose group was allocated randomly to each participant. A computer-generated random number sequence was followed in randomizing. Thirty minutes before the surgical incision, women in the single-dose group got one gram of intravenous cefazolin. Women in the multiple-dosage group got an initial dose of intravenous cefazolin (1g) 30 minutes before the surgical incision, then extra doses every 8 hours for a total of three doses. Direct patient evaluations along with medical record reviews gathered the data. Within 30 days following the cesarean section, the main result was the frequency of postoperative infections including endometritis and Surgical Site Infections (SSIs). Additional effects included length of hospital stay, side effects from medications, and emergence of antibiotic resistance. Trained nurses and doctors oversaw postoperative surveillance. Daily during their hospital stay, patients were evaluated for symptoms of infection; they were followed up at the outpatient clinic at 7, 14, and 30 days following surgery. Every indication of an infection was recorded and handled using hospital guidelines. Endometritis was diagnosed based on clinical signs including uterine tenderness, fever, and abnormal vaginal discharge, confirmed by laboratory findings such as elevated white blood cell count and positive bacterial cultures. SPSS version 25.0 was used to examine data. The subjects' baseline features were compiled using descriptive statistics. Chi-square tests for categorical data and t-tests for Continuous variables let the two groups' incidence of postoperative infections and other outcomes were compared p-value less than 0.05 was considered statistically significant. The Lady Reading Hospital Ethics Committee authorized the research with approval vide Ref No 497/LRH/MTI. Before each subject was included into the research, informed permission was acquired from each one. Participants were guaranteed their freedom to withdraw from the research at any moment without affecting their medical treatment as well as their confidentiality of their data. Following this thorough approach, the research sought to give a thorough comparison of single vs. several doses of antibiotic prophylactic treatment in reducing postoperative infections in women having elective cesarean sections.

RESULTS

The research included 82 women in total and randomly divided them into either the single-dose or multiple-dose group 41 in each of the former categories. table 1 listed the

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individuals' baseline characteristics in general. The two groups had no appreciable variations in age, Body Mass Index (BMI), gestational age, or underlying medical problems, therefore guaranteeing comparability across groups.

Table 1: Baseline Characteristics of Participants(n=82)

Variables	Single-Dose Group Mean ± SD / N (%)	Multiple-Dose Group Mean ± SD / N (%)	p-Value
Age (Years)	29.5 ± 4.3	28.7 ± 4.8	0.487
BMI (Kg/m^2)	28.2 ± 3.5	27.9 ± 3.7	0.736
Gestational Age (Weeks)	38.1 ± 1.2	37.9 ± 1.3	0.491
Hypertension	5 (12.2%)	4 (9.8%)	0.729
Diabetes	3 (7.3%)	2 (4.9%)	0.645

Within 30 days following the cesarean section, the main result was the frequency of postoperative infections including endometritis and Surgical Site Infections (SSIs). With a p=0.039, the multiple-dose group had a far lower incidence of any postoperative infection than the single-dose group 4.9% vs. 19.5%. Although in the multiple-dose group the incidence of SSIs and endometritis separately was lower, these variations were not statistically significant (p=0.140 and p=0.154, respectively). Of the six SSIs in the single-dose group, four were superficial infections and two were deep incisional infections after further investigation. Both of the SSIs in the multiple-dose group were superficial. Among the instances of endometritis in the single-dose group, both affected women with extra risk factors including obesity and protracted labor before the cesarean surgery figure 1 provided the outcomes.

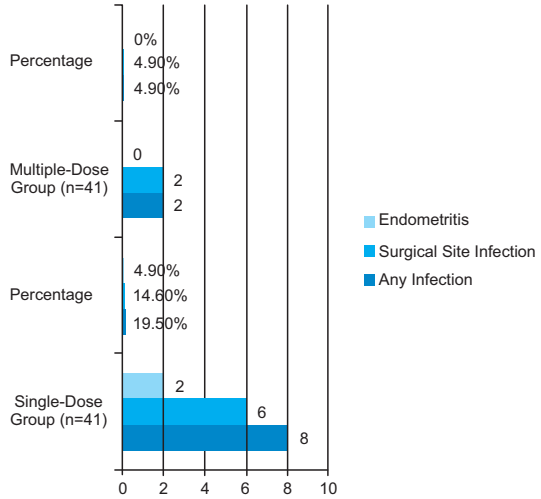

Figure 1: Incidence of Postoperative Infections

Secondary outcomes included the length of hospital stay, adverse drug reactions, and the development of antibiotic resistance. The mean length of hospital stay in the multiple-dose group was somewhat shorter than in the single-dose group (4.7 ± 1.1 days vs. 5.2 ± 1.4 days), this difference was not statistically significant (p=0.081). Especially, the most of the prolonged stays in the single-dose group were linked to SSIs, suggesting a possible therapeutic advantage from the multiple-dose schedule. The length of hospital stay was measured in days and was summarized in table 2.

Table 2: Comparison of Length of Hospital Stays In Different Dose Groups(n=82)

Length of Stay (Days)	Single-Dose Group Mean ± SD	Multiple-Dose Group Mean ± SD	p-Value
	5.2 ± 1.4	4.7 ± 1.1	0.487

With no appreciable difference between the single-dose and multiple-dose groups (p=0.645), both groups had low incidence of adverse medication responses. The most often occurring side effects were gastrointestinal ones; allergic responses came second; all of them were moderate and no antibiotic medication had to be stopped. Adverse drug reactions were monitored and were presented in figure 2.

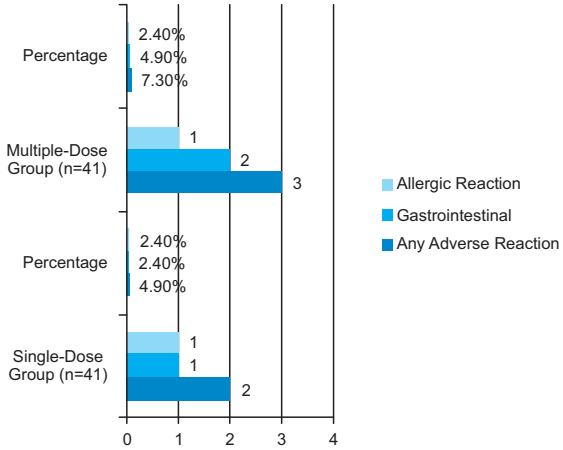

Figure 2: Adverse Drug Reactions in Different Dose Groups

The development of antibiotic resistance was assessed through culture and sensitivity tests for any isolated pathogens. In the single-dose group one instance showed evidence of antibiotic resistance; none in the multiple-dose group. Still, this variation lacked statistical significance p=0.313. The Methicillin-Resistant Staphylococcus Aureus (MRSA) found in the single-dose group underlined the need of ongoing monitoring and careful administration of antibiotics. The results were presented in figure 3.

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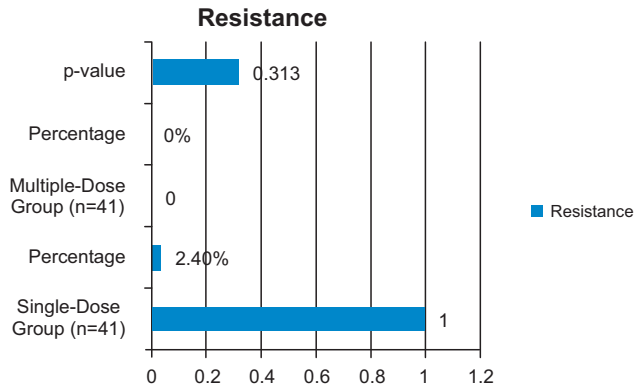

Figure 3: Antibiotic Resistance in Different Dose Groups

DISCUSSION

This study that in women undergoing elective cesarean sections, many doses of antibiotic prophylaxis were more beneficial than one dosage in lowering the general incidence of postoperative infections [13]. This result was consistent with several studies investigating the advantages of prolonged antibiotic prophylactic policies for surgical operations. Extended regimens of antibiotics, especially the addition of a secondary antibiotic to routine cephalosporin prophylactic treatments, greatly lower the frequency of post-cesarean infections compared to a single dose of cephalosporin alone, as previous studies have indicated [14]. Comparable to the declines seen in previous investigations, the drop in infection rates shown in this study (from 19.5% to 4.9%) supports the theory that extended antibiotic coverage can provide improved protection against postoperative infections [15]. Meta-analyses comparing single to multiple doses of antibiotic prophylaxis in cesarean births show that multiple doses significantly lower the incidence of endometritis and wound infections [16]. While the reduction in endometritis was not statistically significant in this sample, the decreased incidence of surgical site infections (14.6% in the single-dose group vs. 4.9% in the multiple-dose group) aligns with these findings [17]. However, concerns have been raised about the potential negative consequences and antibiotic resistance associated with multiple-dose schedules [18]. Although multiple doses may reduce infection rates, they have also been associated with an increased frequency of side effects and concerns about promoting antibiotic-resistant bacteria. In this study, there was no significant difference in adverse drug reactions between the two groups (4.9% in the single-dose group vs. 7.3% in the multiple-dose group) and no significant increase in antibiotic resistance, suggesting that the benefits of multiple-dose prophylaxis may outweigh these risks [19]. Clinically, the notable drop in general postoperative infections resulting from several doses of antibiotic prophylactic treatment has great ramifications. Adopting a multiple-dose schedule might help to improve patient outcomes and save healthcare expenditures related to treating surgical site infections and endometritis, which were the main causes of maternal morbidity [20]. Though not statistically significant, the somewhat shorter hospital stay noted in the multiple-dose group might possibly point to better recovery periods and less healthcare use. Particularly for people at increased risk of infection, including those with obesity, diabetes, or other comorbidities, these findings supported the use of multiple-dose antibiotic prophylactic programs. Existing clinical guidelines might be modified to include this strategy, therefore improving the quality of treatment for women having cesarean sections [21]. While this study provided valuable insights, it has limitations that should be acknowledged. The sample size of 82 women, though adequate for detecting differences in infection rates, may not fully capture the range of potential side effects or the long-term impact of antibiotic resistance.

CONCLUSIONS

This study shows that, compared to a single-dose schedule, many doses of antibiotic prophylaxis greatly lower the risk of postoperative infections in women undergoing elective cesarean sections. The results imply that without raising negative medication responses or antibiotic resistance, longer antibiotic coverage offers greater protection against surgical site infections and endometritis. Using multiple-dose prophylaxis in clinical settings might help to lower postoperative healthcare expenses and enhance mothers's health outcomes.

Authors Contribution

Conceptualization: A
Methodology: A, NU
Formal analysis: RZ, MS
Writing, review and editing: SG, NR, SS

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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