Study on Antibiotic Usage in Surgical Prophylaxis in a Tertiary Care Teaching Hospital

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Abstract

Surgical site infection is a common hospital acquired infection that causes significant health problems and result in prolonged hospitalization and increased treatment cost, in addition to increased patient mortality and morbidity. Prophylactic antibiotic usage is one strategy to reduce the occurrence of SSIs. Antibiotic prophylaxis is used to decrease the bacterial load in the wound to assist the natural host defense in preventing the occurrence of an SSI. A Prospective study was carried out to evaluate antibiotic usage in surgical prophylaxis and to explore the adherence of antibiotic usage in surgical prophylaxis to the international guidelines in Government Cuddalore Medical College and Hospital (GCMCH), Chidambaram. The data was collected from the case sheets and personal interaction with patients. A total of 100 patients were involved. From this, males were more prevalent to surgery than females. Most of the surgeries were GI surgery (53%) followed by Colorectal surgery (23%). Most commonly prescribed prophylactic antibiotic was Cefotaxime (71%) followed by Ceftriaxone (16%). 53% of prophylactic antibiotic administered within 30min-1hour, followedby 32% were 1-2 hours and >2 hours were 15%. When comparing SAP at the study site to the ASHP SAP recommendations, deviations were noticed. Out of 100 patients, only 10 patients had surgical site infection. The present study showed that the guidelines of prophylactic antibiotics was less in adherence to the surgical antibiotic prophylaxis prescribed. But the antibiotics prescribed shows high effectiveness and greatly benefits the patients and the hospital environment.

Keywords: Antibiotic prophylaxis and Surgical site infection.

1. Introduction

Wound infections are the most commonly occurring hospital-acquired infections in surgical patients. It will result in increased antibiotic usage, increased costs and prolonged hospitalization. Appropriate antibiotic prophylaxis can be able to reduce the risk of post-operative wound infections, but additional antibiotic use also increases the selective pressure favoring the emergence of antimicrobial resistance. Therefore, careful use of antibiotics in a hospital setting is essential. Surgical prophylactic antibiotics are the antibiotics used to prevent infection at the surgical site[1].

The first surgical antibiotic prophylaxis was tested in pigs about 40 years ago. This experiment demonstrates effective antibiotic therapy within 3 hours before surgery. Several studies have since been performed in humans and animals showing similar results regarding the prevention of infections after prophylactic antibiotic therapy, used for prophylaxis before and after surgery. Appropriate use of antibioticsshould be used according to guidelines. Improper use leads to resistance to antibiotics. Most often, antibiotics are given at the wrong time or for too long[2].

1.1. Surgical Site Infection

The term "surgical site infection" (SSI) was introduced in 1992 to replace the earlier term "surgicalsite infection". An SSI is defined as an infection occurring within 30 days after surgery (or within 1 year ifhe had an implant placed after surgery) and involving an incision or deep tissue at the surgical site. These infections can be superficial or deep incisional infections, or infections that affect organs or body cavities.Despite improved infection control techniques and surgical procedures, wound infections remain a major cause of morbidity and mortality and place significant demands on health care resources. Therefore, you should always be vigilant to minimize the occurrence of such infections. This requires a systematic approach that considers multiple risk factors associated with the patient, procedure, and hospital environment[3].

1.2. Principles of Surgical Antibiotic Prophylaxis

- Determine if prophylaxis administration is appropriate.
- Determine the flora most likely to cause postoperative infection.
- Select the antibiotic with the narrowest antimicrobial spectrum required based on the above procedure.
- If two drugs have the same antimicrobial spectrum, potency, toxicity, and ease of administration, choose the less expensive drug.
- Timely administer doses.
- A short course of antibiotics (1 surgery within 4 hours).
- Avoid antibiotics that may help treat severe sepsis.
- Avoid using prophylactic antibiotics to compensate for subpar surgical skill.
- Regularly review antibiotic prophylaxis protocols as both costs and patterns of antibiotic resistance can change in the hospital setting[4].

Timing of antibiotic prophylaxis is considered optimal if administered within 30 minutes prior to incision. However, Vancomycin or Fluroquinolone antibiotics should be given within 2 hours before first surgical incision. About one third of SSI could be prevented by taking appropriate infection control measures in the pre, intra and post-operative period. The prevention of infections that might cause sepsis, organ failure, and even death during a hospital stay is mostly dependent on surgical antibiotic prophylaxis or SAP.

2. Aim and Objectives

2.1. Aim

The aim of this study was to evaluate the antibiotic usage in surgical prophylaxis and to study the selection, timing and duration of prophylactic antibiotic administration among surgical patients.

2.2. Objectives

- To study the selection, timing and duration of prophylactic antibiotic administration among surgical patients.
- To explore the adherence of antibiotic usage in surgical prophylaxis to the international guideline and incidence of surgical site infection.

3. Methodology

3.1. Study design

This is a prospective observational study conducted among surgery patients in the Department of Surgery at Government Cuddalore Medical College and Hospital (GCMCH), a 1250 bedded tertiary care teaching hospital located in southern rural part of India.

3.2. Study duration

The study duration was 6 months and data were collected from November 2022 to April 2023 using predesigned proforma for the data collection purpose. Data collected from case sheets of adult surgical patients (In-patients) and personal interaction with patients.

3.3. Inclusion criteria and Exclusion criteria

Patients who were willing to participate in this study, patients of age above 18 years and patients who receiving prophylactic antibiotics were included. Patients with special groups (Pregnant women and Lactating women), patient with post-operative follow-up was missed were excluded.

3.4. Ethical consideration

The present study protocol was approved by the Institutional Human Ethics Committee, of the participating site.

4. Results

This study involved a total of 100 patients.

Table 1. Gender-wise Distribution

GENDER	NO. OF CASES (N= 100)	PERCENTAGE (%)
Male	77	77
Female	23	23

In this study, a total of 100 patients were enrolled. Among 100 patients, there were 77 (77%) male patients and 23 (23%) female patients. According to this, males were more prevalent to

surgery than females. The male to female ratio was found to be 3.35.

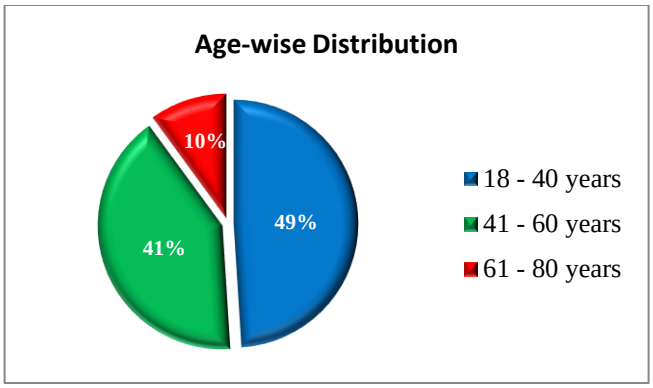

Figure 1. Age-wise Distribution

In this study, 49% of patients were in the age group of 18 - 40 years, 41% of patients were in the age group of 41 – 60 years and 10% of patients were in the age group of 61 – 80 years.

Table 2. Type of Surgical Procedure

SURGERY TYPE	DIAGNOSIS	PROCEDURE	NO. OF CASES (%)
GI surgery	Appendicitis	Appendectomy	18
	Hernia	Hernioplasty	23
		Meshplasty	9
	Gastric antral perforation	Laparotomy withperitoneal lavage	02
	Inflammatory bowel disease	Colonoscopy &biopsy	01
Orthopedic	Gangrene	Amputation	01
Thyroid surgery	Solitary nodularGoiter	Total thyroidectomy	03
Breast surgery	Breast abscess	Incision and drainage	01
	Fibro adenoma	Excision & biopsy	03
Urology	Epididymo-orchitis / chronic orchitis	Orchidectomy	03

	Bladder outlet obstruction / prostaticurethral calculi & vesicle calculi	TURP	02
Miscellaneous	Lipoma, pilonidal sinus, sebaceous cyst	Excision & biopsy	06
	Gluteal abscess, parotid abscess, perianal abscess	Incision and drainage	05
Colorectal surgery	Hemorrhoids	Hemorrhoidectomy	10
	Fistula & fissure	Fistulotomy	12
	Ischiorectal abscess	Incision & drainage	01

Based on the study, most of the surgeries were GI surgery 53%, 23% were colorectalsurgery and 24% were other surgeries.

Table 3. Prophylactic Antibiotic Used

S. NO	PROPHYLACTIC ANTIBIOTIC	NO. OF CASES	PERCENTAGE (%)
1.	Cefotaxime	71	71
2.	Ceftriaxone	16	16
3.	Cefotaxime & Metronidazole	07	07
4.	Ciprofloxacin & Cefotaxime	02	02
5.	Ciprofloxacin, Cefotaxime & metronidazole	02	02
6.	Cefotaxime & Amikacin	02	02

Based on the study the most commonly used prophylactic antibiotic was Cefotaxime 71%, followed by Ceftriaxone 16%.

Table 4. ROA of Prophylactic Antibiotic

S. NO	ROA OF PROPHYLACTIC ANTIBIOTIC	NO. OF CASES (N= 100)	PERCENTAGE (%)
1	Oral	01	01
2	IV	95	95
3	Both	04	04

Based on the study, most common route of prophylactic antibiotic administration was intravenous route 95%.

Table 5. Timing of Prophylactic Antibiotic Administration

S. NO	TIMING OF PROPHYLACTIC ANTIBIOTIC ADMINISTRATION	NO OF CASES (N =100)	PERCENTAGE (%)
1.	30min – 1 hour	32	32
2.	1 – 2 hours	53	53
3.	> 2 hours	15	15

Based on the study, 53% of prophylactic antibiotic administered within 1 – 2 hours, followed by 32% were 30 min – 1 hour and >2 hours were 15%.

Table 6. Antibiotic Prescribed Pre-operatively

S. NO	ANTIBIOTIC PRESCRIBED PRE-OPERATIVELY	NO. OF CASES (N=100)	PERCENTAGE (%)
1.	Cefotaxime	67	67
2.	Ceftriaxone	10	10
3.	Cefotaxime & Amikacin	02	02
4.	Cefotaxime & Metronidazole	09	09
5	Ciprofloxacin &Metronidazole	07	07
6.	Piperacillin + Tazobactam &Metronidazole	02	02
7.	Ciprofloxacin	01	01
8.	Amikacin & Metronidazole	01	01
9.	Ofloxacin + Ornidazole &Cefotaxime	01	01

Based on the study, most commonly prescribed pre-operative antibiotic was Cefotaxime 67%, 10% were Ceftriaxone and 9% were Cefotaxime + Metronidazole.

Table 7. Antibiotics Prescribed Post Operatively

S. NO	ANTIBIOTIC PRESCRIBED POST OPERATIVELY	NO OF CASES (N = 100)	PERCENTAGE (%)
1.	Cefotaxime	31	31
2.	Amoxicillin + Potassium clavunate	02	02
3	Ciprofloxacin &Metronidazole	17	17
4.	Cefotaxime & Metronidazole	19	19
5.	Meropenam & Oflaxacin	01	01
6.	Piperacillin + Tazobactam & Metronidazole	03	03
7.	Piperacillin + Tazobactam, Metronidazole & Linezolid	01	01
8.	Cefotaxime & Gentamicin	16	16
9.	Ceftriaxone	04	04
10.	Ceftriaxone & Metronidazole	02	02
11.	Cefotaxime & Amikacin	04	04

Based on the study, most commonly prescribed post-operative antibiotic was Cefotaxime 31%, 17% were Cefotaxime + Metronidazole, 17% were Ciprofloxacin + Metronidazole and 16% were Cefotaxime + Gentamicin.

Table 8. Surgical Site and Anti-Microbial Administration Compared with ASHP Guidelines

TYPE OF SURGERY	NO. OF CASES	ASHP RECOMMENDATIONS	PRE AND POST SAP
Hernia repair (hernioplasty, meshplasty)	32	Cefazolin Cefazolin + metronidazole Cefoxitin Cefotetan	Cefotaxime 06 (18.8%) Cefotaxime + Metronidazole 06(18.8%) Cefotaxime + Gentamicin 12(37.5%) Cefotaxime + Amikacin 04 (12.5%) Ceftriaxone 04 (12.5%)
Appendectomy	18	Cefazolin + metronidazole Cefoxitin Cefotetan	Cefotaxime + metronidazole 10(55.6%) Cefotaxime 05 (27.7%) Piperacillin and Tazobactam + Metronidazole 02 (11.1%) Ciprofloxacin + Metronidazole 01(5.6%)

GI surgery	03	Cefazolin + metronidazole Cefoxitin Cefotetan Ceftriaxone + metronidazole	Ceftriaxone + Metronidazole 01(33.3%) Cefotaxime + Metronidazole 01(33.3%) Piperacillin & Tazobactam + Metronidazole 01 (33.3%)
Thyroid surgery	03	Amoxicillin clavunate	Amoxicillin clavunate 01 (33.3%) Cefotaxime 02 (66.7%)
Breast surgery	04	Cefazolin Ampicillin sulbactam Clindamycin, Vancomycin	Amoxicillin clavunate 01 (25%) Cefotaxime 03 (75%)
Urologic surgery	05	Cefazolin Trimethoprim-sulfamethoxazole fluoroquinolone	Cefotaxime + Gentamicin 03(60%) Cefotaxime + Amikacin 01 (20%) Piperacillin & Tazobactam + Metronidazole 01 (20%)
Colorectal	23	Cefazolin + metronidazole Cefoxitin Cefotetan Ceftriaxone + metronidazole Ampicillin-sulbactam Ertapenam	Cefotaxime 04 (17.4%) Cefotaxime + Metronidazole 05(21.7%) Ciprofloxacin + Metronidazole 12(52.2%) Ceftriaxone 02 (8.7%)
Miscellaneous	11	Cefazolin	Cefotaxime 06 (54.5%) Cefotaxime + Metronidazole 03(27.3%) Ciprofloxacin + Metronidazole 02(18.2%)

Based on the study, when comparing SAP at the study site to the ASHP SAP recommendations, deviations were noticed.

Table 9: Surgical Site Infection

S. No	Surgical site infection	No of cases (N=100)	Percentage (%)
1.	Tenderness	04	40
2.	Pus discharge	03	30
3.	Edema + induration	02	20
4.	Induration	01	10

In our study, out of 100 patients only 10 patients had surgical site infection.

5. Discussion

Antibiotics administered prior to the contamination of previously sterile tissue or fluids are considered prophylactic. Prophylactic medications are intended to stop infections before they start. This study aims to analyses the antibiotic usage in surgical prophylaxis in a tertiary care teaching hospital.

In this study, a total of 100 patients were enrolled. Among 100 patients, male (77%) patients were more prevalent to surgery than female (23%) patients. The male to female ratio was found to be 3.35. This is similar to the study conducted by Aditi A. Kudchadkar, et.al[5]. In this study, 49% of patients were in the age group of 18 - 40 years, 41% of patients were in the age group of 41 – 60 years and 10% of patients were in the age group of 61 – 80 years.

Based on this study, most of the surgery were GI surgery (53%) followed by colorectal surgery (23%). It was similar to the study conducted by Getachew Alemkere[6]. Most of the surgical procedures were hernioplasty (23%), followed by appendectomy (18%)and fistulotomy (13%). Other surgeries include excision and biopsy, incision and drainage, hemorrhoidectomy, orchidectomy, thyroidectomy and laparotomy with peritoneal lavage. Among these surgeries, most of them were elective than emergency surgery.

The most commonly used prophylactic antibiotic was Cefotaxime 71%, followed by ceftriaxone 16%. This was similar to the study conducted by rehanHS[7], Nisa najwa rokhmah[8]. The most commonly administered prophylactic route wereintravenous route (95%). In this study, SAP administration time was reported 1 - 2 hour (53%) before incision, followed by 30 min - 1 hour (32%) which was similar to many studies. Administration antibiotic more than2 hour before incision shall increase the risk of SSIs[6]. Antimicrobial administration time before surgical incision was as per the hospital guidelines 1-2 hour. Hence review the pattern of prophylactic antibiotic is necessary in relation to the durationof surgery. There is no data was found about intraoperative administration of antibiotic for the surgeries that took more than 3 hours.

Based on the study, most commonly prescribed pre-operative antibiotic was Cefotaxime 67%, 10% were Ceftriaxone and 9% were Cefotaxime + Metronidazole. Most commonly prescribed post-operative antibiotic was Cefotaxime 31%, 17% were Cefotaxime + Metronidazole, 17% were Ciprofloxacin + Metronidazole and 16% were Cefotaxime + Gentamicin.
In our study population received SAP similar to some studies but differs from guidance of using. According to the study, there were differences between SAP at the study site and the ASHP SAP standards. The surgical prophylaxis guidelines issued by ASHP recommended first or second generation Cephalosporins are used as prophylactic antibiotic for many surgeries not Cefotaxime (3rd generation cephalosporin antibiotic). Cefotaxime is a broad-spectrum antibiotic. Cefazolin was not utilized in any of the surgical procedures. The reason for not compliance to the guidelines,

1) Surgeons are at ease to begin prophylactically with Cefotaxime and to continue as a therapeutic antibiotic till the patient is released.
2) Cefotaxime and Ceftriaxone are prescribed based on the prevalence of micro-organism which are sensitive to these antibiotics
3) Non-availability of Cefazolin.
4) Cefotaxime & Ceftriaxone are the highly available drugs in our hospital facility so surgeons majorly prescribe these drugs as surgical prophylaxis.

As per ASHP guidelines, Cefotaxime and Ceftriaxone were not recommended to any surgical procedure. Because being a broad-spectrum drug can induce emergency of resistance. The study shows Cefotaxime and Ceftriaxone were prescribed commonly, due to the high effectiveness as prophylaxis and the availability which greatly benefits the patients.

Extended surgical prophylaxis administration times beyond recommended limits were a common instance of guidelines not being followed, as this study examined. Although the guidelines promote to end prophylactic administration within 24 hours, most of the SAP administrations continued forup to more than 1 day. It is similar to the study conducted by Bratzler DW, Dellinger EP[9].
In this study the rate of surgical site infection was low in the hospital (10%). So, most of the antibiotics were used as a prophylactic antibiotic and not for the treatment of SSI. The study also showed that prolonged duration of operation was a significant risk factor for SSIs, comorbid condition like DM and old age were one of the risk factors. Consequently, the risk associated with surgical procedures lasting longer than an hour was approximately double that of treatments lasting less than an hour. Moreover, wound classwas also found to be an important risk factor in the development of SSI. Hence, dirty had the highestchance to getting infected followed by the contaminated wound and clean-contaminated.

7. Limitation

The present study was conducted on a small sample size (100) and for a short duration of time (6 months). Hence it may not represent the total population.

8. Conclusion

In this study all cases of surgical procedure were given antimicrobial prophylaxis either as single or combined form. The antibiotics selection was not based on ASHP guidelines in this study due toits availability, cost effectiveness and prevailing microbiological profile. In relation to ASHPSAP guidelines, overuse of antimicrobials was found before and after surgery. The selection of antimicrobial was also different compared to the ASHP guidelines and theguidelines at study site. Instead of first or second generations Cephalosporin, Cefotaxime (third generation) was more commonly used.

The present study showed that the guidelines of prophylactic antibiotics was less in adherence to the surgical antibiotic prophylaxis prescribed. But the antibiotics prescribed shows high effectiveness and greatly benefits the patients and the hospital environment.

For surgical prophylaxis, it is important to select an antibiotic with narrowest antibacterial spectrum to reduce the emergence of resistance and also because broad spectrum antibiotics may berequired if patient develops serious sepsis. In surgical practice, there is considerable variation in the timing of the prophylactic antibioticadministration and prolonged use of prophylactic antibiotic more than 24 hours noted.

9. Reference

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