Physicians' Awareness of International Guidelines Regarding Prophylactic Antibiotic Use in Cardiac Surgery

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Abstract— Background: *Antimicrobial prophylaxis (AMP) use not only can increase the prevalence of antibiotic resistant strains, but also can negatively affect an institution's antibiotic budget. This prospective study aims to assess Queen Alia Heart Institute (QAHI) physicians' awareness of referral international guidelines regarding AMP in cardiac surgery and to find out obstacles against adherence to these guidelines.* **Materials and methods:** *Over a 1 month period beginning in February 2007, two pages questionnaire that requires 10 minutes to complete, was used to assess physicians' at QAHI (n=29) current practice regarding AMP in cardiac surgery and their awareness of international guidelines and their opinions regarding obstacles against adherence. The questionnaire assessed: doctor's demographic data, doctors' awareness of prophylactic antibiotic guidelines, doctors' opinion regarding the need for adopting international guidelines in antibiotic prophylaxis or to develop local institute-based guidelines and their opinions regarding obstacles against adherence to guidelines. The questionnaire was approved by the Career Ethics Committee in the Royal Medical Services and by the medical director of QAHI.* **Results:** *Response rate was 69%. 35% were anesthesiologists and 65% were surgeons. The physicians' awareness of guidelines was measured; (a) Indirectly, by analyzing their answers regarding the way they use AMP in clinical practice. (b) Directly, from the answers about their reference(s). (45%) respondents were aware of the guidelines, (55%) were not fully aware of the guidelines. When physicians were asked about their references in AMP use, the reported references in decreasing order were: self experience (40%), international guidelines (30%), text books (25%) and (5%) did not answer the question. The main identified obstacles against adherence in decreasing order were: unavailability of the antibiotic(s), lack of awareness of these guidelines, physicians' belief of having different local pattern of antimicrobial resistance and senior's preferences of AMP agents other than those in the guidelines.* **Conclusion and Recommendations:** *There is a room for improvement regarding AMP use at QAHI. We recommend the standardization of AMP protocol in the hospital, by developing a local hospital guideline by a committee that includes surgeons, anesthesiologists, microbiologists, pharmacists, and members of hospital epidemiology and infection control department, then to provide this standardized protocol to surgeons and trying to achieve consensus, before its implementation. strategies, such as: introducing a special forms for mordering preoperative antimicrobial prophylaxis, the use of an antibiotic prophylaxis chart in the operating theatres, giving the pharmacy a central role in the administration of AMP and to organize a group education and consensus meeting, to monitor prescriber behavior and prescription errors to give feedback to the prescriber.*

I. INTRODUCTION

Practice Guidelines are intended to assist physicians and other health care providers in clinical decision-making by describing a range of generally acceptable approaches for the diagnosis, management, or prevention of specific diseases or conditions (1). The last decade has seen a proliferation of evidence based clinical practice guidelines (2). Antibiotic guidelines and associated interventions have been demonstrated to be effective in improving antibiotic use (3). Some countries have incorporated these principles into a national drug policy and provided government funding for a range of activities aimed at improving rational drug use (4). Health organizations have become interested in such policies because of concern about inappropriate antibiotic prescribing and a reported increase in the prevalence of antibiotic resistant organisms (5, 6). Antibiotic resistance has been described as a major threat to global public health by the World Health

Organization (WHO) because there are now few, and, in some cases, no antibiotics available to treat certain life threatening infections (7).

Appendix 1 represents a summary of recommendations of three published international guidelines for AMP in cardiac surgery: the National Surgical Infection Prevention Project (NSIPP) "Antimicrobial prophylaxis for surgery: an advisory statement" (8), the Society of Thoracic Surgeons (STS) practice guideline series "Antibiotic prophylaxis in cardiac surgery, Part I: Duration, part II: Antibiotic choice" (1, 9), American College of Cardiology/American Heart Association (ACC/AHA) "2004 guideline update for coronary artery bypass graft surgery" (10).

Despite the availability of these guidelines, recent studies assessing the current practice of prophylaxis throughout the world have shown that over-consumption of antimicrobial drugs and inappropriate timing remains a problem in surgical prophylaxis (11, 12, 13, 14, 15, 16, 17)

In addition to monitoring and implementing interventions to improve adherence to clinical practice guidelines in AMP, obstacles against adherence should be identified. That is; in spite of the tremendous resources and efforts that have been invested in the development and implementation of clinical practice guidelines over the past 15 years (18, 19, 20), these guidelines are not uniformly successful in improving care and several obstacles against implementation have been described

(21, 22, 23). In many cases, obstacles have been related to factors extrinsic to the guideline itself e.g., organizational and provider-specific obstacles in a particular system of care that interfere with implementation success, or obstacles related to the clinicians' awareness and perception of a guideline and there support to implement that specific guideline. In other cases, however, factors intrinsic to the guideline have contributed to the obstacles against implementation, e.g., ambiguity, inconsistency, and incompleteness (22, 24, 25).

In Jordan generally and in Queen Alia Heart Institute (QAHI) specifically, AMP in cardiac surgery is not governed by national or local guidelines, respectively. Studies that assess the current clinical practice concerning AMP and that evaluate the incidence and the bacteriology of SSI in cardiac surgery in Jordan are not present until the time of this study. Studies related to this area focused on the presence of a clear evidence of antibiotic misuse and the high prevalence of nasal carriage of *Staphylococcus aureus* among Jordanian population (26, 27, 28, 29, 30). Since inappropriate prophylactic antibiotic use not only can induce the problem of antibiotic resistance, and drug toxicity but also can negatively affect an institution's antibiotic budget, initiatives to curtail inappropriate AMP use have become the focus of many drug use evaluation efforts. This study aims to assess QAHI physicians' awareness of international guidelines regarding AMP in cardiac surgery and to find out (if present) obstacles against adherence to these guidelines.

II. METHODS

Practitioners' Based Questionnaire: Researchers developed a self-completed questionnaire which had been pre-tested on a small pilot scale (n=5) and subsequently modified to ensure that the data would provide reliable information (see appendix 3). Over a 1 month period beginning in February 2007, the two pages questionnaire that requires 10 minutes to complete, was distributed to and then collected from all participants in their working places by researchers. The questionnaire assessed:

-Demographic data: doctor's name, university of first degree, year of graduation, specialty, qualifications.

-Doctors' awareness of prophylactic antibiotic guidelines through indirect questions that inquired about: the use or lack of use of AMP, the specific antibiotic agent or agents used, duration, timing, criteria used in making clinician's decisions of AMP including (patient's factors -age, sex, weight -; doctor's experience; antibiotics availability or any other criteria) and doctor's reference(s) in selecting AMP course.

-Physicians' opinion regarding the need for adopting international guidelines in antibiotic prophylaxis and the need for developing local institute-based guidelines.

-Physicians' opinions regarding obstacles against adherence to guidelines.

Most of the questions had pre-formulated answers. However, they all had extra space for other opinions. For some questions more than one choice could be selected.

The questionnaire was approved by the Career Ethics Committee in the Royal Medical Services and by the medical director of QAHI

Assessment of Obstacles against Adherence to Guidelines

According to the answers of the questions used to assess doctors' awareness of prophylactic antibiotic guidelines (Table 1) including: the use or lack of use of antibiotic prophylaxis, the specific antibiotic agent or agents used for prophylaxis, the duration of antibiotic prophylaxis and timing of antibiotic prophylaxis; physician was described as: aware: if answered all questions according to any of the previously mentioned 3 guidelines recommendations (see appendix 1), not aware: if all answers were inconsistent with any of the 3 guidelines recommendations and not fully aware if only consistent with some of the recommendations. For physicians who described as not aware, lack of awareness to guidelines was considered the main barrier against adherence. For those who were described as aware or not fully aware, opinions of possible obstacles against adherence to guidelines were analyzed. Obstacles were then arranged in term of importance according to the frequency of their selection.

TABLE 1. Criteria for Assessment of Adherence to International Guidelines

Parameter	Discordant if
Antibiotic Choice	Agent differed from recommendation (i.e. if not cefazolin, cefuroxime, cefamandol or if there is indication vancomycin , aminoglycoside, or clindamycin) A combination used when it's not indicated Any switchover from an appropriate agent to another appropriate or inappropriate agent in the same patient in the absence of microbiologic or clinical indication.
Total Duration of Prophylactic Antimicrobial Use	Duration differed from recommendation (if >48hrs or <24hrs)
Dose	Dose differed from recommendations. For pediatrics doses calculated according to body weight using Drug Information Hand Book as it is not specified by the guidelines.
Dosing Interval During Surgery	If additional dose were not given in procedures longer than the half life of the prophylactic antibiotic used Or if dosing interval exceeded the guideline by >30 min.
Dosing Interval on the Ward	Dosing interval deviated from the guideline by >60 min
Timing of First Dose at Fixed Time before Incision	Timing of first dose deviated >15 min from the recommended time, or timing of first dose was outside the recommended time-range.

Data Analysis

All data were coded, entered and analyzed using the SPSS® package for Windows version 14.0 (SPSS Inc., Chicago, IL). Frequency, percentage were calculated and presented. Relative Risk (RR) was calculated using the formula "RR=incidence rate among exposed / incidence rate among unexposed" (Kuzma *et. al.*, 2004). Statistical analysis for differences between groups was performed using Independent t-test, Chi- Square and Fisher-exact tests. Differences between groups were considered statistically significant if P values were < 0.05.

III. RESULTS

Characteristics of Respondents: Of 29 surveys distributed, completed surveys were received from 20 physicians

(response rate 69%). Seven (35%) were anesthesiologists and 13 (65%) were surgeons.

All of respondents were Jordanian board-certified and 6 out of 13 surgeons were Jordanian cardiac surgery board-certified. Twelve (60%) of respondents had been in practice for 10 years or more.

Physicians' Awareness of International Guidelines: The physicians' awareness of guidelines was measured; (a) Indirectly, by analyzing their answers regarding the way they use AMP in clinical practice. (b) Directly, from the answers about their reference(s).

a) Indirect Assessment of Physicians Awareness to International Guidelines: According to the criteria defined earlier, 9 (45%) respondents were aware of the guidelines, that is; they answered that they usually give AMP for all patients undergoing cardiac surgery, the antibiotic of choice is the second generation cephalosporin cefuroxime or vancomycin in indicated cases, the timing of 1st dose is at induction of anesthesia and the duration is no longer than 48.The remainder 11 (55%) were not fully aware of the guidelines as the answer(s) of at least one (but not all) of the 4 questions was not in concordance with any of the guidelines. Table 2 shows the frequency of answers that considered deviations from guidelines.

b) Self Reported References Regarding AMP Practice: When physicians were asked about their references in AMP use, the reported references in decreasing order were: self experience (n=8, 40%), international guidelines (n=6, 30%), text books (n=5, 25%) and one (5%) did not answer the question

TABLE 2. Frequency of Answers that were Considered Deviations from Guidelines

Deviation	Frequency (*n*)
AMP Indication:	
Give AMP, but not to all patients undergoing cardiac surgery	1
AMP Choice:	
3rd generation Cephalosporins	4
Combinations of AMP Agents that are not Recommended	6
The available antibiotic in the hospital pharmacy	1
AMP Timing:	
Timing of 1st dose in the midnight prior to surgery	2
Timing of 1st dose 2hrs prior to surgery	1
No specific answer (every 8hrs)	4
AMP Duration:	
More than 48hrs (1week)	1

The Main Identified Obstacles against Adherence to International Guidelines: From the pre-formulated answers, the main identified obstacles against adherence to guidelines in decreasing order were:

- Unavailability of the antibiotic(s) that should be used in the hospital pharmacy (n=13, 65%).
- Lack of awareness of these guidelines (n=5, 25%).
- Different local pattern of antimicrobial resistance (n=2, 10%).
- The belief that these guidelines should be investigated if they are applicable to our patients (n=2, 10%).

- In the other options, 2 (10%) physicians reported that senior's preferences of AMP agents other than those in the guidelines is an obstacle against adherence to guidelines.

The Need for Developing Local Guidelines in AMP: Most of the physicians (n=18, 90%) reported that we need to develop our own local guidelines for AMP. The following themes emerged as suggested reasons for the answer (open-ended question):

- The presence of locally different type of flora and microbial resistant strains (n=10, 50%).
- To decrease the misuse of antibiotics (n=2, 10%).
- The different set up that we have in the operating theater (n=1, 5%).
- To reduce the cost of AMP (n=1, 5%).
- To assure the availability of antibiotics in the hospital pharmacy (n=1, 5%).
- And one of the physicians reported that "although he is encouraging the idea of developing local guideline; it should be based on international guidelines with some modifications".

Two physicians (10%) reported that we do not need to develop our own local guidelines in AMP for 2 reasons:

Physician 1: "*international guidelines are applicable in other areas*"

Physician 2: "*there is no research center in Jordan nor honest personnel research, so international guidelines should be adopted*".

Association between Respondents' Characteristics and AMP: There was no association between respondents' characteristics (academic institution, board certification and years of experience) and their reported answers regarding obstacles against adherence to guidelines nor their opinions regarding the need for developing our local guidelines. But anesthesiologists were more aware of guidelines than surgeons (5 out of 7 anesthesiologists were aware, while only 4 out of 13 surgeons were aware; RR=2.3) but that was statistically not significant (*P> 0.05*).

IV. DISCUSSION

The aim of this part of our study was to find out the obstacles against adherence to international guidelines and proper AMP practice in cardiac surgery.

As lack of awareness of these guidelines is a main barrier against adherence, which is confirmed by many studies (31, 32, 33), we assessed physicians' knowledge of proper AMP use in cardiac surgery and indirectly measured their awareness of international guidelines. There were no major differences in the international guidelines recommendations regarding AMP in cardiac surgery, and the basic concepts of proper practice regarding indication, antibiotic choice, timing and duration are the same. As there is no national or local hospital guidelines and no specific adopted international guidelines in the hospital and with the different backgrounds of physicians that reflect their different medical schools and different training abroad, the assessment of their knowledge was based on the basic concepts of AMP mentioned earlier and that are nearly consistent all over the world. Our study demonstrates a

relatively high degree of unawareness of AMP guidelines among physicians. Just below half of the physicians (45%) surveyed were "aware" of the basic principles regarding AMP in cardiac surgery and the rest were "not fully aware", but none of them was classified as "unaware". For those who were "not fully aware", antibiotic choice was the main vague area. Of the 9 physicians who were classified as "aware" of guidelines, 6 reported that their reference in AMP practice was international guidelines, and 2 reported their references to be textbooks and one reported his reference to be self experience. This finding contradicts the actual practice where we found that adherence to AMP in all aspects was zero(34), and it may drive us to ask: why in spite of physicians' awareness of all (45%) or most of (55%) the main guidelines' recommendations, we still have such a low adherence? This inquiry was answered by analyzing obstacles that, in physicians' opinions, may prevent adherence to guidelines. Obstacles against adherence that were reported by physicians in our study were: unavailability of the recommended antibiotics in the hospital pharmacy, lack of awareness of international guidelines, the different pattern of antimicrobial resistance that we could have, the belief that international guidelines should be investigated if applicable to our patients and seniors preferences of AMP agents other than those recommended by guidelines.

Although the first obstacle, regarding unavailability of recommended antibiotics in the hospital pharmacy, in physicians' opinions, was the main obstacle in our study, it was not considered an obstacle in other studies. As the recommended 1st or 2nd generation cephalosporins are cheaper than the agents used, this obstacle may reflect the lack of standardization of agents used as AMP, that is; with such a wide range of prescribed agents, it is difficult to predict what agent to keep available in the hospital pharmacy. Standardization of AMP agents and including the pharmacists in the process, may overcome this obstacle. The other obstacles were consistent with the findings of other studies, like the study by Sohn *et al.*, (2002)(35) where it was reported that many surgeons did not believe that CDC SSI guidelines were directly applicable to their patients due to the differences in hospital environment and limited resources for patient care and infection control. Similarly, in Mol *et al.*, study (2004)(36) where adherence barriers to antimicrobial treatment guidelines in teaching hospital were studied and reported that residents in most teaching hospitals are not independent decision makers, and experienced specialists supervise their prescribing choices, so to change current practice we should focus on addressing both senior staff and residents. The present study also demonstrates that 90% of surveyed physicians reported the need for developing our own local guidelines for reasons such as: having a locally different antimicrobial resistant patterns, to decrease the misuse of antibiotics, having different set up in the operating theater, to reduce the cost of AMP and to assure the availability of antibiotics in the hospital pharmacy. Developing local guidelines that take into consideration institutional postoperative infection rate, the bacterial epidemiology patterns, institution-based antibiotic susceptibility data, best literature evidence and surgeons preference is an important strategy to rationalize AMP and can increase adherence to guidelines as many studies showed better adherence to local guidelines than to international guidelines (33).

V. CONCLUSION AND RECOMMENDATIONS

We recommend the standardization of AMP protocol in the hospital, either by adoption of a certain international guideline or more preferably, by developing a local hospital guideline by a committee that includes surgeons, anesthesiologists, microbiologists, pharmacists, and members of hospital epidemiology and infection control department, that is based on the specific bacterial epidemiology patterns for cardiac surgery population, the antibiotic susceptibility data, post operative infection rate and the most reported infecting microorganisms and their susceptibility pattern, the best literature evidence and surgeon preference. Then to provide this standardized protocol to surgeons and trying to achieve consensus, before its implementation. also we recommend that we should develop a plan to implement a standardized AMP protocol which includes different strategies, such as: to introduce a special forms for ordering preoperative antimicrobial prophylaxis, to use an antibiotic prophylaxis chart in the operating theatres, to give the pharmacy a central role in the administration of AMP, to organize a group education and consensus meeting, to monitor prescriber behavior and prescription errors and to give feedback to the prescriber.

Limitations of the Study

The response rate of the study (physicians' survey) was 69%; there is a possibility that there was a bias in results due to incomplete response.

Appendix 1: summary of 3 Guidelines Recommendations for AMP in Cardiothoracic Surgery

1-The National Surgical Infection Prevention Project (NSIPP) "Antimicrobial prophylaxis for surgery: an advisory statement" (8).
2- The Society of Thoracic Surgeons practice guideline series "Antibiotic prophylaxis in cardiac surgery, Part I: Duration, part II: Antibiotic choice" (1), (9).
3- American College of Cardiology/American Heart Association (ACC/AHA) "2004 guideline update for coronary artery bypass graft surgery" 10).

Guideline	Antibiotic selection	Dose and route of administration	Duration	Timing of doses
Antimicrobial Prophylaxis for Surgery: An Advisory Statement from the National Surgical Infection Prevention Project.(1)	-Cefazolin, cefuroxime or cefamandole. -If the patient has a b-lactam allergy: vancomycin or clindamycin	Cefazolin iv; 1-2 g (20–30) mg/kg standard dose. (if <80 kg, use 1 g; if >80 kg, use 2 g) End stage renal disease t½: 40-70 hr Cefuroxime iv; 1.5 g standard dose.50 mg/kg adjusted dose.End stage renal disease t½: 15-22 hr. Cefamandole iv; 1 g standard dose. End stage renal disease t½: 12.3–18 hr. Vancomycin iv infusion; 1 g over 60 min standard dose, 10–15 mg/kg (adult) adjusted. End stage renal disease t½: 44.1–406.4 hr Clindamycin iv; 600–900 mg standard dose, if <10 kg, use at least 37.5 mg; if > 10 kg, use 3–6 mg/kg. End stage renal disease. t½: 3.5–5.0 hr	24 hours	Within 60 min before incision. For vancomycin the infusion should begin within 120 min before incision. Doses should be repeated intraoperatively if the operation still in progress 2 half-lives after the first dose.
The Society of Thoracic Surgeons Practice Guideline Series: Antibiotic Prophylaxis In Cardiac Surgery.(2)	-Cefazolin. -If presumed or known MRSA colonization; Vancomycin (1-2doses)+Cefazolin. -In patients with b- lactam allergy, Vancomycin (up to 48hrs.) +aminoglycoside (one preoperative and one postoperative dose)	Cefazolin iv; 1 gm Preoperative prophylactic dose, for a patient >60 Kg it is recommended to be 2 g. Vancomycin I.V infusion over one hour; dose of 1 - 1.5 g or a weight adjusted dose of 15 mg/kg, Aminoglycoside iv; (usually gentamicin, 4 mg/kg) in addition to vancomycin prior to cardiac surgery.	for up to 48	For cefazolin; administration within 60 minutes of the skin incision, second dose of one gram should be administered every 3 - 4 hours, if long procedure. For vancomycin; administration slowly over one hour, with completion within one hour of the skin incision. For aminoglycosides; the initial dose should be administered within one hour of the skin incision
ACC/AHA 2004 Guideline Update for Coronary Artery Bypass Surgery(3)	Cephalosporin class; cefuroxime (superior efficacy compared with the other cephalosporins). Or cefazolin or cefamandol. Vancomycin; reserved for penicillin-allergic and justified in periods of methicillin-Staphylococcus species outbreaks.	Cefuroxime: 1.5 g preoperatively, 1.5 g after cardiopulmonary bypass, 1.5 g Q12bhrs. Cefamandole, cefazolin : 1 g preoperatively, 1 g at sternotomy, 1 g after cardiopulmonary bypass, 1 g Q6bhrs.b Vancomycin 1 g Q12/h/until lines/tubes out. At least 2 doses.	For 48 hours	Initial dose to be given 30-60 minutes before Skin incision. Vancomycin: 30 60-minute infusion timed to end before skin incision.

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Doctors Questionnaire

Dear colleague:

This questionnaire aims to assess the clinical practice of prophylactic antibiotic use in cardiac surgery in Jordan. It consists of 11 questions, some are open ended and others are closed ended questions. It'll take you about (10-15) minutes to fill it in.

Thanks for your cooperation.

Doctor's name: Year of graduation:

University of first degree: Specialty:

Qualifications: Working place:

Please answer the following questions:

1) Do you usually give prophylactic antibiotics to patients undergoing cardiac surgery?

☐ Yes ☐ Rarely	☐ Most Of the Times	☐ Sometimes	☐ No

2) What is/are antibiotic(s) that you most commonly use as prophylactic antibiotic in cardiac surgery?

....
....
....
....

3) For how long (total duration) do you use prophylactic antibiotics in cardiac surgeries?

☐ One dose ☐ 1 day ☐ 2 days ☐ 1 week
☐ Other duration: (Mention).........................

4) What is the timing of doses? ....

....
....
....

5) What is/are the factor(s) that mostly affect your choice of prophylactic antibiotic and the duration of its use?

☐ Your experience of antimicrobial susceptibility
☐ Patient's factors (age, sex, wt)
☐ Availability
☐ Other factors (mention):

....
....

6) What is your reference for prophylactic antibiotic use in cardiac surgery?

☐ International guidelines (mention)..
☐ Text books (mention)..
☐ Clinical trials (mention)..
☐ Self experience (mention)...
☐ Local guidelines in the hospital (mention)................................
☐ Others (mention)...

7) Do you think that we should adopt international guidelines for antibiotic prophylaxis?

☐ Yes, (move to question 8)

☐ No ,(move to question 10)

If yes:

8)*Which one do you recommend (name or origin of guideline)?

....

....

....

9)*what obstacles do you think may prevent you from applying international guidelines?

☐ Lack of awareness of these guidelines.

☐ Availability of antibiotics.

☐ Others (mention)..

....

If no:

10) What are the causes that prevent you from adopting international guidelines for antibiotic prophylaxis?

☐ Different pattern of microbial resistance.

☐ Lack of awareness of these guidelines.

☐ Self experience is more reliable.

☐ Antibiotic that should be used are not available in hospital pharmacy.

☐ You believe that these guidelines should be investigated if they are applicable to our patients.

☐ Others (mention). ....

....

....

11) Do you think that we need to develop our local guidelines (in Jordan) for antibiotic prophylaxis?

☐ Yes, why?..

....

....

....

☐ No, why?..