Original Article

Preoperative antibiotic prophylaxis practice and guideline adherence in Jordan: a multi-centre study in Jordanian hospitals

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Abstract

Introduction: The use of antimicrobial prophylaxis for surgical procedures is one of the measures employed to prevent the development of surgical site infections (SSI). The appropriate choice of antimicrobial agents, dosage regimen, timing, duration and use of intravenous route must be evidence based.

This study aimed to assess the practice of surgical antibiotic prophylaxis and adherence of practitioners to the American Society of Health-System Pharmacists (ASHP) guidelines for antimicrobial prophylaxis in surgery and to explore reasons for non-compliance.

Methodology: A cross-sectional study was conducted in 20 Jordanian hospitals from October 2006 to June 2007. A questionnaire was designed to collect information from physicians regarding the practice of surgical antibiotic prophylaxis (SAP), references used for guiding SAP practice, prevalence of surgical site infection (SSI), and causative microorganisms.

Results: SAP was employed in almost all surgical departments of hospitals. The improper timing of antimicrobial administration for SAP was attributed to lack of knowledge of the guidelines (46.1%), while the improper antimicrobial choice was ascribed to drug unavailability (61.8%).

Conclusion: This study shows that physicians are aware of the importance of antimicrobial prophylaxis before surgical procedures. However, further efforts are needed to ensure the implementation of the standard SAP guidelines in Jordanian hospitals.

Key words: ASHP guidelines; hospital; Jordan; surgical prophylaxis; surgical site infection

J Infect Dev Ctries 2012; 6(10):715-720.

(Received 22 October 2010 – Accepted 06 July 2011)

Introduction

The use of antimicrobial prophylaxis for surgical procedures is one of the measures used to overcome the development of surgical site infections (SSI) [1]. SSI is the most frequently encountered infection in surgical patients [2]. SSI is also considered among the most expensive nosocomial infections [3]. Prophylactic use of antibiotics can reduce the incidence of SSI [2] by providing an adequate level of the antimicrobial agent in the tissues before surgery [4].

The risk of surgical site infection also depends on whether the surgery is a clean, clean-contaminated, contaminated or dirty procedure [4]. Surgical antibiotic prophylaxis (SAP) is not only intended to establish bactericidal tissue and serum levels at the time of skin incision, but also to reduce the microbial burden of intraoperative contamination to a level that cannot overcome host defenses [5]. SAP is not indicated for contaminated or dirty surgical procedures [6,7]. It is only recommended for clean-contaminated [6,8] and some of the clean procedures [6].

Appropriate selection of antibiotics depends on the knowledge of pathogens most likely to be associated with a given surgical procedure. The appropriate choice of antimicrobial agents, dosage regimen, timing, duration, and route of administration must be evidence based. Inappropriate use of antibiotic prophylaxis, for example, over-consumption or inappropriate timing [9], have been shown to increase the risk of adverse drug reactions [10], hospital costs, emergence of resistant strains of microorganisms, and super-infections [10,11]. Several studies have reported overuse and/or misuse of preoperative antibiotics in various countries [2,3,6,8,10]. Some studies also revealed that long duration of surgical prophylaxis is a

Table 1. Demographics of the study

Type of hospital	**Physicians studied N (%)**
Military	7 (6.9)
University	13 (12.7)
Public	36 (35.3)
Private	46 (45.1)
Hospital departments	**Physicians studied N (%)**
General	32 (31.4)
ENT	14 (13.7)
Orthopedic	21 (20.6)
Transplantation	2 (1.9)
Urologic	4 (4.0)
Obstetric/Gynecologic	28 (27.5)
Vascular surgery	1 (0.9)

common practice [2,8]. In this study, the American Society of Health-System Pharmacists (ASHP) guidelines [7] were used to assess the appropriateness and the degree of adherence to surgical antibiotic prophylaxis in 20 Jordanian hospitals.

Methodology

A cross-sectional survey was conducted in 20 Jordanian hospitals between October 2006 and June 2007. The survey questionnaire was distributed in those hospitals. Large hospitals (with 500 beds or more) and smaller hospitals (with 15-200 beds) were included in the study. The questionnaire was hand-delivered to 160 physicians. It consisted of closed- and open-ended questions. Open-ended questions were designed as general questions or prompts, whereas closed-ended questions were asked to investigate the participants' practice of SAP and their awareness of the ASHP guidelines. The questionnaire was designed to collect information regarding the following factors: size and type of hospital; surgeons' specialties and number within surgical team; number of surgical procedures per month; antimicrobial prophylaxis use; type of guidelines used and sources of information; antimicrobial prophylaxis indication (based on surgical wound classification); timing of the first given dose; antimicrobial dosing in surgical procedures lasting more than 4 hours; antimicrobial choice, dose, number of doses, and duration of antimicrobial prophylaxis (according to surgery type); alternative regimens; reasons for improper timing and use of antibiotics; and prevalence of SSI.

Results

Between October 2006 and June 2007, a survey was conducted in 20 hospitals distributed over 4 major Jordanian cities. Of the 160 physicians that were invited to participate, 102 (63.8%) completed the questionnaire. Types of the surveyed hospitals and departments are shown in Table 1.

Physicians reported that many sources were used to establish SAP practice guidelines. The survey showed that physicians depend mainly on textbooks (52%) and guidelines (53.9%). Cooperation with the infectious disease department or consultation of an infectious disease specialist was reported in only two hospitals. In addition, surgical wound classification was used as a basis for prescribing SAP. About 20.6% of the physicians correctly employed SAP for clean and 83.3% for clean-contaminated surgeries. However, 77.5% used SAP incorrectly for contaminated surgeries, and 71.6% for dirty operations.

ASHP guidelines require the initiation of a single antibiotic at the time of anesthesia [6]. In that respect, about half (49%) of the physicians timed the first dose of SAP with anesthesia induction. The remaining physicians timed the first dose of SAP either before anesthesia or after the operation. About 47% of physicians used more than two doses of SAP, 21% used two doses, and 32% used only one dose. Seventy-four percent of physicians employed a single prophylactic agent, whereas, only 10% used combinations of antimicrobial agents. Medical personnel responsible for prescribing the antibiotics were the physicians in 71% of the cases (Table 2).

Table 2. Descriptive analysis of surgical antibiotic prophylaxis (SAP) practice

Justification of SAP*	**N (%)**
Based on sources used by physicians to extract practice guidelines	
Guidelines	55 (54%)
• Departmental	12 (22%)
• Hospital	16 (29%)
• National	9 (16%)
• Combination of 2 or 3 guidelines	18 (33%)
Textbook	53 (52%)
Knowledge from initial training	24 (24%)
Consultation with an infectious disease physician	15 (15%)
Use of whatever antibiotic available	9 (8.8%)
Department protocol[¥]	19 (19%)
Others (Internet or personal experience)	7 (6.1%)
Based on timing of first SAP dosage	
>2 h before operation	8 (7.8%)
1–2 h before operation	14 (14%)
Less than 1 h before operation	17 (17%)
At the time of induction of anesthesia	50 (49%)
After operation	13 (13%)
Based on number of SAP doses per surgical procedure	
1 dose	33 (32%)
2 doses	21 (21%)
>2 doses	48 (47%)
Based on the responsibility for prescribing the antibiotics	
Physician	72 (71%)
Pharmacist	3 (2.9%)
Anesthesia administrator	11 (11%)
Nurse	6 (5.9%)
Shared responsibility	10 (9.8%)
Based on antimicrobial agents commonly used in SAP practice	
1st generation cephalosporins	18 (18%)
2nd generation cephalosporins	26 (26%)
3rd generation cephalosporins	32 (31%)
β -lactam-resistant penicillin	2 (2.0%)
Extended spectrum of penicillin	6 (5.9%)
Other antimicrobials	7 (6.9%)
Based on the causes of improper timingof SAP	
Work flow	34 (33%)
Lack of organizational communication	21 (21%)
Lack of knowledge of guidelines	47 (46%)
Others	2 (2.0%)
Based on causes of improper antibiotic choice	
Drug unavailable	63 (62%)
Drug cost	15 (15%)
Institution policy	15 (15%)
Patient not insured	5 (4.9%)
Others	3 (2.9%)

* Physicians were allowed to choose more than one choice for each of the parameters. [¥] Departmental protocols indicate common practice in these departments that are not necessarily developed as departmental practice guidelines.

Table 3. Comparison of surgical antibiotic prophylaxis (SAP) practices among various surgical wards

Parameter	Department N (%)		
	General surgery	Orthopedic	Obstetric or Gynecologic
Based on timing of first SAP dosage			
>2 h before operation	0	0	5 (18)
1–2 h before operation	5 (16)	1 (4.8)	7 (25)
Less than 1 h before operation	7 (22)	8 (38)	1 (3.6)
At the time of induction of anesthesia	10 (31)	10 (48)	15 (54)
After operation	10 (31)	2 (9.5)	0
Based on number of SAP doses per surgical procedure			
1 dose	9 (28)	5 (24)	11 (39)
2 doses	3 (9.4)	7 (33)	8 (29)
>2 doses	20 (62)	9 (43)	9 (32)
Based on antimicrobial agents choice commonly used in SAP practice			
First	7 (39)	5 (46)	0
Second	5 (28)	3 (27)	3 (23)
Third	6 (33)	3 (27)	11 (85)

Table 3 shows the top two to three most frequent pathogens causing surgical site infections reported by surgical departments. The survey results revealed that the antibiotic regimens used varied among the attending physicians in dosage and duration. The most commonly used antibiotic for surgical prophylaxis was ceftriaxone, followed by cefuroxime and, cephalexin. Other antibiotics such as amoxicillin and metronidazole were less frequently used. A significant percentage of physicians (46%) attributed the improper timing of SAP administration to the lack of knowledge of the guidelines, while the improper choice of SAP was mostly due to drug unavailability (62%). Surgical site infection rates were as follows: less than 1% in 56 departments; 1-5% in 44 departments; 6-20% in 2 departments; and there was no reported infection rate in one department.

Discussion

In this study, we assessed the practice and adherence to the American Society of Health-System Pharmacists (ASHP) guidelines for antimicrobial prophylaxis prior to surgery and explored reasons for non-compliance. Results showed that all of the surveyed hospital departments used SAP, which reflects the awareness among health-care professionals in Jordanian hospitals regarding the importance of prophylactic antimicrobial agents in preventing SSI. Overall, the physician's decision in selecting a prophylactic antimicrobial agent(s) was based on information taken from either textbooks or standard guidelines, which have been adopted in practice by the hospitals. All physicians used wound classification as a basis for SAP indication. Antimicrobial agents were mostly employed in clean-contaminated, contaminated, and dirty surgeries, respectively. According to ASHP guidelines, the use of antibiotics for dirty and contaminated surgeries is classified as treatment and not as prophylaxis. However, antibiotics are not indicated for clean procedures [7]. Despite this, our study shows that there were inconsistencies between ASHP guidelines and current practice. Similar findings were reported in a previous study conducted in Japan [5].

Optimal timing of antibiotic administration is considered an important factor for effective prophylaxis [12]. Inappropriate timing may result in low plasma concentration of the antimicrobial agent at the time of incision and throughout the procedure [13], contributing to higher infection rates [14]. In contrast to other studies [8,15], our results indicated that 49% of physicians administered the SAP at the time of anesthesia induction. This is considered the correct timing according to ASHP guidelines for most procedures, since this ensures adequate antibiotic concentrations in the targeted tissues during the period of potential contamination [7].

Most of the participating physicians used two or more doses of SAP, while 32.4% used only one dose. According to ASHP guidelines, minimal duration for antimicrobial coverage includes the time from incision until the closure of that incision, which is usually

covered by single antibiotic dose [7]. For most procedures, it is recommended that SAP should be discontinued within 24 hours of the procedure [7,16]. In a Czech study, SAP duration was inappropriate in 36% of the cases [8]. However, a Turkish study has reported that 12% of surgeons used a single dose of antimicrobial agent for clean-contaminated procedures, and in 20% of the selected procedures, the antibiotic prophylaxis was within less than 24 hours of the procedure [8]. In another multi-center audit performed in a Dutch hospital, 49% of the procedures had more than one antimicrobial dose administered [9]. An Indian study reported that antibiotics were administered for as long as 14 days and only 1% to 8% of surgeons who prescribed antibiotics in surgical procedures stopped prophylaxis after 24 hours [16]. Extended prophylaxis has been shown to be of no benefit [2,11,17], and is potentially harmful [2,18] due to the development of drug toxicity, super-infections [2], and bacterial resistance [2,6].

The first-generation cephalosporin, cefazolin, is regarded as the antimicrobial agent of choice for most procedures according to ASHP guidelines. It has a relatively long duration of action [7], is effective against the most commonly encountered organisms in surgical procedures, and has a relatively low cost [4,7]. In Jordanian hospitals, the third-generation cephalosporin (ceftriaxone) was most commonly used in the surveyed departments, followed by the second-generation (cefuroxime) and for limited cases the first-generation cephalosporin (cephalexin). In one study conducted in India, the most commonly prescribed antibiotics (single agent, clean procedures) were cephalosporins (39%), followed by beta-lactams and quinolones [16]. Ceftriaxone and cefuroxime were the preferred antibiotics used for SAP [16]. In another study performed in Eastern France, among 117 patients who received inappropriate SAP, 95.7% received a broad-spectrum antibiotic regimen [11]. This excessive use of broad-spectrum antibiotics for prophylaxis increases the risk for resistance [2,4,19], causes more adverse events[19], and increases health-care costs [2,19].

The reported results reveal that lack of knowledge about the ASHP guidelines was the most common reason for the improper timing of the antimicrobial prophylaxis administration, applicable to 46.1% of the cases. Therefore, continuous education programs might be helpful to overcome this problem. On the other hand, drug unavailability was the reported reason for the inappropriate antimicrobial choice in 61.8% of the cases. Approximately one third of surgeons who based their practice on any guidelines used a combination of guidelines as the basis for their clinical interventions, which indicates the urgent need for adoption of specific guidelines such as those from ASHP to ensure standardization of SAP practice in hospitals in Jordan.

Conclusion

In conclusion, physicians in Jordanian hospitals are aware of the importance of antimicrobial prophylaxis before surgical procedures. However, further efforts are needed to ensure the implementation of the accepted practices of SAP in Jordanian hospitals. This might be achieved by establishment of effective continuous medical education programs for physicians and pharmacists, and periodic assessment of compliance with evidence-based SAP guidelines.

Acknowledgements

This study was supported by Jordan University of Science and Technology.

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Conflict of interests: No conflict of interests is declared.