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Antibiotic Utilization Patterns In Surgical Patients At A Tertiary Care Hospital: A Prospective Study

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Abstract
Background: *Antibiotics have significantly improved outcomes in surgical care, yet their overuse poses challenges such as antibiotic resistance and increased healthcare costs. Effective antibiotic stewardship, particularly in surgical settings, is crucial for optimizing outcomes and reducing resistance. This study aims to evaluate antibiotic utilization patterns and adherence to prophylactic guidelines at a tertiary care hospital.*
Objectives: *The primary objective was to prospectively study antibiotic utilization in surgery at a tertiary care hospital. Secondary objectives included assessing the prescribing patterns of antibiotic prophylaxis and analyzing the duration of antibiotic use.*
Methodology: *This prospective observational study was conducted in the inpatient department at Tertiary care Hospital. Data sources included inpatient case sheets, medication charts, nurse and physician notes, laboratory investigation charts, and patient interviews. Inclusion criteria encompassed all in patients undergoing surgery, while those with viral, fungal, or parasitic infections, pregnant women, outpatients, and patients not receiving antibiotics were excluded.*
Results: *The study involved 70 patients, predominantly male (74.25%), with a mean age of 50.23 years. Antibiotics were administered intravenously in 99.31% of cases, with Metronidazole (37.24%) and Piperacillin/Tazobactam (22.75%) being the most commonly prescribed. The typical duration of antibiotic therapy was 5-6 days. The chi-square test revealed no significant association between gender and antibiotic usage (p=0.690). Beta-lactams were the most frequently used class, reflecting a reliance on broad-spectrum antibiotics.*
Conclusion: *This study reveals a significant reliance on intravenous and broad-spectrum antibiotics, particularly Beta-lactams, in surgical settings at a tertiary care hospital. The predominance of antibiotics like Metronidazole and Piperacillin/Tazobactam, coupled with the typical therapy duration of 5-6 days, highlights the critical need for optimized antibiotic stewardship. The lack of a significant association between gender and antibiotic use suggests that the observed patterns are broadly applicable. Addressing these practices through targeted interventions and adherence to guidelines is essential for improving patient outcomes, reducing antibiotic resistance, and managing healthcare costs effectively. This research contributes valuable insights for refining antibiotic protocols and reinforces the global need for robust stewardship programs to sustain effective infection control and enhance overall healthcare quality.*

Keywords: *Antibiotic stewardship, surgical site infections, antibiotic prophylaxis, intravenous antibiotics, Beta-lactams, Metronidazole, Piperacillin/Tazobactam, antibiotic resistance, healthcare costs, tertiary care hospital*

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I. Introduction

Antibiotics have revolutionized medicine since Sir Alexander Fleming's discovery of penicillin in 1928, providing critical tools for treating bacterial infections and significantly improving life expectancy.[1] These drugs, which include both natural and synthetic compounds, work by targeting various bacterial processes such as cell wall synthesis and nucleic acid metabolism.[2] Despite their efficacy, the overuse and misuse of antibiotics, especially in surgical settings, present major challenges, including the rise of antibiotic resistance and increased healthcare costs.[3] Surgical site infections (SSIs), a common complication despite prophylactic use, are influenced by factors such as comorbidities, timing of antibiotic administration, and adherence to guidelines.[4] Effective antibiotic stewardship, including adherence to established prophylaxis guidelines, is crucial for mitigating resistance and optimizing healthcare outcomes.[5] While developed countries have made strides in managing resistance through stewardship programs, developing nations face significant hurdles and require tailored guidelines to address local resistance patterns and improve antibiotic use.[6] The Global Antibiotic Resistance Partnership (GARP) emphasizes the need for region-specific strategies to combat antibiotic resistance globally.[7]

II. Objectives

Primary Objective:

 Prospective study on antibiotics utilization in surgery at a tertiary care hospital.

Secondary Objectives:

 To assess the prescribing pattern of antibiotic prophylaxis.
 To analyse the duration of antibiotic usage.

III. Study Design

Study Type and Site: This was a prospective observational study conducted in the inpatient Surgery department of a tertiary care hospital.

Source of data and Materials:

 Inpatient case sheets
 Inpatient medication charts
 Nurse notes
 Physician notes
 Laboratory investigation charts
 Patient Interview

Inclusive Criteria:

All in-patients of either sex, suffering from infective illness admitted under surgery at a tertiary care hospital.

Exclusion Criteria:

 Infective diseases caused by viruses, fungi, parasites.
 Pregnant women suffering from infective illness.
 Out patients
 Patients not receiving antibiotic

Ethical considerations:

 Informed Consent: Participants were provided with detailed information about the study and were required to give written consent.
 Confidentiality: Data were anonymized and stored securely to protect participants' privacy.

Study duration: From January to October 2023

Statistical Analysis: statistical analysis was performed using IBM SPSS statistics software for windows, version 22 (Armonk, NY, USA). Data Analysis

- Descriptive Statistics: To summarize Socio-demographic characteristics of the study populations
- Inferential Statistics: The chi-square test for independence was conducted to determine if there is a significant association between gender and antibiotic usage.

IV. Results

Sociodemographic Details:

The study investigated sociodemographic characteristics and antibiotic usage patterns in a surgical setting at a tertiary care hospital, revealing that the patient population was predominantly male (74.25%), with the most common age group being 41-50 years. The mean age of the patients was approximately 50.23 years, with a standard deviation of 18.15 years, indicating a broad age distribution ranging from about 32.08 to 68.38 years. Each patient received an average of two antibiotic prescriptions, with nearly all (99.31%) administered intravenously. The most frequently prescribed antibiotics were Metronidazole and Piperacillin/Tazobactam, predominantly from the beta-lactam class. The typical duration of antibiotic therapy was 5-6 days. These findings underscore a high reliance on intravenous and broad-spectrum antibiotics, pointing to potential areas for optimization in antibiotic stewardship.

Table 1: Sociodemographic Details

Variable	Details
Total Number of Patients	70
Age Distribution (most common)	41-50 year
Mean Age (Years)	50.23
Standard Deviation	18.15

Gender Distribution	74.25% male, 25.67% female
Duration of Antibiotic Usage	5-6 days (44.13%)
Average Number of Antibiotics per Prescription	2
Most Common Class of Antibiotics	Betalactam (46.15%)
Route of Antibiotic Administration	IV (99.31%)
Commonly Prescribed Antibiotics	Metronidazole (37.24%), Piperacillin/Tazobactam (22.75%)

Usage Pattern of Antibiotics:

The table "Usage Pattern of Antibiotics" details antibiotic usage among male and female patients. The most used antibiotic is Metronidazole, accounting for 37.24% of the total, with 28.27% in males and 8.96% in females. Piperacillin/tazobactam is the second most common, at 22.75%. Beta lactams (e.g., Cefoperazone/sulbactam, Augmentin, Meropenem) are widely used, with notable contributions from each antibiotic. Aminoglycosides (Amikacin and Gentamicin) and the Quinolone Ciprofloxacin each contribute 4.82-5.51%. Linezolid, an Oxazolidinone, is the least used at 1.37%. Overall, antibiotic usage is higher in males (77.25%) than in females (22.75%).

Table 2: **Usage Pattern of Antibiotics**

Name of antibiotics	**Gender**					
	Male	%	Female	%	Total	%
Beta lactams						
Piperacillin/tazobactam	25	17.24	8	5.51	33	22.75
Cefoperazone/sulbactam	6	4.13	2	1.37	8	5.51
Augmentin	7	4.82	4	2.75	11	7.58
Meropenem	4	2.75	0	0	4	2.75
Ampicillin	2	1.37	0	0	2	1.37
Cefuroxime	5	3.44	3	2.06	8	5.51
Cefuroxime/sulbactam	1	0.68	0	0	1	0.68
Aminoglycosides						
Amikacin	7	4.82	1	0.68	8	5.51
Gentamicin	6	4.13	1	0.68	7	4.82
O						
Quinolone						
Ciprofloxacin	6	4.13	1	0.68	7	4.82
Nitroimidazole						
Metronidazole	41	28.27	13	8.96	54	37.24
Oxazolidinones						
Linezolid	2	1.37	0	0	2	1.37
Subtotal	112	77.25	33	22.75	145	100

Association between gender and antibiotic usage:

The chi-square test for independence was conducted to determine if there is a significant association between gender and antibiotic usage. The chi-square statistic was 2.248 with a p-value of 0.690, and degrees of freedom were 4. Given that the p-value is greater than the common significance level of 0.05, we fail to reject the null hypothesis. This indicates that there is no significant association between gender and the pattern of antibiotic usage among the patients in the study. The observed frequencies closely match the expected frequencies under the assumption of independence, supporting the conclusion that antibiotic usage is independent of gender in this sample.

Table 3: chi-square test

Antibiotic Class	**Observed (Male)**	**Observed (Female)**	**Expected (Male)**	**Expected (Female)**
Beta lactams	46	17	48.26	14.74
Aminoglycosides	13	2	11.49	3.51
Quinolone	6	1	5.36	1.64
Nitroimidazole	41	13	41.36	12.64
Oxazolidinones	2	0	1.53	0.47
Chi-Square Statistic (χ2\chi^2χ2)	**2.248**	**Degrees of Freedom (dof)**	**4**	**p-value 0.690**

Study of Pharmacoeconomics of antibiotics prescribed in our study population:

Pharmacoeconomics is very much important as the cost affecting the patients is known and also it encourages generic prescription in order to reduce the cost burden. In our study the cost was assessed for various antibiotic prescription where penicillin costed – 400-600 INR/day, cephalosporin costed 200-400 INR/day, nitroimidazole costed 100-200 INR/day, aminoglycosides costed 300- 400 INR/day, fluoroquinolones costed 200-

300 INR/day, carbapenem costed 300-400 INR/day, oxazolidinone costed 300-500 INR/day. The study of Pharmacoeconomics of antibiotics prescribed in our study population is presented in table 4.

Table 4: Study of Pharmacoeconomics of antibiotics prescribed in our study population.

Class of antibiotics	Name of the antibiotics	Cost of antibiotics (INR)	Frequency of prescription
Penicillin	Piperacillin/Tazobactam, Augmentin, Ampicillin	400-600	Four times and twice daily
Cephalosporin	Cefoperazone, cefuroxime, Cefoperazone/Sulbactam	200-400	Twice daily
Nitroimidazole	Metronidazole	100-200	Thrice daily
Aminoglycosides	Amikacin, gentamicin	300-400	Twice and once daily
Fluoroquinolones	Ciprofloxacin	200-300	Twice daily
Carbapenem	Meropenem	300-400	Twice and thrice daily
Oxazolidinone	Linezolid	300-500	Twice daily

V. Discussion

The study assessed antibiotic usage patterns and sociodemographic characteristics in a tertiary care hospital's surgical department, highlighting a predominantly male patient population with a mean age of 50.23 years. The findings revealed a high reliance on intravenous antibiotics, with Metronidazole and Piperacillin/Tazobactam being the most frequently prescribed, reflecting a similar trend reported by Rehan HS et al., who noted that cephalosporins were commonly used in surgical prophylaxis.[8] The broad use of Beta-lactam antibiotics, which constituted 46.15% of prescriptions, aligns with global patterns observed by Feleke M et al., who found Ceftriaxone and Gentamicin to be prevalent in paediatric settings.[9] This extensive use of broad-spectrum antibiotics, including the high percentage administered intravenously (99.31%), underscores a significant reliance on such agents for infection control, a practice also observed in other studies like that of Ashok S et al., which detailed varied gender distribution in antibiotic use. The study's pharmacoeconomic analysis highlighted the considerable costs associated with different antibiotic classes, with cephalosporins and penicillin being among the most expensive, aligning with Hatam N's findings on the high costs of prophylactic antibiotics in Iran.[10] This comprehensive use of broad-spectrum antibiotics and the associated costs emphasize the critical need for optimized antibiotic stewardship to reduce resistance and manage healthcare expenditures effectively.

VI. Conclusion

This study reveals a significant reliance on intravenous and broad-spectrum antibiotics, particularly Beta-lactams, in surgical settings at a tertiary care hospital. The predominance of antibiotics like Metronidazole and Piperacillin/Tazobactam, coupled with the typical therapy duration of 5-6 days, highlights the critical need for optimized antibiotic stewardship. The lack of a significant association between gender and antibiotic use suggests that the observed patterns are broadly applicable. Addressing these practices through targeted interventions and adherence to guidelines is essential for improving patient outcomes, reducing antibiotic resistance, and managing healthcare costs effectively. This research contributes valuable insights for refining antibiotic protocols and reinforces the global need for robust stewardship programs to sustain effective infection control and enhance overall healthcare quality.

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