

Perioperative antibiotic prophylaxis and cost in a Turkish University Hospital

Profilassi antibiotica pre-operatoria e relativi costi in un ospedale universitario in Turchia

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■ INTRODUCTION

Surgical site infections account for a large proportion of hospital-acquired infections, are associated with a high morbidity and mortality, and place a large burden upon the inpatient healthcare budget [1, 2]. Prevention is important and is based on a combination of preoperative preparation, surgical techniques, perioperative antibiotic prophylaxis and post-operative wound care. There is considerable evidence that antibiotics are used excessively and inappropriately in the prevention and treatment of health care-associated infections, including surgical-site infections. In the case of the latter, timing of prophylaxis is crucial to success yet antibiotics are often administered at the wrong time or for too long a period, with implications for the cost of patient care [1]. In this study we tried to assess the practice of perioperative antibiotic prophylaxis and its cost.

■ MATERIALS AND METHODS

This study was performed in Pamukkale University Hospital, Denizli, Turkey. Denizli is a city located in the western part of Turkey with a population of 300.000 inhabitants. All surgical procedures performed in the year 2002 were included. All operations in general surgery, obstetrics and gynecology, orthopedics, pediatric surgery, otorhinolaryngology, plastics surgery,

urology, neurosurgery and cardiothoracic surgery reviewed. All data were collected by an Anesthetist and recorded into a computer program (SPSS). Data consisted of personal data, patients' admission date, clinic, type of surgical procedure, operation time, prophylactic antibiotic (dosage, route), duration of prophylaxis and cost. Assessment of surgical prophylaxis were done with the following criteria:

- 1) Did the surgical procedure justify prophylaxis?
- 2) When was prophylaxis done and was the duration period optimal?
- 3) Which antibiotic given and was it an appropriate selection? [1-3].

The cost of antibiotics for each perioperative surgical prophylaxis was calculated.

Operations were classified as clean, clean-contaminated, contaminated and dirty. Evaluation of the results was made according to criteria in the literature [4]. Statistical analyses were performed by using student's t test and chi-square tests.

■ RESULTS

In the year 2002, a total of 2038 operations were performed in our hospital. Of these 2038 patients, 1342 (66%) were women and 696 (34%) were men. The patients aged between 1 and 89 years (median: 45; IQR:32). Ninety-two percent of all procedures were elective, and the rest (8%) were emergencies. Approximately 85.7% were

Table 1 - Choice of antibiotics for surgical prophylaxis.

Clinic	Prophylaxis/ Total case	SAM (%)	Cefepime (%)	Cefazolin (%)	Ceftriaxone (%)	Ciprofloxacin (%)	Others (%)
Gyne/Obst	543/545	29.4	56.9	-	9.6	-	4.1
Orthopedics	401/423	12.2	2.5	36.4	-	48.6	0.1
G Surg	291/313	58.7	-	14.4	-	7.9	19.0
Urology	291/292	9.0	20.3	-	66.9	-	3.9
Otorhinolaryn	144/178	93.7	-	-	6.3	-	-
Neurosurg	87/93	3.4	75.9	20.7	-	-	-
Plastic Surg	88/88	74.7	-	4.4	-	20.9	-
Pediatric Surg	38/81	23.7	-	-	65.8	10.5	-
CVS	19/25	29.4	-	-	70.6	-	-

Abbreviations: G. Surg: General surgery, Gyne/Obst: Gynecology/Obstetrics, Otorhinolaryn: Otorhinolaryngology, CVS: Cardio-vascular surgery, Neurosurg: Neurosurgery.

clean surgery, 8.5% clean-contaminated, 5.3% contaminated, and 0.5% dirty. Ninety-three percent of all patients received antibiotic prophylaxis during the study period. Although timing of prophylaxis was appropriate in all procedures (patients who received prophylaxis were given the prophylactic antibiotic drug(s) between 0 and 2 hours before the incision), duration was optimal only in 29.0% of all cases. Of all patients; 29.0% (551) received antibiotics for prophylaxis for a day, and the rest 1351 (71%) received for more than a day. In detail; 390 patients (20.5%) received antibiotic for 48 hours, 421 patients (22.1%) for 72 hours, and the remaining 540 patients (28.4%) more than three days. A great deal of operations was performed in obstetrics & gynecology, orthopedics, general surgery and urology clinics (Table 1).

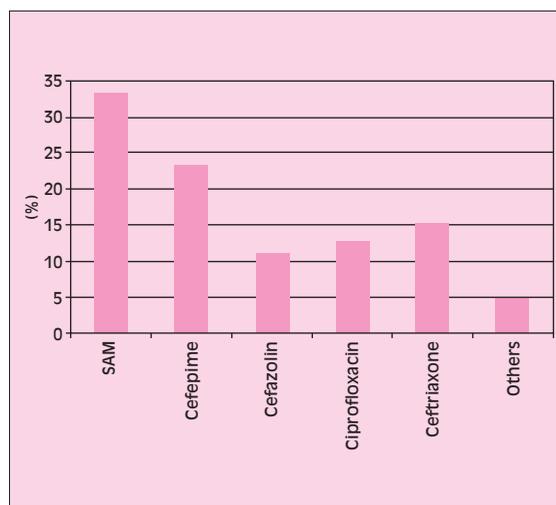


Figure 1 - Distribution of prophylactic antibiotics (%).

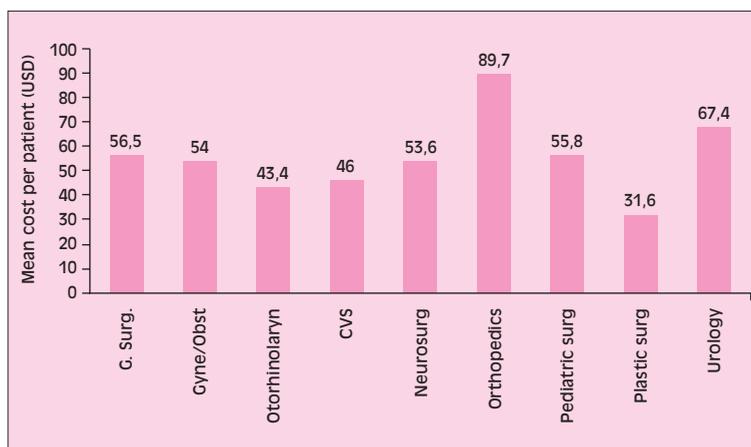


Figure 2 - Mean cost of antibiotic for prophylaxis per patient in US Dollars. Abbreviations: G. Surg: General surgery, Gyne/Obst: Gynecology/Obstetrics, Otorhinolaryn: Otorhinolaryngology, CVS: Cardio-vascular surgery, Neurosurg: Neurosurgery.

Sulbactam/ampicillin (SAM) (33.2%), cefepime (23.4%), ceftriaxone (15.1%), ciprofloxacin (12.6%) and ceftazidime (11%) were the most used antibiotics during the study period (Figure 1). All of the prophylactic antibiotics were administered by intravenous route. In a great deal of cases, the choice of antibiotics for prophylaxis was either sulbactam/ampicillin, ceftazidime or ceftriaxone (Table 1).

Dosages of antibiotics were all as follows; 1 gr. at the time of induction of anesthesia, and additional two doses if necessary in a day.

The average cost for each perioperative antibiotic prophylaxis was found 62.0 US Dollars (range: 31.6-89.7 US Dollars) for each patient in our study (Figure 2).

■ DISCUSSION

The contribution of antibiotic prophylaxis to reduce surgical site infections for some procedures is well known. In spite of extensive knowledge about the effectiveness of antibiotic prophylaxis, their administration regimens are often inappropriate. Inappropriate perioperative antibiotic prophylaxis may contribute to development of resistance to antibiotics and to high costs [5, 6].

In this study 93.3% of the whole patients received antibiotic prophylaxis, and a great deal of these appliances were unnecessary. Although there is no data to recommend prophylaxis, a lot of patients who are undergoing procedures like inguinal hernia repair, laminectomy, transurethral prostatectomy, tonsillectomy and septo-rhinoplasty received antibiotic prophylaxis in the study. Rate of appropriate perioperative surgical prophylaxis varies. Vaisbrud et al. reported that 95% patients received appropriate antibiotic for prophylaxis [7]. Dettenkofer et al. stated that only 45.3% of patients received antibiotics in accordance with international standards in a study performed in eight German hospitals [8]. In another study, Bailly et al. reported that only 41.7% of the patients in their study received proper antibiotics [9]. In a multicenter study in Netherlands on adherence to local guidelines for surgical antimicrobial prophylaxis a rate of 28% was found for proper usage [10].

Timing of antimicrobial prophylaxis was optimal in our study and all of the patients received prophylaxis 20-30 minutes before operation that is the time of induction of anesthesia. This is consistent with studies of Vaisbrud et al. who also reported that all of their patients received pro-

phylaxis at time of induction of anesthesia [7]. In patients receiving antimicrobials, the most common mistake is prolonged prophylaxis (>24 hours). In our study, the percent of proper duration was low, and most of the patients (71%) received prophylaxis more than one day. Bailly et al. reported prolonged prophylaxis occurred in 87.9% of patients [9]. In a study in Belgian hospitals prophylaxis was prolonged by more than two days postoperatively after 23% of the procedures and by more than four days in 8% [11]. In a study in Taiwan more than 70% patients received more than three days of postoperative antibiotic prophylaxis [12]. Motola et al. reported in Italy that an important group of patients underwent operations received prophylaxis till 5 days in their study [13]. In contrast to these two studies, Vaisbrud et al. reported the duration of prophylaxis was <24 hours in 91% of patients [7]. Codina et al. pointed that duration of perioperative antibiotic prophylaxis was shorter than 24 hours in 75% of procedures [14].

SAM, cefepime, ceftriaxone and ciprofloxacin were the most used antibiotics during the study period. In fact, ceftazidime is the recommended prophylactic antibiotic in many operations like caesarean section, open reduction of fracture, cholecystectomy, pacemaker insertion, gastric resection [4]. In operations like inguinal hernia repair, mastoidectomy, arthroscopic surgery, septo-rhinoplasty, tonsillectomy, and laminectomy prophylactic antibiotics have not been proved effective [4]. As seen in the study ceftazidime was the third most used antibiotic for prophylaxis after SAM and cefepime in a great number of patients. The results of our study suggest that the choice of prophylactic antimicrobial agent was inappropriate and unnecessary in most of the cases. Motola et al. reported that third generation cephalosporins were the most frequently used antibiotics in patients undergoing clean and clean-contaminated procedures [13]. Bailly et al. reported most of their patients (95.7%) received a drug with a broader spectrum of activity than that recommended (third-generation cephalosporins or quinolones instead of first- and second generation cephalosporins or amoxicillin/clavulanate [9]. In a study on 888 patients in Africa, ceftriaxone was the most commonly used antibiotic for prophylaxis, followed by amoxicillin/clavulanate and cefotaxime [15]. In a study in France on the proper antibiotic in surgical prophylaxis, most anesthetists preferred first and second genera-

tion cephalosporins followed by amoxicillin/clavulanate [16]. Kurz et al. reported that 57% of the patients were given unnecessary prophylaxis [11]. In a study in Malaysian hospitals it is reported that majority of prescriptions (70%) were issued for such prophylaxis was probably not necessary [17]. In a study in Brazil on antibiotic prophylaxis performed in patients undergoing cholecystectomy, hysterectomy and herniorrhaphy, the choice of antibiotic was correct in 75% of the cases [18]. Vaisbrud et al. revealed that 95% of their patients received appropriate surgical prophylaxis and cefonicid was the single most frequently used drug (42%) in the group of patients for whom prophylaxis was indicated [7]. In dirty procedures as in abdominal surgery involving the distal ileum, appendix or colon appropriate anaerobic coverage was administered as therapy.

In our study, total cost of perioperative antibiotic prophylaxis for a year was found 117.924 US Dollars in 1902 patients. The average cost for each perioperative antibiotic prophylaxis was found 62.0 US Dollars (range: 31.6-89.7 US Dollars) for each patient (Figure 2). In Turkey, the mean cost of cefazolin which is frequently used for prophylaxis in a great deal of operations, using a maximum of three dosages ranges between 2.7-8.1 US Dollars. As is seen the average cost for prophylaxis is approximately ten times higher than the regimens suggested in our study. This is accordance with the study of Motola et al. who reported that the resulting costs were about tenfold higher than costs of antibiotic prophylaxis carried out according to international guidelines [13]. In a study in Taiwan, including 3.104 patients, total cost of prophylactic antibiotics was

found approximately 169.862 US Dollars (54.7 US Dollars per patient), and the authors added that if a single dose of cefazolin been used for all patients, the cost would have been reduced by 92.1% [19].

Assessments of these results reveal that antibiotic prophylaxis before operations seems to be inadequate in most of the surgical procedures in our hospital. Other studies also reported that antimicrobial prescription and empirical treatment ratios were still high and inappropriate at inpatient groups [20, 21]. Because of no written guidelines exist in different surgical departments of our hospital the choice of antibiotics for prophylaxis were inappropriate in most of the cases. But these ratios may be increased if standardized antimicrobial administration rules improved [22-25]. On the other hand Esposito and Mittelkotter [26] stated that advances in surgical techniques, the changes in bacterial ecology in hospitals, the spread of bacterial resistance and the substantial increase in the surgical population at risk suggest that third generation cephalosporins, particularly ceftriaxone, should be taken into consideration for surgical prophylaxis.

In conclusion, principles of perioperative prophylactic antibiotic administration should be strictly reviewed. Additional efforts are necessary in order to improve prophylaxis in accordance with published evidence based guidelines. This will not only reduce ratios, and antimicrobial costs for surgical prophylaxis, but will also increase quality of patient care.

Key words: perioperative antibiotic prophylaxis, appropriateness, costs

SUMMARY

Although surgical site infections have decreased with the use of prophylactic antibiotics, inappropriate surgical antibiotic prophylaxis is still a worldwide problem. In this retrospective study, perioperative antibiotic prophylaxis was evaluated in a university hospital. All surgical procedures (n=2038) performed in the year 2002 were included. The study setting was the Anesthesiology and Reanimation unit in Pamukkale University Medicine Faculty Hospital. A total of 1902 patients received antibiotic prophylaxis. Ninety-two percent of all procedures were elective, 8% emergencies. Approximately 85.7% were clean surgery, 8.5% clean-contaminated, 5.3% contaminated, and 0.5% dirty. Approximately

93.3% of patients received antibiotic prophylaxis. Although timing of prophylaxis was appropriate in all procedures, duration was optimal in only 29.0% of all cases. Sulbactam/ampicillin (33.2%), cefepime (23.4%), ceftriaxone (15.1%), ciprofloxacin (12.6%) and cefazolin (11%) were the most commonly used antibiotics. Instead of an estimated optimal cost of perioperative antibiotic prophylaxis ranging between US\$2.6 and 7.8 according to guidelines, the average cost was US\$62 per patient.

We believe that compliance regarding the optimal choice, frequency and duration of perioperative antibiotic prophylaxis is inadequate, thereby making additional efforts necessary.

RIASSUNTO

Nonostante l'impiego di antibiotici in profilassi abbia contribuito ad una flessione dell'incidenza delle infezioni della ferita chirurgica, l'inappropriatezza con la quale tale profilassi viene effettuata rappresenta tuttora un problema avvertito su scala mondiale. Nel presente studio, retrospettivo, abbiamo valutato le modalità di esecuzione della profilassi antibiotica pre-operatoria in un ospedale universitario. Sono stati presi in considerazione tutti gli interventi chirurgici (n=2038) eseguiti nel corso del 2002 presso l'Unità di Anestesiologia e Rianimazione dell'Ospedale della Facoltà di Medicina di Pamukkale, in Turchia. Complessivamente, sono stati sottoposti a profilassi antibiotica pre-operatoria 1902 pazienti. Nel 92% dei casi, si trattava di interventi eseguiti in elezione, e nel rimanente 8% di interventi d'urgenza. All'incirca l'85,7% di tutti gli interventi era di chirurgia pulita, l'8,5% erano pulito-contaminati, il

5,3% contaminati e lo 0,5% erano interventi di chirurgia sporca. Il momento di somministrazione dell'antibiotico è risultato appropriato in tutti gli interventi considerati; diversamente, la durata della profilassi si è rivelata ottimale solo nel 29,0% dei casi. Ampicillina/sulbactam (33,2%), cefepime (23,4%), ceftriaxone (15,1%), ciprofloxacina (12,6%) e cefazolina (11%) sono stati gli antibiotici di più frequente impiego. Le linee guida stimano il costo ottimale di una profilassi antibiotica pre-operatoria in una cifra compresa tra 2,6 e 7,8 US\$/paziente. Al contrario, nella nostra esperienza, il costo medio per paziente è stato di US\$62/paziente. È nostra opinione che la scelta ottimale dell'antibiotico, del momento della somministrazione e della durata della profilassi antibiotica pre-operatoria sia inadeguata, e che siano dunque necessari sforzi aggiuntivi per migliorarla.

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