Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/r8y96v88

AN ANALYTICAL STUDY ON THE ROLE OF ANTIBIOTIC PROPHYLAXIS IN SURGERY: BASED ON REGULAR SURGERIES UNDERTAKEN IN A TEACHING HOSPITAL

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Abstract:
Background: The use of prophylactic antibiotics can significantly lower the likelihood of postoperative wound infections. Well-structured studies have shown that administering the correct prophylactic antibiotics in surgical procedures can reduce infection rates by approximately half compared to patients who do not receive these antibiotics.
Aims and Objectives: To assess the discretion of the Surgeons over the Hospital's antibiotic policy in evaluating and selecting the preoperative antibiotics as a prophylactic measure by the surgeons.
Methods: A prospective observational study was undertaken to analyse the decision of the surgeons on the selection of the prophylactic antibiotics and the timing of their administration in patients undergoing surgery. The outcome of preoperative antibiotics in the postoperative period in terms of wound infections, wound healing, Hospital stay and final outcomes. The collected data were compared with the hospital's established antibiotic protocol and other studies to determine how closely surgeons adhered to the guidelines.
Results: 01/32 (0**2.77**%) of the patients of the group who received antibiotics preopera**tively was infected, 02/36 (05.88**%) of the patients of the group which received antibiotics in 01 to 30 minutes were infected, 02/20 (10**.52**%) of the patients of the group who received antibiotics between 30 and 60 minutes were infected **and 01/07 (14.28%**) of the patients of the group which received antibiotics after 60 minutes was infected. There was significant statistical significance between the groups as well as the timing of the antibiotic administered. (p value was 0.001; with p significant at <0.05).
Conclusions: The study concludes that prophylactic antibiotics play a critical role in significantly reducing the incidence of postoperative wound infections. The findings support that following the ASHP guidelines leads to effective prevention of SSIs, demonstrating a rational and evidence-based approach to antibiotic use.

Key Words: Hospital Infection, Antibiotics, Preoperative, postoperative, wound infection and resistance.

INTRODUCTION: The administration of prophylactic antibiotics plays a crucial role in surgery, aiming to eliminate endogenous pathogens and prevent postoperative infections [1, 2] that may arise during the procedure. Most surgical site infections (SSIs) are observed within 30 days following an operation, typically occurring between the 5th and 10th day after surgery. However, when a prosthetic implant is involved, SSIs affecting deeper tissues can manifest months later. Although many studies rely on standardized criteria, such as those provided by the Centers for Disease Control and Prevention (CDC) or surgical site infection surveillance services [3,4], SSIs remain a significant contributor to postoperative complications, including extended hospital stays, increased healthcare costs, and higher mortality rates. Proper administration of prophylactic antibiotics prior to surgery can help reduce the likelihood of SSIs. Nevertheless, inappropriate antibiotic use continues to be a common issue in various surgical practices [5-8]. Currently, about 30–50% of antibiotics used in hospitals are for surgical prophylaxis, with between 30% and 90% of these cases being deemed inappropriate. In many instances, antibiotics are either administered at an incorrect time or are continued for an excessive duration [9]. There is ongoing debate regarding the optimal duration of prophylactic antibiotic use and which specific types of surgeries warrant this preventive measure [10]. There are established protocols for the administration of antibiotic prophylaxis in surgical procedures [11-12]. However, these guidelines are not consistently followed, particularly regarding the selection of the appropriate antibiotic and its timing of administration. This lack of adherence has contributed to the global rise in antibiotic resistance, which poses a serious public health threat, especially affecting treatment outcomes. Creating localized guidelines for prophylactic antibiotic use, tailored to specific microbial resistance patterns, can enhance the effectiveness of these preventive measures [13]. Surgeons frequently opt for broad-spectrum antibiotics before surgery, or they may use antibiotics that do not align with the recommended guidelines.

MATERIALS: Study design: A prospective analytical study was conducted after taking Institution Ethics committee approval. Study site: The study was conducted in Department of General Surgery Department and Minimal access Surgery, Andaman & Nicobar Islands Institute of Medical Sciences. Study period: The study period was between Jan 2022 and December 2023. Study subjects: The subjects were those patients attending with different surgical diseases and undergone surgery which included minor and major ad Day care procedures. Inclusion Criteria: Patients aged above 18 years and below 68 years were included. Patients of both the genders were included. Patients undergoing elective and emergency surgeries were included. Patients undergoing open and laparoscopic procedures were included. Patients with clean & Clean contaminated wound type of surgeries were only included. Patients willing to participate in the study were only included. Exclusion criteria: Patients aged below 18 years and above 70 years were excluded. Patients with co-morbidities were avoided; such as Diabetes Mellitus, Hypothyroidism and malnutrition and electrolyte imbalance. Patients with contaminated & Dirty-Infected wound type of surgeries were excluded. Ethical approval: Institution ethics committee approved the study and the proforma and consent forms were approved. Study Protocol: A total of 96 patient's undergone different surgical procedures were included in the study matching with the criteria mentioned above. Patients were assorted with the type of antibiotic used using random number obtained from the internet link: https://www.gigacalculator.com/calculators/random-number-generator.php.The surgical cases undertaken and included in the study were: Appendectomy, anal fissure Cholecystitis Hydrocele, Hernia, Total mastectomy, Thyroidectomy, Ileostomy, Circumcision, Splenectomy, Ileal perforation, Laparoscopic Appendicectomy, Tubectomy and surgery for Haemorrhoids and Parotidectomy. ASHP guidelines were followed in the selection of antibiotics used prophylactically. There were three antibiotic regimens included in the study: 1. Inj. Ceftriaxone 1 Gm IV slowly mixed with 100 mL of normal saline. 2. Inj. Amoxicillin 1 Gm and Clavulinic acid 125 mg IV given slowly mixed with 100 mL of normal saline and 3. Inj. Cefotaxime 1 Gm IV given slowly. The time of administration of the antibiotic was noted in the proforma as: 1. Pre operative dose. 2. Antibiotics at the time of incision. 3. 1 to 30 minutes after the incision 4. 30 to 60 minutes after the incision and

5. After 60 minutes after the incision. Post-operatively he same antibiotics were continued for one week in all the patients. Post-operatively the Surgical Site Infection symptoms and signs were noted: Symptoms: Pain, tightness at the site of incision, serous fluid discharge and fever. Signs: Noted were, Oedema, sutures biting the edges of the wound, Redness, indurations, tenderness and Purulent discharge from the incision site. All the Data was entered in Microsoft excel sheets. Statistical analysis: All the data was analyzed and expressed in nominal form, percentages and mean with SD. Significance was calculate using student's T-test/Z-test. Nominal categorical data between the groups was compared using chi-square test or Fisher's exact test.

RESULTS:

Among the 96 patients 66/96 (68.75%) were males and 30/96 (31.25%) were females. The male to female ratio was 2.2:1. Patients aged between 18 and 28 were 17/96 (17.70%), between 29 and 38 were 19/96 (19.79%), between 39 and 48 were 21/96 (21.87%), between 49 and 58 were 2596 (26.04%) and between 59 and 68 were 14/96 (14.58%), (Table 1) There were 44/96 (45.83%) patients belonging to low income group, 32/96 (33.33%) patients belonged to middle income group and 20/96 (20.83%) belonged to High income group. 71/96 (75%) patients were from Rural areas and 24/96 (25%) patients were from Urban areas. (Table 1) Patients with BMI less than 28Kg/M^2 were 50/96 (52.08%) and more than 28Kg/M^2 were 46/96 (47.91%), **(Table 1).** There was no significant association among the demographic data observed in the study. (p value was >0.05 for all the variables)

Table 1: Showing the Demographic data of the subjects in the stud (n-96).

Observation	Number	Percentage	P value
Gender			
Male	66	68.75	0.071
Female	36	31.25	
Age in Years			
18 to 28	17	17.70	
29 to 38	19	19.79	0.092
39 to 48	21	21.87	
49 to 58	25	26.04	
59 to 68	14	14.58	
Income group			
Low	44	45.83	0.088
Middle	32	33.33	
High	20	20.83	
Living area			
Rural	72	75	0.112
Urban	24	25	
BMI			
<28Kg/M^2	50	52.08	0.851
>28Kg/M2	46	47.91	

From the total surgeries included in this study there were 14 (14.58%) surgeries of Appendicectomy, 07 (07.29%) surgeries of Circumcision, 06 (06.25%) surgeries of Laparoscopic Appendicectomy, 02 (02.08%) surgeries of Total Thyroidectomy, 03 (03.12%) surgeries of Ileostomy, 13 (13.54%) surgeries of Hydrocele, 12 (12.5%) surgeries of Hernia repair, 06 (06.25%) surgeries of Anal fissure, 02 (02.08%) surgeries of Splenectomy, 03 (03.12%) surgeries of Ileal perforation, 08 (08.33%) surgeries of Tubectomy, 06 (06.25%) surgeries of Laparoscopic Cholecystectomy, 04 (04.16%) surgeries of Total mastectomy, 07 (07.29%) surgeries for Hemorrhoids, and 03 (03.12%) surgeries of Total Parotidectomy. (Table 2) There was no significant association between number of surgeries undertaken in the study (p value was 0.13;

>0.05), **(Table 2).**

Table 2: Showing the types of surgeries undertaken in the study (n-96)

Types of Surgery	Number	Percentage	P value
Appendectomy	14	14.58	0.113
Circumcision	07	07.29	
Laparoscopic Appendicectomy	06	06.25	
Total Thyroidectomy	02	02.08	
Ileostomy	03	03.12	
Hydrocele	13	13.54	
Hernia repair	12	12.50	
Anal fissure	06	06.25	
Splenectomy	02	02.08	
Ileal perforation	03	03.12	
Tubectomy	08	08.33	
Laparoscopic Cholecystectomy	06	06.25	
Total mastectomy	04	04.16	
Surgery for Hemorrhoids	07	07.29	
Total Parotidectomy	03	03.12	

The hospital stay for the patients with abdominal hysterectomy was 7 to 10 days, vaginal hysterectomy was 7 to 10 days, appendectomy was 3 to 9 days, hemorrhoid was 5 to 6 days, Laparoscopic Cholecystectomy was 1 to 18 days, Hydrocele patients stayed for 3 to 5 days, Hernia repair patients strayed for 5 to 9 days and Total Thyroidectomy patients stayed for 10 days. All the other minor cases stayed for 3 to 5 days.

Table number 3 showed the number of surgeries and the timing of administration of Antibiotics in the study. It was noted that there were 36/96 (37.50%) patients who were given antibiotics pre-operatively, 34/96 (35.41%) patients who were given antibiotics between 1 and 30 minutes, 19/96 (19.79%) patients who were given antibiotics between 30 and 60 minutes and 07/96 (07.29%) patients who were given antibiotics after 60 minutes. **(Table 3)** There was no significant association between number of surgeries undertaken and the timing of the antibiotic administered. (p value was 0.991; >0.05)

Table 3: Showing the timings of Antibiotics administered in the study (n-96).

Type of Surgeries	Pre-op dose	01 to 30 minutes.	30 to 60 minutes.	>60 minutes.
Appendectomy- 14	06	05	02	01
Circumcision- 07	03	02	01	01
Laparoscopic Appendicectomy- 06	02	02	01	01
Total Thyroidectomy-02	01	01	--	--
Ileostomy- 03	01	01	01	--
Hydrocele - 13	05	05	03	--
Hernia repair- 12	03	04	02	03
Anal fissure- 06	03	02	01	--
Splenectomy- 02	01	01	--	--
Ileal perforation- 03	02	01	--	--
Tubectomy- 08	03	02	02	01
Laparoscopic Cholecystectomy- 06	01	02	03	--
Total mastectomy- 04	02	02	--	--
Surgery for Hemorrhoids- 07	02	02	03	--
Total Parotidectomy- 03	01	02	--	--
Total- 96	36	34	19	07
Percentage- 100%	37.50	35.41	19.79	07.29

P value was 0.991.

01/32 (02.77%) of the patients of the group who received antibiotics preoperatively was infected, 02/36 (05.88%) of the patients of the group which received antibiotics in 01 to 30 minutes were infected, 02/20 (10.52%) of the patients of the group who received antibiotics between 30 and 60 minutes were infected and 01/07 (14.28%) of the patients of the group which received antibiotics after 60 minutes was infected. There was significant statistical significance between the groups as well as the timing of the antibiotic administered. (P value 0.001; p significant at <0.05), **(Table 4), (Fig 1).**

Table 4: Showing the number of cases infected in each group timing and their significance (n-96)

Time of administration of Antibiotics	Sample size- %	Number of cases infected	Infection rate	P value
Pre-op dose	36- 37.54	01	02.77%	0.001
01-30 minutes	34- 35.41	02	05.88%	0.001
30-60 minutes	19- 19.79	02	10.52%	0.001
>60 minutes	07- 07.29	01	14.28%	0.001

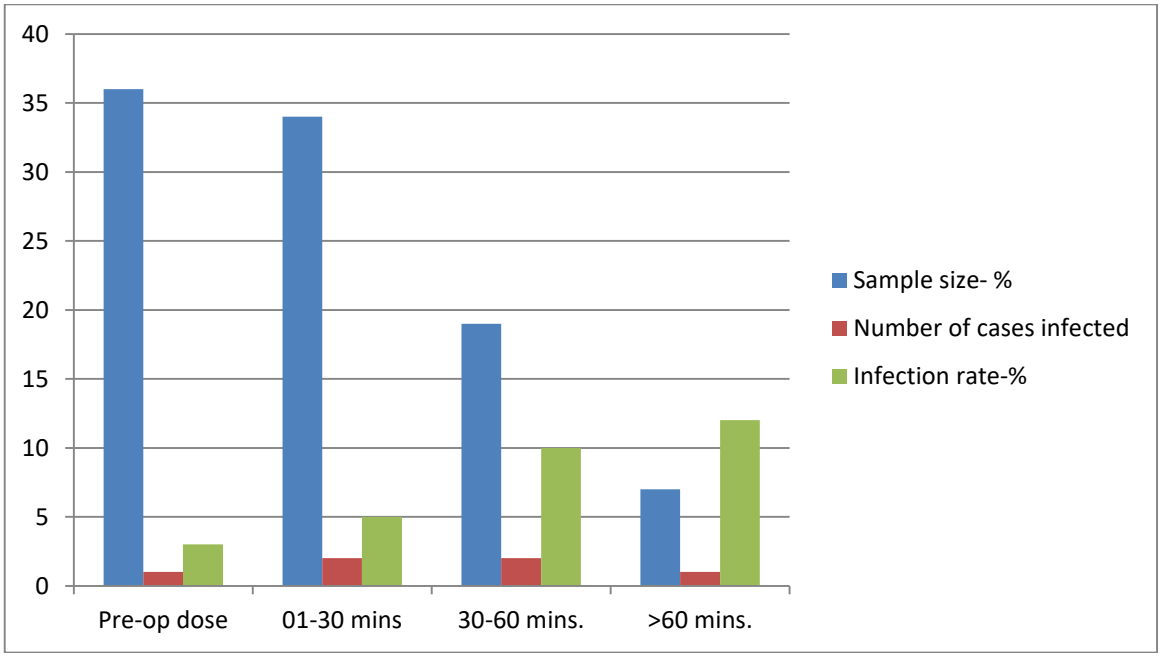

Fig 1: Showing the number of cases (percentage also) infected in each group timing and their significance (n-96)

DISCUSSION:

The present study found that the infections were lowest, at 05.0%, when antibiotics were administered either very early before surgery or within 30 minutes after the incision was made, highlighting the critical importance of timing. Delaying antibiotic administration beyond 60 minutes significantly increased infection rates to 12.5% for patients receiving the antibiotic post-incision. This finding underscores the need to adhere to specific timing protocols to maximize the protective benefits of prophylactic antibiotics. These outcomes align with guidelines regarding the duration of antibiotic effectiveness, especially during the peri-operative period by Berríos-Torres et al., 2017 (14) **Infection Rates by Surgical Procedure:** The present study examined infection rates across various surgical procedures and observed that prophylactic antibiotics are beneficial across all surgical operations undertaken in the department of General Surgery. A proper prophylactic regimen should target the most probable infecting organisms. Infections can be avoided when adequate drug concentrations are maintained in the blood and tissues during and immediately after the surgical procedure. Consequently, antibiotic prophylaxis should be initiated shortly before the operation

(within 60 minutes). Starting the regimen too early was found to be unnecessary and potentially risky, while a delayed start proved less effective [15]. A single preoperative dose was sufficient; however, if surgery is delayed or prolonged, a second dose may be needed, particularly if a short-acting antimicrobial is used. Postoperative antibiotic administration is not only unnecessary but can also be harmful. In this study, the American Society of Health-System Pharmacists (ASHP) guidelines were used as a reference. These guidelines offer healthcare practitioners a standardized approach to the appropriate, safe, and effective use of antimicrobial agents for preventing surgical-site infections (SSIs), based on the latest clinical evidence and emerging trends (15). Among the 96 patients included in this study, 66/96 (68.75%) were males and 30/96 (31.25%) were females. The male to female ratio was 2.2:1. Patients aged between 18 and 28 were 17/96 (17.70%), between 29 and 38 were 19/96 (19.79%), between 39 and 48 were 21/96 (21.87%), between 49 and 58 were 2596 (26.04%) and between 59 and 68 were 14/96 (14.58%), (Table 1) There were 44/96 (45.83%) patients belonging to low income group, 32/96 (33.33%) patients belonged to middle income group and 20/96 (20.83%) belonged to High income group. 71/96 (75%) patients were from Rural areas and 24/96 (25%) patients were from Urban areas. (Table 1) Patients with BMI less than $28Kg/M^2$ were 50/96 (52.08%) and more than $28Kg/M^2$ were 46/96 (47.91%), (Table 1). There was no significant association among the demographic data observed in the study. (p value was >0.05 for all the variables) the number of surgeries and the timing of administration of Antibiotics in the study. It was noted that there were 36/96 (37.50%) patients who were given antibiotics pre-operatively, 34/96 (35.41%) patients who were given antibiotics between 1 and 30 minutes, 19/96 (19.79%) patients who were given antibiotics between 30 and 60 minutes and 07/96 (07.29%) patients who were given antibiotics after 60 minutes. **(Table 3) The duration of hospital stay was also impacted, with an average stay of 7 to 10 days. Several factors influence the likelihood of postoperative wound infections (16, 17).** 01/32 (02.77%) of the patients of the group who received antibiotics preoperatively, was infected, 02/36 (05.88%) of the patients of the group which received antibiotics in 01 to 30 minutes were infected, 02/20 (10.52%) of the patients of the group who received antibiotics between 30 and 60 minutes were infected and 01/07 (14.28%) of the patients of the group which received antibiotics after 60 minutes was infected. There was significant statistical significance between the groups as well as the timing of the antibiotic administered. (P value 0.001; p significant at <0.05), **(Table 4), (Fig 1).** There was significant statistical significance between the groups as well as the timing of the antibiotic administered. (p value 0.001;p significant at <0.05), (Table 4), (Fig 1). **Implications for Practice:** The results of this study present several important considerations for clinical practice such as **Standardized Procedures:** Adhering closely to establish schedules, especially regarding the precise timing of medication administration, is essential for optimal outcomes. Secondly the **Focused Interventions:** Special attention should be given to high-risk groups, such as obese and diabetic patients, by implementing tailored approaches to meet their specific needs.

Education and Training: Both live and recorded training sessions can effectively address knowledge gaps, equipping healthcare professionals with the skills and strategies to apply best practices in their daily work.

CONCLUSION

The study concludes that prophylactic antibiotics play a critical role in significantly reducing the incidence of postoperative wound infections. The findings support that following the ASHP guidelines leads to effective prevention of SSIs, demonstrating a rational and evidence-based approach to antibiotic use.

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