Ahmad et al. | Article 8032
J Pure Appl Microbiol. 2023;17(1):627-635. doi: 10.22207/JPAM.17.1.60
Received: 16 August 2022 | Accepted: 22 February 2023
Published Online: 03 March 2023

P-ISSN: 0973-7510; E-ISSN: 2581-690X

RESEARCH ARTICLE OPEN ACCESS

Protocol based Surgical Antimicrobial Prophylaxis in Endo-Urologic Surgeries: An Attempt to Convince the Surgeons to Follow the Guidelines

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Abstract

Surgical antibiotic prophylaxis (SAP) prevents infectious complications during surgery by administering an effective antimicrobial agent before surgery. There is, however, lack of adherence to the standard SAP administration protocol. We reviewed 576 surgeries and find that cefuroxime/cefazolin was used as SAP in less than 31% of surgeries followed by ceftriaxone and cefoperazone. In 61% of cases, SAP was continued for more than 24 hours and in 2/3rd more than one SAP was prescribed, we noted the best SAP compliance was for the timing of pre-operative dosage. We then selected a unit of urology and applied the recommended SAP protocol, and monitored the patient's outcome. All the surgeries were endoscopic urological procedures and our protocol was effective in 97.7% of patients. Out of 89, 78(87.6%) surgeries went uneventful, whereas 11 (12.4%) had post-operative complications. Two out of 89 (2.2%) cases had UTI post-operatively which was considered as surgical site infection. following the EAU guidelines for antibiotic prophylaxis reduced antibiotic use without increasing postoperative infection rates and SAP should be followed as per the standard guidelines in other units also. This small study is a way forward for our HICC team to motivate other surgeons to follow the guidelines and become antimicrobial stewardship champions. Our study demonstrates the feasibility of developing and successfully implementing such protocols.

Keywords: Surgical Antibiotic Prophylaxis, Surgical Site Infection, Urologic Surgical Procedures, Antimicrobial Resistance, Antibiotic Stewardship

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Citation: Ahmed M, Arsalan, Chaudhary B, Rehman A, Khan F, Sultan A. Protocol based Surgical Antimicrobial Prophylaxis in Endo-Urologic Surgeries: An Attempt to Convince the Surgeons to Follow the Guidelines. *J Pure Appl Microbiol.* 2023;17(1):627-635. doi: 10.22207/JPAM.17.1.60

INTRODUCTION

Surgical site infection (SSI) is defined as an infection occurring at the incision site or deep to it within 30 days of surgery.[1] SSI are one of the most common nosocomial infections and account for 20% of all infections occurring in hospital inpatients.[2,3] There is a 2- to 11-fold increase in mortality risk, with 75 percent of SSI-related deaths directly attributable to the SSI.[4] Out of all hospital-acquired infections mortality rate for SSI is 8%; however, mortality associated with SSI varies according to the surgical procedure.[5] Surgical antibiotic prophylaxis (SAP) prevents infectious complications during surgery by administering an effective antimicrobial agent before surgery.[1] However, lack of adherence to follow protocol for SAP is among one of the factors for irrational use.[6,7]

Bacteria that become resistant to multiple antibiotics are often the result of incorrect or prolonged antibiotic use.[8] 30% to 50% of antibiotics prescribed in hospitals are for post-surgical prophylaxis, and almost 30% to 90% of these regimens are unnecessary.[9] The Hospital Infection Control Committee's (HICC) most difficult task is to persuade surgeons to adhere to the antimicrobial prophylaxis guidelines. The majority of surgeons used antibiotics of their own choosing as prophylaxis and are unwilling to adhere to a standard procedure. Choosing a broad-spectrum antimicrobial for prophylaxis is generally taken as an alternative to infection prevention practices and to avoid taking the risk of infection transmission. Other than the choice of antibiotic, another reason for the establishment of antibiotic resistance is failure to follow surgical prophylactic protocols. These can be in the form of incorrect timing and duration of the prophylactic therapy.[6,10]

Surgical antimicrobial prophylaxis lacks sufficient information and recommendations in India; hence there is an unmet need to collect baseline data. The purpose of this study was to examine the trend in the prescription of antimicrobial prophylaxis in various surgical specialties and apply the recommended SAP in a selected unit of surgery, and observe the outcomes of patients in that unit.

MATERIALS AND METHODS

A prospective observational study was conducted in Jawaharlal Nehru medical college, Aligarh from December 2019 to March 2020, with prior approval from the institutional ethics committee. A review of the surgical prophylaxis given in various surgical specialties was done as a routine HICC activity. To convince the other surgical teams, we chose one unit i.e. the urology unit to follow the prescribed guidelines of SAP and assess the outcomes of the patients. Detailed clinical history, indication for surgery, details of the surgery performed and prophylaxis given, and the presence of co-morbidities were recorded. Patients were followed up to a period of 30 days after the surgery to assess the SSI. The research was carried out as part of our center's antibiotic stewardship program.

The European Association of Urology (EAU) guidelines for perioperative antibiotic prophylaxis strongly recommend obtaining a urine culture prior to all urological surgeries. It is recommended that patients who will be undergoing contaminated surgeries (a positive urine culture) have their bacteriuria under control prior to surgery, and they should also consider a prolonged regimen (with no specific duration in mind). The WHO guidelines[1] were used to design the protocol for antibiotic prophylaxis. Whereas the European Association of urology guidelines were also utilized.[11]

All surgical operations were divided into clean, clean-contaminated, and contaminated. According to the EAU criteria,[11] clean, clean-contaminated, and contaminated surgeries were characterized as follows:

- Clean procedures were defined as those having an uninfected surgical site, no entrance into the urogenital tract (UT), no inflammation, and no interruption in sterile technique.
- Clean contaminated procedures were defined as entry into the UT or the gastrointestinal tract (GIT) with minimal or little (managed) leakage and no interruption in sterile procedures.
- Contaminated procedures comprised leakage of substances into the UT and/or GIT, the

presence of inflammatory tissue, the presence of bacteriuria (UT), a substantial breach in sterile technique, or open, fresh accidental wounds.[11]

The following protocol as shown in Table 1 was suggested for urological surgeries. Single-dose 1.5-g intravenous cefuroxime was administered for clean and clean-contaminated surgeries that was discontinued within 24 hours after the surgery. Antibiotics were given for 48 hours for the patients with risk factors such as morbid obesity, diabetes, malnutrition, and chronic renal disease. Patients with positive urine culture were given antibiotics according to the culture report and their indwelling tubes and catheters were replaced/removed to try to sterilize the urine. They were then operated on under antibiotic cover.

This protocol was followed for all elective endourological surgeries, as well as the postoperative course and complications were recorded by following the patients up to a period of 30 days and the results were evaluated. Adherence to the prophylaxis protocol without additional antibiotic use or change and an uneventful postoperative course were both considered indicators of effectiveness.

RESULTS

As a routine protocol of HICC, 576 surgeries were reviewed over a period of three months (Figure 1). A total of 1036 antibiotic doses were given for SAP pre-operatively (Figure 1). Cefuroxime/cefazolin was used as SAP in less than 180/576 (31.3%) of the surgeries performed, of which it was used as a sole agent in only 80/576 (13.9%) cases and was used in combination with other antimicrobials in the 100/576 (17.4%). There was non-uniformity in the choice of antibiotic used for prophylaxis. Apart from cefazolin/cefuroxime, the antibiotics used for SAP were ceftriaxone 140/576 (24.3%), cefoperazone 130/576 (22.6%), metronidazole 92/576 (16%), piperacillin-tazobactam 90/576 (15.6%), cefoperazone-sulbactam 84/576 (14.6%), amoxicillin-clavulanic acid 75/576 (13%), amikacin 67 (11.6%), cefotaxime 62/576 (10.8%), ceftazidime 40/576 (6.9%) and even meropenem and vancomycin each 38/576 (6.6%). The best compliance amongst the practices regarding SAP was for the timing of pre-operative dosage, which was given within 60 min prior to surgery, except for the cases of paediatric surgery where there was a breach in dosage timings in majority i.e 45 out of 65 cases (69.2%) Table 2. However, while considering the discontinuation of SAP, compliance was very poor and the SAP was discontinued within 24 hours in only 100 (17.4%) cases Figure 2. On observing the compliance to stop the SAP within 24 hours, it was noted that only 100/576 surgeries (17.4%) discontinued SAP at 24 hours, with the obstetrics and gynaecology surgeries showing best compliance. In majority of surgeries (63.5%, 366/576) (40.1%, 231/576) antibiotic was continued upto 48-72 hours. In more than half of the surgeries audited i.e., 340/576 (59%) more than one antibiotic was used in prophylaxis, while in a few even 3 antibiotics were given as SAP 60/576 (10.4%). (Table 3)

To ensure the compliance and evaluate the challenges in following the guidelines we analysed a total of 89 (70 male & 19 female)

Table 1. Modified perioperative surgical prophylaxis protocol in urologic surgeries

Type of surgery	Surgery	Antibiotic to be given
Clean	Nephrectomy, Adrenalectomy/Varicocelectomy/other	Single dose (Inj. Cefuroxime 1.5 GMS IV)
Clean contaminated (Sterile urine culture)	TURBT/TURP/BNI/URS/PNL/RIRS/NSS/ Prostatectomy/Urethroplasty/Pyeloplasty Single dose (Inj. Cefuroxime 1.5 GMS IV)	
Contaminated	Any procedure done on positive urine culture	Pre OP sensitive antibiotics 1 day prior to surgery upto 48 hours.

TURBT = transurethral resection of bladder tumour, TURP = Transurethral resection of prostate, BNI = Bladder neck incision, PNL = Percutaneous nephrolithotomy, RIRS = Retrograde intrarenal surgery, NSS = Nephron sparing surgery

patients from a chosen unit of our hospital. The mean age of the study population was 43.64±16.45 years and 11.2% had comorbidities Table 4. The majority of surgery performed were clean-contaminated 80 (89.8%) Table 5. Five out of 89 cases (5.6%) had positive urine culture prior to surgery which was made sterile preoperatively. All the surgeries were urologic endoscopic and our protocol was effective in 97.7% of patients. Out of 89, 78(87.6%) surgeries went uneventful, whereas 11 (12.4%) had postoperative complications. Postoperative complications included erythema, blister and de-squamation of skin in 11(12.4%) cases. Two out of 89 (2.2%) cases had UTI post-operatively which was considered as surgical site infection; one of the patient underwent transurethral resection of prostate (TURP) and in other cystoscopy with biopsy was done.

DISCUSSION

It is critical to select and administered antimicrobials correctly in pre and post-surgical conditions as well as to assess and monitor the preoperative environment, which may influence the development of SSI. An antimicrobial prophylaxis's primary goal is to reduce surgical site infection (SSI) and other avoidable periprocedural infections, with the secondary goal of avoiding the use of antibiotics.[12] Despite the availability of national and international guidelines, there is hesitation among surgeons to follow these guidelines. It is a challenge for the Hospital Infection Control Unit of the Hospital to convince the surgeons to follow the prescribed guidelines. The HICC first evaluated the data of the compliance of SAP in various surgical units.

Table 2. Timing of antibiotic administration before surgery for prophylaxis

Timing of administration before surgery	Departments							
	Obstetrics and Gynecology	General Surgery	Plastic surgery	Paediatric surgery	Neuro-surgery	Ortho-paedic	ENT	CTVS
Within 60 minutes	85 (100)	130 (100)	60 (100)	20 (30.8)	48 (100)	152	30	6
Beyond 60 minutes	-	-	-	45 (69.2)	-	-	-	-

ENT= Ear Nose and Throat, CTVS= Cardiothoracic and Vascular Surgery

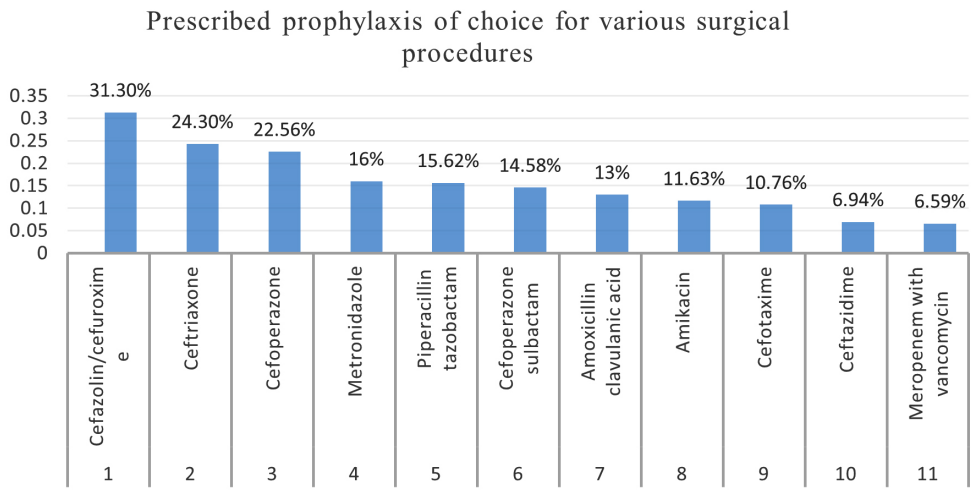

Figure 1. Prescribed prophylaxis of choice for various surgical procedures

In 180 (31.3%) cases either cefazolin or cefuroxime were prescribed alone (13.9%) or in combination (17.4%) which are the recommended prophylactic drug in all procedures (except in patients with a serious beta-lactam allergy). Similar results were seen in Hasibi F et al, study where cefuroxime was used in (31.63%) of cases.[13] Cefazolin was most commonly prescribed antibiotic (90.3%) in Hassan et al.[14] study and administered in 47.9% cases in study of Fatima et al.[15] Ampicillin were used as most frequent prescribed antibiotic (43.8%) in Bunduki et al study.[16] The goal is to administer the drug with a moderate spectrum of activity, which may target only the suspected surgical pathogens and thus curtail the development of antimicrobial resistance.[16] However, the choice of antibiotic as noted was based on the surgeon's decision. It varied from Amoxycillin-clavulanic acid to meropenem-vancomycin combination. It was observed that more the complicated the surgery was, higher the class of antibiotic chosen for the surgery, similarly, the duration of SAP was also found to be dependent upon the complexity of the surgery performed. Therefore, as seen in our study, SAP was continued even beyond 7 days in 83.3% of neurosurgery (due to complexity of surgery and the risk involved), 50% plastic surgery cases (due to the higher risk of contamination and risk of rejection of grafts due to infection) and 32.8% of orthopaedic surgery cases (higher blood loss, implants, and dirty wounds). Similar study shows that SAP was continued for more than 24 hours in 80% of surgeries.[15] Study in Pakistan also shows in 43.3% of cases SAP was continued for more than 24 hours.[17] Prophylaxis was continued for more than 48 hours in 100% of cases in study in congo.[18]

The majority 340 (59%) of the patients had prescribed two antibiotics and in 60 cases

Table 3. Number of antibiotics used as SAP in various specialities for surgery

Speciality	No. of surgeries performed	Number of antibiotics used		
		Single No. (%)	Two No.(%)	More than two. No.(%)
Obs gyne	85 (14.8)	50 (58.8)	30 (35.3)	5 (5.9)
General Surgery	130 (22.9)	90 (69.2)	30 (23.1)	10 (7.7)
Plastic surgery	60 (10.5)	10 (16.6)	50 (83.3)	-
Paediatric surgery	65 (11.4)	-	60(92.3)	5 (7.7)
Neurosurgery	48 (8.4)	-	48 (100)	-
Orthopaedic surgery	152 (26.7)	20 (13.2)	100 (65.8)	32 (21)
ENT	30 (5.2)	6 (20)	16 (53.3)	8 (26.7)
CTVS	6 (1.1)	-	6 (100)	-
Total	576 (100)	176 (30.5)	340 (59.1)	60 (10.4)

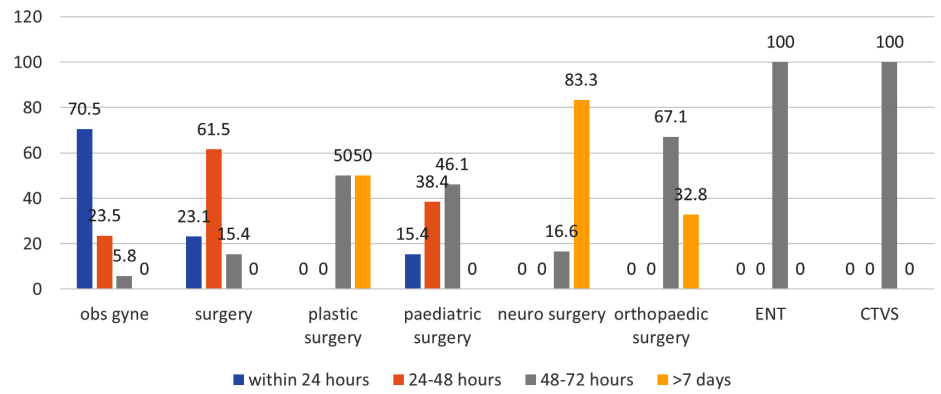

Figure 2. Duration of SAP administration

Table 4. Demographic data and type of surgical approach Variable

Variable	Results
Total number of surgeries (n)	89
Mean age (years) SD	43.64±16.45
Male/Female	70/19
Presence of comorbidities (%)	11.2

SD = Standard deviation

Table 5. Outcome of our modified antibiotic prophylaxis protocol according to the type of surgery

Type of surgery	Success per protocol	Failure per protocol
Clean (n=4)	4(100)	-
Clean contaminated (n=80)	78(97.5)	2(2.5)
Contaminated (n=5)	4(80)	1(20)

(10.4%) three antimicrobials were given for SAP. Similar results were seen in study of Shah et al.,[19] where 56% of the patients were prescribed more than two antibiotics perioperatively, however similar study shows that only single antibiotic is used as prophylaxis in 95.92% of cases.[13] EAU8 recommends use of a single antibiotic as a prophylaxis perioperatively. However, the surgeons use more antimicrobials to give broad spectrum coverage to all sorts of pathogens that might infect the patient. In our study, we found that most of the patients 531 (92.1%) had received the first dose of perioperative antibiotic within 60 minutes prior to surgery. A study done by Shah et al.[19] reported that 63% of patients receive prophylaxis 30 minutes prior to surgery. A similar study in India found that preoperative doses were administered at varying times, with some beginning as early as six hours before surgery.[20] Study in Italy found only moderate compliance with this recommendation.[18] Whereas 86% adherence to timing of administration prior to incision was noted in study of Berrondo et al.[21]. SAP was administered 90 min in Bertschi D et al.,[22] De Jong et al.[23] study, and was administered 60 minutes before surgery in Kasatpibal et al.[24] and Zhang X et al.[25] study, In our study non-compliance in pre-op dose timing was seen in only one unit, that was due to some administrative issues and was later on resolved.

Overall, as seen in this study, compliance to SAP was very poor. Poor adherence to antibiotic prophylaxis recommendations has been shown in other studies with similar results.[26,27] We tried to evaluate the reasons for non-compliance and it was noted that knowledge gaps, overcautious attitude of the surgeons, fear of losing faith by the patients, and non-availability of the desired drug in the hospital inventory were few of the reasons for the same. One of the most critical reasons noted was the lack of local evidence from the hospital. Majority of surgeons wanted the HICC to prove that if they switch to a narrower spectrum, it is not going to harm their patients. Thus, to convince our surgeons, we chose a unit that had previous experience of using the recommended antimicrobials.

Out of a total of 89 patients included in the study from a chosen unit 78.7% were males and 21.3% were females. Out of 89, 78(87.6%) surgeries went uneventful, whereas 11 (12.4%) had postoperative complications. Postoperative complications included erythema, blister, and de-squamation of skin in 11 cases. These local reactions occurred in the initial part of the study as were a setback to HICC, since the participating unit was then hesitant to continue the study. However, the HICC reviewed these cases and events that occurred during the surgery and it was then found that there was a change of OT staff, which led to concentrated dilutions of chlorhexidine being used in part preparation.[27] Two out of 89 (2.2%) cases had UTI post-operatively which was considered as surgical site infection.

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CONCLUSION

Surgical Antimicrobial Prophylaxis is an important part of the SSI prevention bundle and also of Antimicrobial Stewardship program. However, convincing the surgeons for implementing the recommended antimicrobials is a challenge. Small and consistent efforts do show impact and we need to create our own local data to persuade those in practice to follow the recommendations.

We thus conclude that following the EAU guidelines for antibiotic prophylaxis reduced antibiotic use without increasing postoperative infection rates and SAP should be followed as per the standard guidelines in other units also. This small study is a way forward for our HICC team to motivate other surgeons to follow the guidelines and become antimicrobial stewardship champions. This study provides an analysis of the surgical antibiotic prophylaxis (SAP) done in one Indian institution and demonstrates that it is feasible to improve SAP by little means. Thus, it could serve as an example for other similar centres. These protocols are likely to reduce antibiotic resistance as well as treatment costs.

Limitations of study

The major limitation of our study is that it only includes elective endoscopic cases of a single unit i.e urology, emergency cases were not included in this study.

ACKNOWLEDGMENTS

The authors would like to thank Mr. Soyab Khan, Infection Control Nursing Officer for helping us with audit of SAP practices during surgeries.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTION

FK conceptualized and designed the study. A data acquisition. AR and A performed data analysis. BC and AS wrote the manuscript. MA critically revised the manuscript. MA read and approved the final manuscript for publication.

FUNDING

None.

DATA AVAILABILITY

All datasets generated or analyzed during this study are included in the manuscript.

ETHICS STATEMENT

This study was approved by the Institutional Ethics Committee, Jawaharlal Nehru Medical College, Aligarh, India.

INFORMED CONSENT

Written informed consent was obtained from the participants before enrolling in the study.

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