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Original Article

Pharmacology Section

A Study on the Usage Pattern of Antimicrobial Agents for the Prevention of Surgical Site Infections (SSIs) in a Tertiary Care Teaching Hospital

AFZAL KHAN A.K, MIRSHAD P.V, MOHAMMED RAFIUDDIN RASHED, GAUSIA BANU

ABSTRACT

Context: Inappropriate antimicrobial use increases the incidence of drug resistance, drug toxicity and superinfections, thereby increasing the healthcare costs. Various approaches for rationalizing the antimicrobial therapy, have been suggested. Collection of baseline data on the pattern of the antimicrobial use is usually suggested as the first step in this direction, which will help in identifying the problem areas, which demand our attention.

Aims: To study the usage pattern of prophylactic antimicrobials in surgical patients, in order to detect any inappropriateness concerning the selection, timing, redosing and the duration of antimicrobial administration.

Settings and Design: A retrospective review of the randomly selected medical records of general surgical cases over an 8 month period in a tertiary care teaching hospital.

Methods and Material: The medical records of 258 patients who had undergone surgical procedures were verified for the appropriateness of the antimicrobial prophylaxis, with respect to the choice of the antimicrobial agent, the time of its administration, the intraoperative dosing, and the duration of the postoperative use. The obtained data was analyzed and conclusions were drawn with the help of descriptive statistics.

Results: Third generation cephalosporins were used preoperatively in all the 258(100%) patients through the intravenous route. In addition, 77(30%) patients received metronidazole or amikacin. The antimicrobials were administered half an hour to one hour before the surgery. No intraoperative redosing was given. The duration of the postoperative prophylaxis was extended to 36 hours or more in 248(96%) of the cases.

Conclusions: The timing of administration of the preoperative dose was appropriate and well delegated to the operating room nurse. The intra operative dose was appropriately omitted. The main concern was the increasing use of the third generation cephalosporins and the unnecessary prolonged duration of the postoperative prophylaxis, which needed to be addressed.

Key Words: Antimicrobial, Usage pattern, Surgical site infection

INTRODUCTION

Surgical Site Infections (SSI) are a common complication associated with surgery, with reported incidence rates of 2-20%. It is also the second most common cause of nosocomial infections [1]. Surgical antimicrobial prophylaxis refers to a very brief course of an antimicrobial agent which is initiated just before surgery, to prevent infections at the surgical site [2]. It is one of the most widely accepted practices in surgery. However, despite the evidence of the effectiveness and the publication of guidelines for the antimicrobial prophylaxis, its use is often found to be suboptimal [3]. Approximately 30-50% of the antimicrobial use in hospitals, is now for surgical prophylaxis. However, between 30-90% of this prophylaxis is inappropriate [4].

Optimal prophylaxis includes an appropriate selection of safe and effective antimicrobials, initial dosing at an appropriate time and redosing if required, in oder to maintain effective serum and tissue levels throughout the operation, and discontinuation when the patient is no longer receiving a benefit [3].

Inappropriate usage and prolonged, postoperative doses do not provide any added benefit and they may increase the incidence of resistant pathogens in the subsequent nosocomial infections [5]. Once antimicrobial resistance develops, it can have a significant impact on the patients' morbidity and mortality, thereby increasing the health care costs [6].

Available studies bear witness to the widespread concern about the inappropriate use of antimicrobial agents. The findings strongly suggest the need for antimicrobial drug utilization studies as the basis for a quality control or an audit of the antimicrobial therapy [7].

Since errors in the antimicrobial prophylaxis for surgical patients remain one of the most frequent types of medication errors in hospitals [8] and due to the unavailability of adequate information and standard treatment guidelines for surgical antimicrobial prophylaxis in India, there is a need to generate baseline data on the pattern of the use of prophylactic antimicrobials before recommending any desired modifications [9].

Poor adherence to the guidelines has been reported by various studies, specifically in the area of the antimicrobial selection, timing and the duration of the antimicrobial prophylaxis [10].

Hence, this study was planned in order to examine the prevalent practices in our hospital regarding the use of antimicrobials for surgical prophylaxis, with respect to the choice of the antimi-

crobial agent, the timing of its administration, the intraoperative redosing and the total duration of the prophylaxis, in order to detect any inappropriateness, so that corrective measures could be suggested.

SUBJECTS AND METHODS

The medical records of the patients who underwent surgery in a Medical College Teaching Hospital in Kerala during the 8 months between May 2011 and January 2012, were randomly selected to obtain 300 case files, out of which only 258 cases were included in our analysis. 42 files were excluded due to a gross negligence in their documentation regarding the dates and timings. As the focus of our study was on the pattern of the prophylactic antimicrobial use, the cases with documented preoperative infections and those with more than 48 hours of preoperative antimicrobial administration were also excluded. An uninformed visit to the operating room and observation were additionally performed to ascertain and verify the timing of the antimicrobial administration, relative to the start of the surgery and to ascertain the personnel who were responsible for administering the preincisional antimicrobial dosing, as a clear and precise documentation regarding these two parameters was not found in 32% of the case files. The chiefs of the administrative and medical records departments were informed and their consent was taken to utilize the hospital data for our study.

The Main Outcome Measures: In our analysis, four different parameters of the appropriateness of the prophylaxis, such as the choice of the antimicrobial agent, the timing of administration of the preoperative dose, additional intraoperative dosing if any and the choice and the duration of the post operative prophylaxis, were studied. The relevant patient and operative procedure related information was also sought. The data which was thus collected was expressed in terms of averages, standard deviation, ratios and proportions. No additional statistical analysis was performed.

RESULTS

A total of 258 case files were examined retrospectively. The mean age of the patients was 31.95 (Range 1-66 years). All the study cases had undergone operative procedures when they were admitted to the general surgery department. Hernia repair was the most frequent surgical procedure which was performed (40%). The length of the hospital stay ranged from three to twelve days, with a mean stay length ±SD of 5.4±1.9 days, and a median stay length of 5.0 days. See [Table/Fig-1and 2] for details.

All the patients who underwent surgeries were prescribed preoperative antimicrobials intravenously. A third generation cephalosporin like cefotaxime was prescribed in 237(92%) cases and ceftriaxone was prescribed in 21(8%) cases. Metronidazole, ornidazole or amikacin were prescribed along with cephalosporins to 77(30%) of the patients.

Patient Characteristic	Frequency
No. of charts reviewed	258
Mean age (yrs)	31.95
Female (%)	43.8
Preoperative length of stay (mean, days)	1 .9±1.5 (SD)
Postoperative length of stay (mean, days)	3.53±1.3 (SD)
Duration of procedure (mean, minutes)	102.5±38.9 (SD)

[Table/Fig-1]: Patient characteristics

Procedures Performed	Frequency(%)
Hernia Repair	40
Appendicectomy	36
Thyroidectomy	9
Cholecystectomy	7
Other procedures	8

[Table/Fig-2]: Procedures performed

With regards to the timing of the antimicrobial administration which was relative to the start of the surgery, all the patients received the preincisional intravenous dose, half an hour to one hour before the surgery, on the operating table, before the induction of the anaesthesia. An additional direct observation confirmed the same, wherein an operative room nurse was solely delegated the responsibility of administering the preincisional dose to all the patients before the anaesthesia was induced.

Twenty patients (7.8%) who were given the preincisional dose were already receiving antimicrobial drugs (oral cefdinir and metronidazole), which were prescribed on their hospital admission i.e. 24-48 hours before the scheduled operative procedure. The intraoperative repeat antimicrobial dosing was not administered to any of the patients. The antimicrobial agent which was prescribed postoperatively in most of the cases was cefotaxime, which was given to 186(72%) of the cases. 52(20%) patients were prescribed cefoperazone, while nine(3.5%) patients received cefuroxime, a second generation cephalosporin. Metronidazole, ornidazole or amikacin were used along with the above antimicrobials in 83(32%) of the cases. Postoperative intravenous antimicrobials were not used in 11(4.3%) cases, who were instead given oral amoxicillin.

The duration of the postoperative prophylaxis extended to 36 hours or more in 248(96%) of the cases during their hospital stay. Only 10 (3.9%) patients received the antimicrobials for less than 36 hours. The number of postoperative doses which was administered, ranged from 2-12, at an average of 6.58 doses. The intravenous antimicrobials were replaced with oral agents in 62(24%) the patients during their postoperative hospital stay, after a mean duration of 2.75 days. Oral cefixime was prescribed in 75% of the cases as a replacement and the remaining patients commonly received amoxicillin. Oral antimicrobials were also prescribed on discharge, to 247(95.7%) patients, for an average duration of 4.3 days. Cefixime was mainly prescribed, followed by metronidazole, levofloxacin, cefpodoxime and amoxicillin. In addition, topical antimicrobials were also prescribed in 134(52%) patients. Fusidic acid was most commonly used in 93(36%) cases, followed by povidone iodine alone in 41(16%) cases and as a combination with topical metronidazole in 21(8%) cases.

DISCUSSION

Four parameters of the appropriateness of the antimicrobial prophylaxis, such as the choice of the antimicrobial agent, the timing of administration of the first dose, the intraoperative redosing and the duration of the prophylaxis, were analysed.

All the cases in our study received prophylactic antimicrobials prior to the surgery, even though prophylactic systemic antimicrobials are not typically indicated for the patients who undergo clean surgical procedures [11,12].

The intravenous route which is ideally recommended, as it produces reliable and predictable serum and tissue concentrations,[13]

was used in all the cases for the preincisional antimicrobial administration.

As for the choice of the antimicrobial agent, the third generation cephalosporins were commonly used in our hospital, as noted in earlier studies which were done in India and elsewhere in Asia [9,12,14-18]. The use of antimicrobials in most of these cases seemed to be empirical, based on operating surgeon's clinical experience. The local resistance pattern might have a major influence during the drug selection.

The combination of amikacin/metronidazole with the third generation cephalosporins was noted in 30% and 32% of the pre and the postoperative cases respectively. Metronidazole has shown benefit and it has been recommended as a combination in the surgical prophylaxis, to provide an adequate anaerobic cover [2]. A number of antimicrobial trials which had compared a variety of broad-spectrum single agents with aminoglycoside- based combinations, showed no significant differences in their efficacy [19]. Therefore, the routine addition of an aminoglycoside to other agents which have a broad-spectrum gram-negative coverage, such as the 3rd/4th generation cephalosporins, has been shown to provide no additional benefit [16].

Antimicrobials should be administered within sixty minutes prior to the making of the incision and ideally, as near to the time of making of the incision as possible [20]. Achieving the proper timing and redosing when necessary, are dependent on the multidisciplinary organization of the hospital and the operating room [5].

Our study faced limitations in this regards. Since our findings were limited to the information which was documented in the case records, we came across 83 cases (32%) out of 258, which had incomplete and unclear documentations, especially with regards to the timing of administration which was relative to the start of the surgery, which was similarly experienced by previous researchers as well [21].

None of the patients in our study received any parenteral second or third antimicrobial doses intraoperatively, as the duration of the surgery did not exceed the recommended duration. Usually, a single dose of the antimicrobial is found to be sufficient if the duration of the surgery is four hours or less or if there is no substantial blood loss during the surgery [20,10].

Very similar to most of the previous studies, the main parameter of concern which was noted in our study was the prolonged duration of the antibiotic prophylaxis [7, 9, 12, 22]. Overall, only 10 (3.9%) patients in our study received the antimicrobials for less than 36 hours, inspite of the published guidelines which had recommended discontinuation of the prophylaxis within 24-48 hours [17]. A prolonged antimicrobial administration can also be harmful to the patients, as it promotes antimicrobial-resistant bacteria and increases the incidence of the antibiotic associated complications [17].

About half of the patients were also prescribed topical antimicrobials like fusidic acid and povidone iodine alone and as a combination with topical metronidazole. The use of topical antimicrobials as prophylaxis is not evidence-based. A recent prospective trial which examined the use of topical fusidic acid in addition to the routine systemic antibiotics which were applied immediately after the surgical closure in the patients who underwent emergency caesarean sections, found a decrease in the SSIs from 17.1% -2.8% (P¼0.046) through a topical antibiotic use. However, this was a small trial (only 70 patients in total) with a high baseline rate of SSIs in the control patients [23]. The broad-spectrum ointments provide occlusion and they may increase the epithelialization while the wound heals, but they offer only little benefit to the already epithelialized wounds [1].

All the above findings suggested that the antimicrobial prophylaxis was clearly overused in our study, which was similar to the findings of several earlier studies which had reported an overuse and/or misuse of the preoperative antimicrobials in different countries [12]. Various measures like the development of local hospital guidelines, surveillance on SSIs, educational interventions, hospital antibiotic policy, promoting good surgical techniques and strict asepsis in the operating theatre, are suggested to prevent the emergence of multiresistant organisms [14]. The local antibiograms with organism-specific susceptibility data should be updated at least yearly, to facilitate and optimize the expert-based recommendations for the empirical therapy [6]. Complete documentations and clear entries in the medical case records should be encouraged and ensured to assist the future studies. Our study has several limitations. Our findings were restricted to the information which was available in the medical records, the data on the postoperative infections was limited and the information on the post discharge complications was not available, thereby limiting our ability in comparing the incidence of SSIs with the data which have been reported elsewhere.

However, the findings from this baseline study represent the first step among a number of interventions which have been designed to improve the antimicrobial prescribing in our institution.

CONCLUSIONS

The current practice of the surgical antimicrobial prophylaxis in our hospital seems to be reasonable and comparable to the standard guidelines, with regards to the timing of administration and the intraoperative redosing. The use of third generation cephalosporins and the unnecessary extended duration of the prophylaxis remains the main concern of our study. As a follow up to this survey, a prospective observational study may be under taken to find out the effect of the prevalent pattern of the surgical prophylaxis on the occurrence of post operative wound infections. An initiative for establishing an hospital antimicrobial policy and antimicrobial prescribing guidelines, in collaboration with the prescribers, should be undertaken.

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AUTHOR(S):
1. Dr. Afzal Khan A.K
2. Dr. Mirshad P.V.
3. Dr. Mohammed Rafiuddin Rashed
4. Dr. Gausia Banu

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Pharmacology, M.E.S Medical College, Kerala-679338, India.
2. Assistant Professor, Department of Pharmacology, M.E.S Medical College, Keral-679338, India.
3. Assistant Professor, Department of Pharmacology, M.E.S Medical College, Kerala-679338, India.
4. Senior Resident, Department of OBG, M.E.S Medical College, Kerala-679338, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Afzal Khan A.K,
Associate Professor, Department of Pharmacology,
M.E.S Medical College, Palachode P.O,
Perinthalmanna, Kerala-679338, India.
Phone: +91-9895269138
E-Mail: drkhan4u@rediffmail.com

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