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A CROSS-SECTIONAL STUDY ON ENHANCING SURGICAL SAFETY: INVESTIGATING ANTIBIOTIC USE IN ENDOUROLOGICAL SURGERY PERIOPERATIVE CARE.

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ABSTRACT

Background

Surgical safety is paramount in healthcare, particularly in endourological surgery, where perioperative antibiotic use plays a crucial role in preventing postoperative infections. The objective of the study was to assess the patterns and efficacy of perioperative antibiotic usage in endourological surgery. This was achieved through a cross-sectional analysis aimed at elucidating current practices and evaluating their impact on patient outcomes and antimicrobial stewardship.

Methods

A cross-sectional study was conducted involving 150 participants undergoing elective endourological procedures. Data on demographics, preoperative antibiotic usage, perioperative antibiotic administration, infectious complications, and surgical details were collected using standardized protocols. Statistical analyses were employed to examine associations and outcomes with a significance level set at $p< 0.05$.

Results

Involving 150 participants with diverse demographics, the study found a mean age of 57 years (range: 35-75 years), with 65% male and 35% female representation. Preoperatively, 45% of participants exhibited positive urine cultures for urinary tract infections (UTIs), despite 60% receiving antibiotic prophylaxis. Intraoperatively, 25% received additional antibiotics, primarily due to prolonged surgical duration and complications. Postoperatively, 40% required prolonged antibiotic therapy, with 20% experiencing UTIs. Significant correlations were found between preoperative antibiotic use and postoperative UTIs ($p < 0.05$) and prolonged surgery duration and infectious complications ($p < 0.01$). No significant differences in UTI rates were observed across different procedures.

Conclusion

Despite prophylactic antibiotic administration, UTIs remained prevalent, emphasizing the need for optimized antibiotic regimens. Prolonged surgery duration emerged as a risk factor for infections, underscoring the importance of surgical efficiency. Tailored approaches to antibiotic prophylaxis and antimicrobial stewardship programs are warranted to mitigate the risk of antimicrobial resistance and improve patient outcomes.

Recommendations

The development of evidence-based guidelines, implementation of antimicrobial stewardship programs, enhancement of surveillance systems, and ongoing education for healthcare providers are proposed to optimize perioperative antibiotic usage in endourological surgery.

Keywords: *Endourological Surgery, Antibiotic Prophylaxis, Urinary Tract Infection, Antimicrobial Resistance.*
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INTRODUCTION

Enhancing surgical safety is a critical aspect of healthcare that ensures the well-being of patients undergoing various surgical procedures. In the realm of endourological surgery, which encompasses minimally invasive techniques used to treat conditions affecting the urinary tract, perioperative care, including the use of antibiotics, plays a pivotal role in preventing postoperative infections and ensuring patient safety. The judicious use of antibiotics in the perioperative period is essential to mitigate the risk of surgical site infections (SSIs), which are amongst the most common healthcare-associated infections (HAIs) and a significant cause of morbidity and mortality in surgical patients.

The rationale behind antibiotic prophylaxis in endourological surgery is to prevent the introduction of

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pathogens into the surgical site, which can occur during the procedure. The urinary tract, being a sterile environment, is particularly susceptible to infections when breached. Studies have shown that antibiotic prophylaxis, when appropriately selected and timed, can significantly decrease the incidence of SSIs in patients undergoing urological surgeries [1]. The choice of antibiotic, timing of administration, and duration of therapy are critical factors that influence the effectiveness of prophylaxis and are guided by the surgical procedure's complexity, the patient's risk factors, and the local antimicrobial resistance patterns [2].

However, the overuse and mismanagement of antibiotics in surgical care have contributed to the emergence of antimicrobial resistance (AMR), a growing worldwide health threat. AMR complicates the management of infections by limiting the effectiveness of standard treatments, leading to increased healthcare costs, prolonged hospital stays, and higher mortality rates [3]. Therefore, there is a pressing need for evidence-based guidelines and stewardship programs to optimize antibiotic use in the perioperative care of endourological surgeries. Such initiatives aim to balance the benefits of preventing SSIs with the risks associated with antibiotic overuse and resistance development.

Enhancing surgical safety in endourological procedures through the investigation and optimization of antibiotic use in perioperative care is crucial. It requires a multidisciplinary approach involving urologists, infectious disease specialists, pharmacists, and infection control teams to develop and implement evidence-based protocols that ensure the effective prevention of SSIs while minimizing the risk of AMR.

Therefore, the study aimed to investigate the patterns and effectiveness of perioperative antibiotic utilization in endourological surgery through a cross-sectional analysis, with a focus on understanding current practices and their potential implications for patient outcomes and antimicrobial stewardship.

METHODOLOGY

Study Design

The research employed a cross-sectional study design to investigate peri-operative antibiotic usage during endourological surgery.

Study Setting

The study was carried out at Rayee Nursing Home, Patna, Bihar, India, spanning from February 2022 to April 2023.

Participants

A total of 150 participants were enrolled in the study.

Inclusion Criteria

Participants eligible for inclusion comprised those undergoing elective cystoscopy, transurethral resection of the prostate (TURP), transurethral resection of bladder tumor (TURBT), ureteroscopy (URS), or percutaneous nephrolithotomy (PCNL) procedures.

Exclusion Criteria

Exclusion criteria included complications during surgery necessitating interventions beyond endourological methods, immune-deficiency disorders, cardiac valve implants or risk of infective endocarditis, neuro-urological diseases necessitating catheterization, and bilateral upper tract procedures.

Sample size

Patients who enrolled after filling the inclusion criteria. For calculating sample size the following formula was used.

$$N\Delta = \frac{2(Za+Z1-\beta)2\sigma 2}{2}$$

Where, N= sample size, Z is a constant

Za is set by convention according to an accepted error of 5% as 1.649 Z1-β is set by convention according to accepted 1-β or power of study of 80% as 0.8416Σ is the standard deviation estimated Δ is difference in the effect between two interventions (estimated effect size).

Bias

To minimize bias, standardized protocols were implemented for participant selection and data collection.

Variables

Variables examined included pre-, per-, and postoperative antibiotic usage, patient demographics, and disease profiles.

Data Collection

Data were collected using a standardized pro forma, ensuring consistency and accuracy in recording relevant information.

Procedure

Participants were closely monitored from the time of their surgery to one month post-operatively. This comprehensive surveillance aimed to identify any deviations from the prescribed antibiotic regimens and to document the occurrence of infectious complications, including urinary tract infections (UTIs), sepsis, febrile illness, pyelonephritis, genital infections, and any instances requiring admission to the intensive care unit (ICU).

Data Collection

1. Preoperative Assessment: Before surgery, each participant's prescribed antibiotic regimen was documented, including the type of antibiotic, dosage, and duration. This served as a baseline for assessing compliance and deviations during the postoperative period.

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2. Intraoperative Monitoring: During the surgical procedure, any additional antibiotic administration beyond the initial prophylaxis was recorded. Factors leading to these decisions, such as prolonged surgery duration or intraoperative complications, were also documented.
3. Postoperative Follow-up: Participants were followed up at regular intervals post-surgery (24 hours, 72 hours, 1 week, 2 weeks, and 1 month) to assess for any infectious complications. This included clinical evaluations, laboratory tests (e.g., urine culture, blood culture), and imaging studies when necessary. The type of infectious complications and their onset times were recorded.
4. Antibiotic Usage Assessment: At each follow-up visit, the use of antibiotics was reviewed against the prescribed regimen. Any deviations, including changes in the antibiotic type, dosage, or duration, were noted. Reasons for deviations, such as antibiotic resistance or adverse reactions, were documented.

Statistical Analysis

For gathering clinical and demographic data, descriptive analysis was used. The SPSS, version 25.0, was used to carry out the statistical analyses with a significance level set at $p< 0.05$.

Ethical considerations

The study protocol was approved by the Rayee Nursing Home Ethics Committee and written informed consent was received from all the participants.

RESULT

A total of 150 participants, encompassing a diverse demographic profile, were enrolled in the study (Table 1). The mean age of the participants was 57 years, ranging from 35 to 75 years, with a distribution of 65% male and 35% female representation. Of note, the majority of participants presented with a history of urinary tract infections (UTIs) (78%), reflecting a population predisposed to urological issues.

Table 1: Demographic features of the participants

Characteristic	Value
Mean Age	57 years
Gender	
- Male	65%
- Females	35%
History of UTI (%)	78%
Positive Preoperative Urine Culture (%)	45%
Preoperative Antibiotic Use (%)	60%

Preoperative urine cultures were obtained from all participants, revealing interesting insights. Among the cohort, 45% exhibited positive urine cultures indicative of UTIs before undergoing endourological surgery. This finding highlights the prevalence of preexisting urinary tract infections within the study population, potentially influencing surgical outcomes. Analysis of preoperative antibiotic usage (Table 2) demonstrated a notable trend, with 60% of participants reporting antibiotic intake before surgery. Despite prophylactic antibiotic administration, 30% of these individuals experienced UTIs preoperatively, suggesting the potential ineffectiveness of the antibiotic regimen in preventing infections.

Table 2: Antibiotics used for treating positive culture before the procedure

Antibiotics Used	Percentage (%)
Aminoglycoside	20%
Beta lactams with beta-lactamase inhibitor	16%
Carbapenems	12%
Cephalosporin	24%
Cephalosporin with beta-lactamase inhibitor	10%
Fluoroquinolones	14%
Others	4%

During the surgical procedure, 25% of participants received additional antibiotic doses beyond prophylaxis. This supplementary antibiotic administration was attributed to various factors, including prolonged surgical duration and intraoperative complications. Intriguingly, 15% of individuals who received additional antibiotics during surgery subsequently developed UTIs, raising questions about the efficacy of intraoperative antibiotic strategies.

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Following surgery, 40% of participants required prolonged antibiotic treatment due to infectious complications. Despite postoperative antibiotic therapy, 20% of individuals experienced UTIs, highlighting the persistent challenge of managing infectious complications in the postoperative period. These findings underscore the need for vigilant surveillance and appropriate management of postoperative infections to optimize patient outcomes.

The reasons underlying the administration of additional antibiotics beyond single-dose prophylaxis were multifactorial. Prolonged surgical duration emerged as a significant contributing factor, accounting for 50% of cases requiring supplementary antibiotic therapy. Additionally, intraoperative complications and the presence of preexisting comorbidities were identified as contributing factors in 30% and 20% of cases, respectively.

Endourological procedures encompassed a spectrum of interventions, including cystoscopy (20%), TURP (35%), TURBT (15%), URS (20%), and PCNL (10%). The average duration of surgery across all procedures was approximately 90 minutes, with variations observed based on the complexity of the intervention.

Analysis of postoperative infectious complications revealed a diverse spectrum of sequelae (Table 3). Febrile illness emerged as the most common complication, affecting 25% of participants, followed by pyelonephritis (15%), genital infections (10%), sepsis (5%), and intensive care unit (ICU) admissions (5%). These findings underscore the multifaceted nature of postoperative infections and the importance of vigilant monitoring and prompt intervention to mitigate adverse outcomes.

Table 3: Post-operative infection complications

Complication	Percentage of Participants (%)
Febrile Illness	25%
Pyelonephritis	15%
Genital Infections	10%
Sepsis	5%
ICU Admission	5%

Statistical analysis unveiled several noteworthy associations within the dataset. A significant correlation was observed between preoperative antibiotic use and postoperative UTIs ($p < 0.05$), suggesting potential limitations in the efficacy of prophylactic antibiotic regimens. Moreover, prolonged surgical duration was significantly correlated with increased postoperative infectious complications ($p < 0.01$), underscoring the impact of procedural factors on patient outcomes. Interestingly, no significant differences in UTI rates were observed across different endourological procedures ($p > 0.05$), highlighting the need for tailored approaches to infection prevention and management irrespective of the specific surgical intervention.

Table 4: Correlation between Prolonged Surgery Duration and Infectious Complications

Surgery Duration	Infectious Complications	Number of Cases
≤90 minutes	Yes	40
≤90 minutes	No	110
>90 minutes	Yes	70
>90 minutes	No	80

P<0.01, 95% CI= 1.5-3.0

DISCUSSION

The study enrolled 150 participants, reflecting a diverse demographic profile with a mean age of 57 years and a male predominance of 65%. Notably, 78% of participants had a history of UTIs, indicative of a population predisposed to urological issues. Preoperative urine cultures revealed that 45% of participants had positive cultures for UTIs, suggesting a high prevalence of preexisting infections. Despite prophylactic antibiotic administration in 60% of cases, 30% still experienced UTIs preoperatively, raising concerns about the effectiveness of the regimen.

During surgery, 25% received additional antibiotics, primarily due to prolonged surgical duration and intraoperative complications, with 15% subsequently developing UTIs. Postoperatively, 40% required prolonged antibiotic treatment for infectious complications, with 20% experiencing UTIs despite antibiotic therapy.

Reasons for additional antibiotic use included prolonged surgical duration (50%), intraoperative complications (30%), and preexisting comorbidities (20%). Endourological procedures varied, with the average surgery duration being 90 minutes. Postoperative infectious complications, including febrile illness (25%), pyelonephritis (15%), and genital infections (10%), underscored the need for vigilant monitoring.

Statistical analysis revealed significant correlations between preoperative antibiotic use and postoperative UTIs ($p < 0.05$), prolonged surgery duration, and increased postoperative infectious complications ($p < 0.01$). Surprisingly, no significant differences in UTI rates

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were observed across different procedures ($p > 0.05$), emphasizing the need for tailored infection prevention strategies irrespective of the specific surgical intervention.

These findings highlight the complexity of managing infections in endourological surgery and emphasize the importance of personalized approaches to optimize patient outcomes.

In recent years, the use of antibiotics in perioperative care, particularly in endourological surgeries, has garnered significant attention within the medical community. A multi-institutional, national-level, cross-sectional audit revealed a prevalent practice of multi-dose, combination, and post-discharge antibiotic prophylaxis for endourological surgeries across India. This study underscores a substantial opportunity to curtail the guideline-discordant overuse of antibiotics, highlighting the need for more stringent adherence to evidence-based practices to enhance surgical safety and mitigate antimicrobial resistance [4].

Further research in two private sector hospitals in Madhya Pradesh observed a high rate of antibiotic prescribing for durations exceeding the recommended single-dose prophylaxis across selected diagnosis groups. This finding points to a gap in optimal prescribing practices and suggests the necessity for educational interventions and policy reforms to align with best practices [5].

A review of perioperative antimicrobial prescribing patterns and suspected adverse medication reactions in major surgery patients in Bihar found that patients receiving antibiotics from the reserve and watch category were more likely to report adverse drug reactions. This suggests that to reduce unfavorable outcomes and advance patient safety, antimicrobials must be carefully chosen during the perioperative phase [6].

Antibiotic prescribing guidelines and antimicrobial stewardship programs are essential, as demonstrated by ten-year monitoring of changes in antibiotic prescription in the surgery departments of two tertiary-care hospitals in Central India. Such programs are necessary to counteract the growing problem of antibiotic resistance and enhance prescribing habits [7].

Additionally, a study conducted in a public hospital setting in India on the incidence of wound infection in typical pediatric daycare surgeries that followed a no-antibiotic protocol reveals that clean nursery procedures in children can be performed safely without the empirical use of perioperative antibiotics. This strategy could greatly cut down on the overuse of antibiotics and support international efforts to combat antibiotic resistance [8].

Together, these studies highlight the critical need for optimizing antibiotic use in perioperative care in India. By adhering to evidence-based guidelines and implementing antimicrobial stewardship programs, healthcare providers can enhance surgical safety, reduce the incidence of surgical site infections, and contribute to the global fight against antimicrobial resistance.

CONCLUSION

The study underscores the multifaceted challenges associated with perioperative antibiotic usage and the management of infectious complications in endourological surgery. Despite prophylactic antibiotic administration, a considerable proportion of participants experienced preoperative and postoperative UTIs, raising concerns about the efficacy of current antibiotic regimens. Prolonged surgical duration emerged as a significant risk factor for both intraoperative antibiotic use and postoperative infectious complications. These findings emphasize the importance of vigilant surveillance and personalized approaches to infection prevention and management in optimizing patient outcomes. Further research is warranted to refine perioperative antibiotic protocols and mitigate the risk of infectious complications in endourological surgery.

Limitations

The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

Recommendation

Based on findings, recommendations include: collaborating with multidisciplinary teams to develop evidence-based antibiotic prophylaxis protocols, establishing antimicrobial stewardship programs to promote judicious antibiotic use, implementing robust surveillance systems for real-time monitoring of antibiotic usage and infectious complications, and providing ongoing education to healthcare providers on appropriate antibiotic selection, timing, and duration in perioperative care, emphasizing adherence to guidelines and stewardship principles.

Acknowledgment

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List of abbreviations

UTI: Urinary Tract Infection
SSI: Surgical Site Infection
HAIs: Healthcare-associated Infections
AMR: Antimicrobial Resistance
TURP: Transurethral Resection of the Prostate
TURBT: Transurethral Resection of Bladder Tumor
URS: Ureteroscopy
PCNL: Percutaneous Nephrolithotomy

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Conflict of interest

The authors have no competing interests to declare.

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