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Evaluation of the Prophylactic Antibiotic Policies of Cardiac Surgery in a University Teaching Hospital

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ABSTRACT

Antimicrobial prophylaxis in cardiac surgery has been demonstrated to lower the incidence of postoperative infection. Inappropriate antimicrobial prophylaxis, as inappropriate selection of the antimicrobial agent or dosing regimen, can increase the prevalence of antibiotic resistant strains, prolong hospital stay, cause postoperative infection, and negatively affect an institution's pharmacy budget for antibiotics. To assess the current postoperative prophylactic antibiotic protocols applied in the cardiac surgeries department in Ain Shams University teaching hospitals with respect to others and to international guidelines for antimicrobial prophylaxis practice in cardiac surgery. Total of 320 paediatric and adult patients who were admitted for cardiac surgery to Ain Shams University teaching hospitals from September 2012 till March 2013.The antimicrobial prophylaxis indication, choice, duration, dose, dosing interval, and timing appropriateness were assessed against 3 international guidelines using a pre-tested, structured clinical data collection form. All patients were monitored daily during their inpatient stay until discharge. Data regarding surgery duration, mechanical ventilation duration, intensive care unit stay, postoperative stay and total hospital stay were obtained. Adherence to all antimicrobial prophylaxis guidelines was not achieved for any study patients. A statistical significant difference for the mechanical ventilation duration, intensive care unit stay, postoperative stay and total hospital stay were found concerning both the paediatrics and the adults between the infected and non-infected group. Study findings indicate that adherence to international guidelines for antimicrobial prophylaxis is far from optimal in cardiothoracic department at Ain Shams University teaching hospitals, leading to the inappropriate administration of many antibiotics.

Keywords: Prophylactic Antibiotic, Antibiotic Resistance, Nosocomial Infection, Clinical Pharmacy.

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INTRODUCTION

Cardiac surgery is an essential treatment for severe coronary artery disease, valvular heart disease, congenital heart disease and other vascular diseases. Surgical intervention aims to save lives and improve the quality of life of patients with cardiac diseases[1]. Although cardiac surgery is generally considered a clean procedure, antibiotic prophylaxis has been demonstrated to lower the incidence of surgical site infection. Surgical site infections of the sternal wound and underlying mediastinum occur in 0.4%-4% of cardiac surgical procedures, with over 50% due to the coagulase-positive *Staphylococcus aureus* or the coagulase negative *Staphylococcus epidermidis*[2]**.** Patients who develop surgical site infections after coronary artery bypass graft (CABG) surgery have a mortality rate of 22% at 1 year compared with 0.6% for those who do not develop a surgical site infection[3]**.** 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[4]. The last decade has seen a proliferation of evidence-based clinical practice guidelines[5]**.** Antibiotic guidelines and associated interventions have been demonstrated to be effective in improving antibiotic use[6]. Organizations that have promulgated guidelines for antimicrobial prophylaxis in cardiac surgery include the National Surgical Infection Prevention Project (NSIPP)[7], the Society of Thoracic Surgeons (STS)[2,4],and the Clinical practice guidelines for antimicrobial prophylaxis in surgery[8]. Despite the availability of these guidelines, recent studies assessing the current practice of prophylaxis throughout the world have shown that inappropriate antibiotic choice, excessive duration of use, and inappropriate timing of antimicrobial drugs remains a problem in surgical prophylaxis[9]. In Egypt in general and, specifically, in the cardiac surgeries department in Ain Shams University teaching hospitals, in which the present study was conducted, antimicrobial prophylaxis in cardiac surgery is not governed either by national or by local guidelines[10]. This problem is typical of other developing countries[11]**.**Studies that assess the current clinical practice of antimicrobial prophylaxis in Egypt were lacking until the present study[12]. Previous research in this topic area focused on the presence of a clear evidence of antibiotic misuse among the Egyptian population[13]. In light of this absence of local or institutional antimicrobial prophylaxis guidelines, the present study used the aforementioned 3 international guidelines-NSIPP, STS, and the Clinical practice guidelines for antimicrobial prophylaxis in surgery-to assess the appropriateness and compliance of antibiotic prophylaxis practices in cardiac surgery within the cardiac surgeries department in Ain Shams Universities teaching hospitals[4].

Study design: Prospective observational study.

Setting: Ain Shams University teaching hospitals.

MATERIALS AND METHODS

This study comprised 320 patients referred to the unit of cardiac surgery department in A in Shams University Hospitals, Cairo, Egypt to undergo various surgical operations to repair their congenital anomalies from September 2012 till March 2013.The study was approved by the ethical committee of faculty of pharmacy Ain Shams University.

Inclusion criteria

All ages adult and paediatric, patients undergoing elective valvularsurgery (repair or replacement), patients undergoing elective congenital heart surgery (corrective and palliative surgery) and patients undergoing elective coronary heart surgery (bypass).

Exclusion criteria

Patients other than cardiac surgery, preoperative active infection who received treatment within one month before surgery, emergency surgery, Beta-lactamic antibiotic allergy and Immune deficiency diseases. The patients were classified according to the occurrence of postoperative infection and according to age category into:

Group I (N=103):- patients with postoperative infection whether they are paediatrics **(Group IA, N=44)** or adults **(Group IB, N=59).**

Group II (N=217):- patients without postoperative infection whether they are paediatrics **(Group IIA, N=91)** or adults **(Group IIB, N=126).**

All patients were subjected to: history taking prospectively, general clinical examination, laboratory examination, Chest X-ray and Two-dimensional transthoracic echocardiographic (postoperatively).

The following were recorded

Wound care technique , frequency , antiseptic material used, observations and hemodynamics in the ICU, the reference range of the laboratory findings at the central laboratories in Ain Shams educational hospitals Patient preparation pre- and post-operative, types of invasive lines and catheters durations of stay in the hospital, morbidity and mortality, number of doses of all antibiotics used postoperatively, the three protocols applied as postoperative prophylactic regimens from September 2012 till March 2013, prophylactic antibiotic and antifungal used, number of surgery rooms, nurses to patients ratio in the intensive care unit and clinical manifestation of postoperative infection.

Statistical analysis

Data management and analysis were performed using Statistical Package for Social Sciences (SPSS) version 20and the figures were performed using Microsoft Excel 2013 where, unpaired student t-test was used to compare the quantitative variables between the infected and non-infected patients and Chi square test was used to compare the qualitative variables between the infected and non-infected patients,*p*-values<0.05 were considered significant**.**

RESULTS AND DISCUSSION

From September 2012 till June 2013, a total number of 320 patients, 135 Paediatrics (61 males and 74 females) and 185 Adults (106 males and 79 females), were fulfilling the inclusion criteria in the study. The adult patients' ages ranged from 18-78 years with mean ± standard deviation (SD) of 44.96 ± 13.39, and their weights ranged from 45-100 kg with mean ± SDof 68.76 ± 11.58, while the paediatric patients' ages ranged from 0.08-16 years with mean ± SD of 3.82 ± 4.21, and their weights ranged from 3-60 kg with mean ± SD of 13.37 ± 10.78. The characteristics of the study population (*n* = 320) are shown in (table 1).For the paediatric patients there is no statistical difference for all the postoperative laboratory findings between the infected and non-infected groups and for the adult patients there is no statistical difference for all the post-operative laboratory findings between the infected and non-infected groups except for the white blood cells finding. For the paediatric patients and concerning the duration of exposure to infection, there is a statistical significant difference for the surgery duration, mechanical ventilation, intensive care unit stay, postoperative stay and the total hospital stay while it is insignificant for the preoperative stay while for the adult patients and concerning the duration of exposure to infection, there is a statistical significant difference for the preoperative stay, mechanical ventilation, intensive care unit stay, postoperative stay and the total hospital stay while it is insignificant for the surgery duration**(table 1)**. Concerning the antibiotic use and for the paediatric patients, there is a statistical significant difference for the total antibiotic doses used and the duration of protocol administration while it is insignificant for the number of antibiotics used **(figure 1, 3)** and for the adult patients and concerning the antibiotic use there is a statistical significant difference for the total antibiotic doses used and the duration of protocol administration and the number of antibiotics used (figure 2, 4). The diagnoses and surgical procedures with their frequency distribution are shown in (table 2) as For group I Paediatric patients the highest number of patients underwent Ventricular Septal Defect Closure Surgery(20.5%) and Total Repair(20.5%) and For group I Adult patients the highest number of patients underwent Mitral valve replacement Surgery(42.4%) also For group II Paediatric patients the highest number of patients underwent Patent ductusarteriosis Surgery(26.4%) and For group II Adult patients the highest number of patients underwent Coronary artery bypass graft Surgery(42.9%). The nosocomial infection rates are shown in **table** (**3**) where surgical site infections in group I adult patients represent the highest frequency (10.8%) among the infection types followed by the blood stream infections in the paediatric patients (4.4%) and regarding the paediatric patients, there were no urinary tract infection, endocarditis, and surgical site infection in the leg or pericarditis . Asperigellus flavus fundus on the valve was present in one adult patient, which is considered a rare infection. Endocarditis, surgical site infection in the leg and pericarditis occurred once in the adult patients. Microorganisms isolated in Group I (Patients with postoperative infection) were shown in table (4). For the paediatric patients 6 cultures of the 14 blood cultures done gave no growth, while 2 patients (14.2%) resulted for Staphylococcus coagulase and 2 patients (14.2%) resulted for Enterococci species, 1 culture of the 23 wound cultures gave no growth, while 1 patients (4.3%) resulted for Non-hemolytic streptococci and 1 patient (4.3%) resulted for Candida, 1 culture of the 4 *endotracheal tube* cultures gave no growth, while 1 patients (25%) resulted for Enterococci species. However For the adult patients, 3 cultures of the 14 blood cultures done gave no growth, while 1 patients (7.1%) resulted for Aspergillus flavus, 15 cultures of the 23 wound cultures gave no growth, while 2 patients (8.7%) resulted for Staphylococcus auries, 1 patient (4.3%) resulted for Staphylococcus coagulase, 2 patients (8.7%) resulted for Enterococci species, 1 patient (4.3%) resulted for MRSA, 2 patients (8.7%) resulted for Klebsiella, 1 patient (4.3%) resulted for Acinetobacter species, 2 patients (8.7%) resulted for Proteus mirabillis. 1 culture of the 4 *endotracheal tube* cultures gave no growth, while 1 patients (25%) resulted for Enterococci species, 3 cultures of the 14 blood cultures done gave no growth, while 1 patients (7.1%) resulted for Aspergillus flavus, 2 cultures of the 2 *urine* cultures gave no growth(Table 4). The criteria used for evaluating the adherence of the used protocols to three international guidelines are shown in table (5), as 100 % of the patients adhered to the criteria concerning the decision of choosing antimicrobial prophylaxis while no one adhered to the appropriate antibiotic choice, 5 patients (1.6%) adhered to the appropriate total duration of antimicrobial prophylaxis use which is 48 hours following the surgery and no one followed the appropriate dose as no one followed the appropriate antibiotic choice, no one followed the appropriate timing of first dose as it was randomly taken. The net result is that 0% followed all the recommendations of any of the three guidelines. The study is evaluating practitioner adherence to antibiotic prophylaxis guidelines through data collection, which was collected, from patients' files, medication sheets, and prescriptions. The compliance of current prophylactic antibiotic practices in cardiac surgery at the unit of cardiac surgery department in Ain Shams University Hospitals with 3 published international guidelines was assessed. These guidelines were from the NSIPP (Antimicrobial prophylaxis for surgery: an advisory statement) [7], the STS (Antibiotic prophylaxis in cardiac surgery, part I: duration, and part II: antibiotic choice) [2,4], and the Clinical practice guidelines for antimicrobial prophylaxis in surgery[8].Parameters were also evaluated separately, so that non adherence to 1 parameter did not preclude assessment of the others. Rates of adherence to international guidelines for indication, choice, total duration, dose and timing were calculated. The present study clearly shows that adherence to the international guidelines for antimicrobial prophylaxis is far from optimal. One of the most disappointing findings of this study was that no patient's care adhered to all guideline parameters. While this result is consistent with those of similar studies in Iran and Nicaragua and Jordan where rates of complete adherence to practice guidelines were 0.3%[14]and 7%[15], and 0%[16]. Higher percentages of adherence to antimicrobial prophylaxis guidelines have been reported in other studies. Gorecki et al. (1999, United States), van Kasteren et al. (2003, the Netherlands), Lallemand et al. (2002, France), and Voit et al. (2005, United States) found in their studies that overall adherence was achieved in 26 %[17], 28 %[18], 41.1%[19], and approximately 50%[20]of surgical patients. Use of antibiotics for longer than the recommended period, especially in the absence of any evidence of secondary infection or surgical site infection until the day of discharge in an attempt to prevent infection while patients were hospitalized, was observed in 98.4% of our study patients as the duration of the protocol administration in our study is 7.2±3.9 days for group IA (paediatric patients with postoperative infection) and 5.6±2 days for group IIA (paediatric patients without postoperative infection) and inspite of the significant difference between them

(*P-value*=0.012) which indicates the more duration of the protocol administration in the infected group, still both groups don't follow the international guidelines that recommend a maximum of 48 hours antibiotic administration following the cardiac surgery. Also, some other researchers like Askarian et al., Thomas et al., Hu et al. and Al-Momany et al have reported this**.** Prolonged antibiotic prophylaxis is, at best, of no benefit and, at worst, potentially harmful to patients because of drug toxicity, the risk of super-infection, and the risk of inducing more bacterial resistance, both in surgical patients and throughout the hospital [21,22,23]**.** A review of the literature revealed a good correlation between the length of surgical procedure and post-operative infection rate[24].In general, cardiac surgery patients invariably leave the operating room with indwelling chest catheters and central venous and arterial lines that can be potential routes for bacterial entry and increase the risk of infection. Gupita *et al*. found that surgery lasting for >5 h is an independent factor predisposing to surgical site infection[26]however Lee *et al.* found no statistical significance different (*P= 0.427*) for the operation time between group with surgical site infection and group without surgical site infection[25]and the same was found by Sohn*et al*. (*P=0.13*)[26]while in our study we found that there is a statistical significant difference (*P=0.009*) in the surgical duration between the infected and non-infected groups in the paediatric patients where it is non-significant (*P=0.115*) between the infected and non-infected groups in the adult patients**.** And concerning the mechanical ventilation duration we also found a statistical significant difference between the infected and non-infected groups in the paediatric patients (*P=0.006)* and in the adult patients *(P=0.029).* The length of pre-operative hospitalization is associated with surgical site infections[27]. Minimal preoperative hospitalization would lessen the chances of nosocomial infection, which would likely reduce the risk of surgical site infection. Lee *et al*. found a statistical significant difference *(P=0.008*) for the preoperative hospital stay between patients without surgical site infections and patients with postoperative surgical site infections, also Nosrati*et al* found that there is a statistical significant difference for the preoperative stay (*P=0.021*) while our study found a statistical significant difference (*P=0.008*) for the preoperative hospital stay between the infected and non-infected groups in the adult patients where the difference is not significant (P=0.213) between the infected and non-infected groups in the paediatric patients[25,28]. From the previous findings concerning the preoperative stay, the surgery duration and the mechanical ventilation duration, the significant difference in our study and in other studies between the infected and the non-infected groups indicate that these factors are probably predisposing risk factors for the nosocomial infection, which may be due to the increase in the duration of exposure to infection. Lee *et al.* found that cases with surgical site infection had a longer intensive care unit stays (*P* <0.001), postoperative ventilation days (*P* <0.001) and total hospital days (*P* <0.001) than those without surgical site infection[25]and these are consistent with our study where we found that for the paediatric patients there is a statistical significant difference for the intensive care unit stay (*P=0.000*), the postoperative stay (*P=0.002*) and the total hospital stay (*P=0.003*), also for the adult patients there is a statistical significant difference for the ICU stay (*P=0.001*), the postoperative stay (*P=0.000*) and the total hospital stay (*P=0.000*). Nosrati*et al* found that there is a statistical significant difference for the postoperative stay (*P=0.001*)[28]which is similar to our results as for the adult patients there is a statistical significant difference for the postoperative stay (*P=0.000*) also for the paediatric patients there is a statistical significant difference for the postoperative stay (*P=0.002*). In our study, the length of stay for our patients was longer than other studies[25,28]. Postoperative stay for our patients was also longer than other countries, possibly because we do not have a formal protocol for the discharge of postoperative cardiac patients. Intensive care unit length of stay has been used as a surrogate measure of resource utilization in the intensive care unit as it is one of the primary cost-effectiveness parameters, another measure is the duration of mechanical ventilation, as this is one of the most common procedures in the cardiac intensive care unit[29].The major component of the excess cost independently attributable to nosocomial infection was the prolonged postoperative stay. This finding accords with several previous studies, in which 65-80% of the additional costs of nosocomial were attributed to prolonged length of stay[30.] Prolongation of antibiotic administration beyond the immediate preoperative period does not appear to improve results;consequently, prolonged postoperative administration of preventive antibiotics increases antibiotic-associated morbidity, increases the resistance of nosocomial bacteria, and increases costs[31]**.** Moreover, the cost issue was obvious in our study as the total antibiotic doses used whether for the non-infected groups (35.21±12.51 and 42.07±11.11 for the paediatric patients and the adult patients respectively) or the infected groups (43.41±22.15 and 55.54±24.37 for the paediatric patients and the adult patients respectively) were very high due to of course the increase prophylactic regimen duration and this by turn increases the cost burden on the hospital as well as the indirect costs related to the productivity and the non-medical costs on the patients and the patient relatives. In our study, we found that 2.2% of 44 paediatric patients with postoperative infection developed surgical site infection. This rate is lower than rates reported in cohort studies in San Francisco (6.3%) [26], Finland (4.4%) [32,]Canada (4.3%) [33], the United States (2.3%) [34]and Israeli study (8%)[35]. On the other hand in our study 10.8% of 59 adult patients with postoperative infection developed surgical site infection. It is well obvious in our study that most of the microbial cultures done produced no growth in the Laboratory results, which may be due to the inappropriate timing of culture intake as the cultures were taken from the infected patients while they were taking the antibiotic regimen of the prescribed protocol. Concerning the microorganisms appeared in the Laboratory results for the postoperative infected paediatric cases, 42.8% results in no growth, 14.2% results in Staphylococcus coagulase and 14.2% results in Enterococci species that appeared in the blood cultures. On the other side for the postoperative infected adult cases, 21.4% results in no growth and 7.1% results Aspergillus flavus appeared in the blood culture as one of the drawbacks concerning the microbial culture intake in the cardiac surgery department is that no culture is taken except after the appearance of the surgical site infection or fever, as cultures must be taken following the surgery with the appearance of the high platelet counts and the increase in the WBCs counts which is a sign of postoperative infection. Lee *et al.* found that Ten (4.4%) of the 225 cases without surgical site infection died, whereas five (14.3%) of the 35 cases with surgical site infection died. Of the five fatal cases with surgical site infection, the causes of death were sepsis (n = 1) and heart-related causes (n = 4)[25]. while our study found that five (5.5%) of the 91 cases of the paediatric patients without postoperative infection died, whereas nine (20.5%) of the 44 cases of the paediatric patients with postoperative infection died with a significant difference between them (P=0.008), also we found that no-one of the 126 cases of the adult patients without postoperative infection died, whereas four (6.8%) of the 59 cases of the paediatric patients with postoperative infection died with a significant difference between them (P=0.003) which suggest that postoperative infection is one of the leading reasons to death postoperatively in open heart surgeries. Antibiotic-resistance creates an enormous clinical and financial burden on healthcare systems worldwide, as the antimicrobial resistance among bacteria is an increasing threat where in hospital environment, particularly in the intensive care unit, antibiotic use is extensive, resulting in selective pressure for antibiotic-resistant pathogens[36]. Our study is limited by its observational nature. We were dependent on existing medical and surgical records, which varied in their level of detail. Because many patients require multistage procedures, we attempted to acquire follow-up data through subsequent hospitalizations and clinic visits, but likely have missed some infections. An additional challenge is the 1-year postoperative surveillance period required to completely identify late infections.

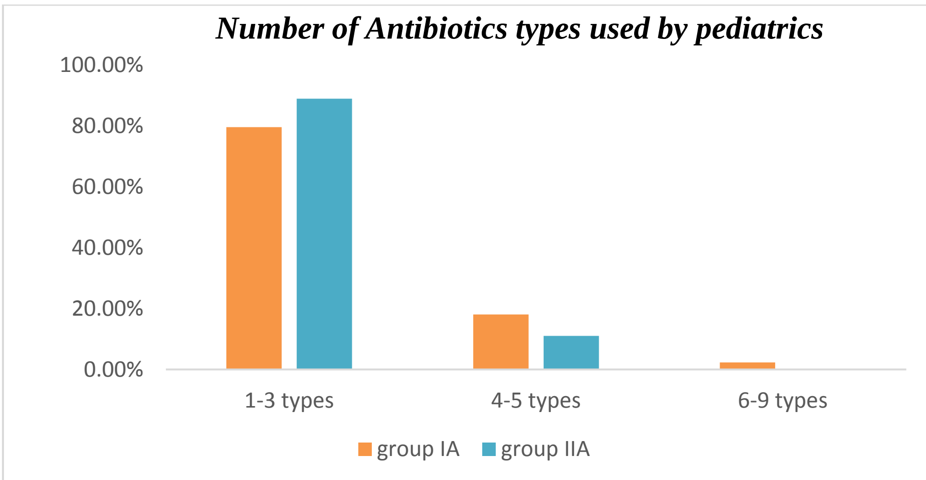

Figure 1: The percentage of the number of antibiotic types used for Group IA (paediatric patients with postoperative infection) and Group IIA (paediatric patients without postoperative infection)

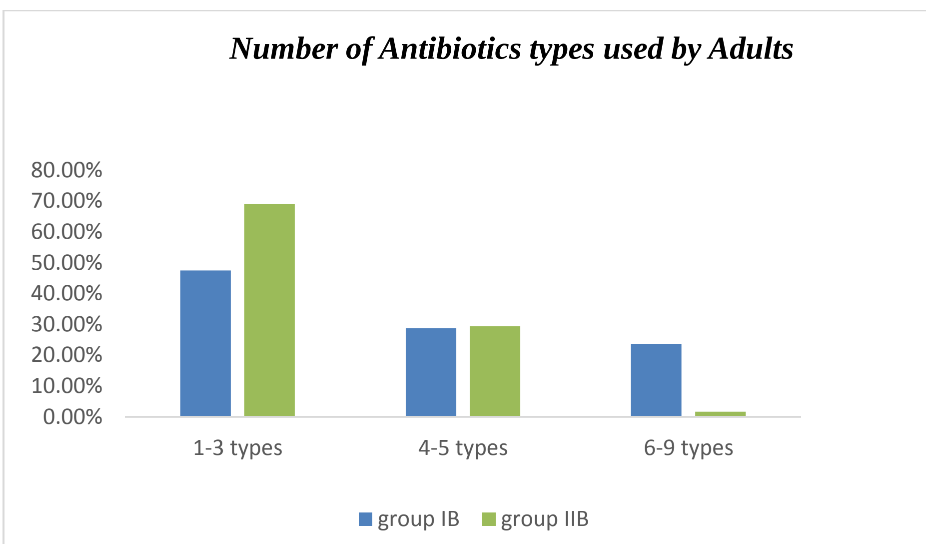

Figure 2: The percentage of the number of antibiotic types used for Group IB (Adult patients with postoperative infection) and Group IIB (Adult patients without postoperative infection)

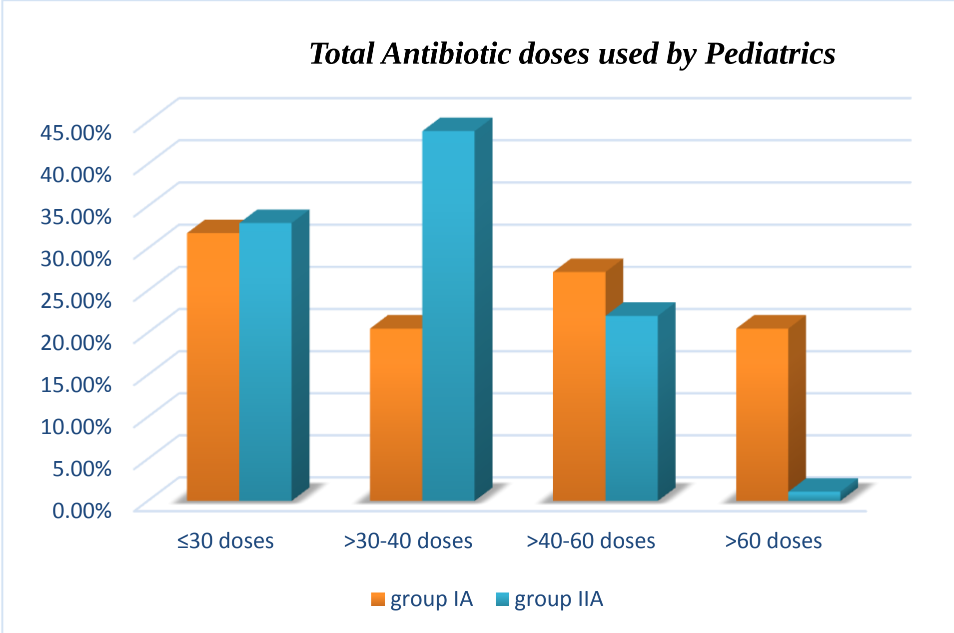

Figure 3: The percentage of the total antibiotic doses used for Group IA (paediatric patients with postoperative infection) and Group IIA (paediatric patients without postoperative infection)

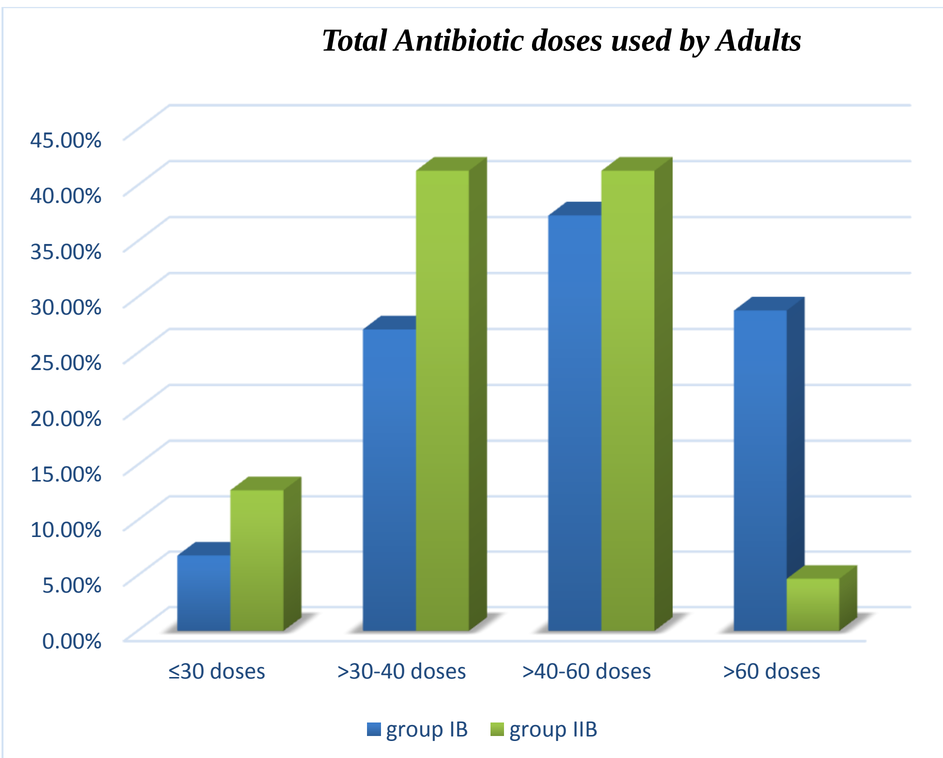

Figure 4: The percentage of the total antibiotic doses used for Group IB (Adult patients with postoperative infection) and Group IIB (Adult patients without postoperative infection)

Table 1: Characteristics of the studied groups

Variable	***Paediatric patients***				***Adult patients***			
	Group IA (N=44) Mean ± SD	Group IIA (N=91) Mean ± SD	*P-value*	Sign.	Group IB (N=59) Mean ± SD	Group IIB (N=126) Mean ± SD	*P-value*	Sign.
Demographics								
Age (years)	3.82 ± 4.21	4.34 ± 4.33	0.030	Sig.	44.96 ± 13.39	45.47 ± 14.07	0.419	NS
Weight (kilograms)	13.37 ± 10.78	14.59 ± 11.48	0.038	Sig.	68.76 ± 11.58	68.64 ± 10.84	0.718	NS
Sex (Male/Female) (n)	26/18	35/56	0.028	Sig.	30/29	76/50	0.225	NS
Postoperative Laboratory Findings								
WBCs (x10/cmm)	22.2±5.2	15.8±16	0.0001	Sig.	20.3±8.7	13.5±3.6	0.0001	Sig.
Platelets (x10/cmm)	177.6±138.2	193.9±122.5	0.512	NS	141.6±63.1	150.6±68.6	0.387	NS
Durations of exposure to infection								
Preoperative stay (days)	4.6±4.4	3.75±2.04	0.213	NS	6.6±7.8	3.7 ±1.8	0.008	Sig.
Surgery duration (min)	249.2±62.6	216±78.7	0.009	Sig.	281.1±68.7	237.8±43.7	0.115	NS
M.Ventilation duration (hrs)	41.5±50.2	18.6±23.2	0.006	Sig.	19.7±11.4	15.9±8.9	0.029	Sig.
Durations of stay in the hospital								
ICU stay (days)	6.4±4.4	3.6±2.1	0.000	Sig.	4.8±3.3	3.2±1.89	0.001	Sig.
Postoperative stay (days)	9.9±5.9	6.86±2.2	0.002	Sig.	12.2±6.2	9..04±3.87	0.0001	Sig.
Total hospital stay (days)	14.5±7.9	10.62±2.8	0.003	Sig.	19.3±11.1	12.79±4.13	0.0001	Sig.
Antibiotic use								
Number of antibiotics used	3.16±1.14	2.85±0.59	0.093	NS	4.12±1.58	3.27±0.79	0.0001	Sig.
Total antibiotic doses	43.41±22.15	35.21±12.51	0.026	Sig.	55.54±24.37	42.07±11.11	0.0001	Sig.
Protocol duration								
Duration of protocol administration(days)	7.2±3.9	5.6±2	0.012	Sig.	6.6±2.7	5.6±1.1	0.013	Sig.

N: number of patients, Sig.: significant.

Table 2: Types of cardiac surgery of the study patients (N=320):

Variable	***Group I (Patients with postoperative infection)***		***Group II (Patients without postoperative infection)***	
	Group IA: Paediatric patients (N=44)		***Group II A:Paediatric patients (N=91)***	
	No. of patients	**Percentage (%)**	**No. of patients**	**Percentage (%)**
Mitral valve replacement	0	0%	4	4.4%
Double valve replacement	0	0%	1	1.1%
Atrial septal defect closure	5	11.4%	15	16.5%
Ventricular septal defect closure	9	20.5%	15	16.5%
Patent ductus arteriosis	1	2.3%	24	26.4%
Total repair of Fallot Tetralogy	16	36.4%	15	16.5%
Aortic valve replacement	3	6.8%	2	2.2%
Arterial Switch	5	11.4%	12	13.2%
Right Blalock Taussing shunt	1	2.3%	3	3.3%
Pulmonary Stenosis	4	9.1%	0	0%
Variable	*Group IB: Adult patients (N=59)*		*Group II B:Adult patients (N=126)*	
	No. of patients	Percentage (%)	No. of patients	Percentage (%)
Mitral valve replacement	27	45.8%	37	29.4%
Aortic valve replacement	5	13.6%	9	7.1%
Double valve replacement	8	30.5%	14	11.1%
Coronary artery bypass graft	18	1.7%	57	45.2%
Atrial septal defect closure	1	8.5%	4	3.2%
Ventricular septal defect closure	0	0%	2	1.6%
Total repair of Fallot Tetralogy	0	0%	1	0.8%
Arterial Switch or mustard	0	0%	2	1.6%

N= number of patients**.**

Table 3: Infection types of Group I (patients with postoperative infection) (N=103):

Variable	**Group I (Patients with postoperative infection)**			
	Group IA: Paediatric patients (N=44)		**Group IB: Adult patients (N=59)**	
	No. of patients	**Percentage (%)**	**No. of patients**	**Percentage (%)**
Surgical site infection	3	2.2%	20	10.8%
Blood stream infection	6	4.4%	2	1%
Pneumonia	2	1.5%	4	2%
Urinary tract infection	0	0%	2	1%
Endocarditis	0	0%	1	0.5%
Asperigellus flavus fundus on the valve	0	0%	1	0.5%
Surgical site infection in the leg	0	0%	1	0.5%
Pericarditis	0	0%	1	0.5%

N=number of patients.

Table 4: Microorganisms isolated in Group I (patients with postoperative infection) (N=103):

Variable	***Group I (Patients with postoperative infection)***							
	Blood culture(N=14)		***Wound culture(N= 23)***		***Urine culture(N=2)***		***Endotracheal tube culture (N=4)***	
	No. of patients	**Percentage (%)**	**No. of patients**	**Percentage (%)**	**No. of patients**	**Percentage (%)**	**No. of patients**	**Percentage (%)**
Group IA: Paediatric patients (N=44)								
No growth	6	42.8%	1	4.3%	0	0%	1	25%
Gram +ve cocci								
Staphylococcus auries	0	0%	0	0%	0	0%	0	0%
Staphylococcus coagulase	2	14.2%	0	0%	0	0%	0	0%
Enterococci species	2	14.2%	0	0%	0	0%	1	25%
MRSA	0	0%	0	0%	0	0%	0	0%
Streptococcus pneumonia	0	0%	0	0%	0	0%	0	0%
Non-hemolytic	0	0%	1	4.3%	0	0%	0	0%

streptococci								
Gram –ve bacilli								
Klebsiella	0	0%	0	0%	0	0%	0	0%
Acinetobacter species	0	0%	0	0%	0	0%	0	0%
Proteus mirabilis	0	0%	0	0%	0	0%	0	0%
Fungus								
Candida	0	0%	1	4.3%	0	0%	0	0%
Aspergillus flavus	0	0%	0	0%	0	0%	0	0%
Group IB: Adult patients (N=59)								
No growth	3	21.4%	15	65.2%	2	100%	1	25%
Gram +ve cocci								
Staphylococcus auries	0	0%	2	8.7%	0	0%	0	0%
Staphylococcus coagulase	0	0%	1	4.3%	0	0%	0	0%
Enterococci species	0	0%	2	8.7%	0	0%	0	0%
MRSA	0	0%	1	4.3%	0	0%	0	0%
Streptococcus pneumonia	0	0%	0	0%	0	0%	1	25%
Non-hemolytic streptococci	0	0%	0	0%	0	0%	0	0%
Gram –ve bacilli								
Klebsiella	0	0%	2	8.7%	0	0%	0	0%
Acinetobacter species	0	0%	1	4.3%	0	0%	0	0%
Proteus mirabilis	0	0%	2	8.7%	0	0%	0	0%
Fungus								
Candida	0	0%	0	0%	0	0%	0	0%
Aspergillusflavus	1	7.1%	0	0%	0	0%	0	0%

MRSA=Methicillin Resistant Staphylococcus Auries, N=number of patient

Table 5: Adherence to the International Guidelines in Antimicrobial Prophylaxis in Cardiac Surgery:

International Guidelines	**Recommendation Criteria**	**Number (%) Meeting Criteria (Concordant With any of A,B,C) (N = 320)**
A = NSIPP 2005 B = STS 2006-2007 C = Clinical practice guidelines for antimicrobial prophylaxis in surgery 2013	1. Appropriate decision making regarding use of antimicrobial prophylaxis (indication)	320 (100%)
Any antimicrobial prophylaxis recommended by A,B,C	2. Appropriate antibiotic choice	0 (0%)
Any recommended duration by A,B,C	3. Appropriate total duration of antimicrobial prophylaxis use	5 (1.6%)
Any recommended dose by A, B, C. For paediatric doses calculated according to body weight c	4. Appropriate dose	-
Any recommended appropriate timing of first dose by A,B,C	6. Appropriate timing of first dose at fixed time (within 30-60 minutes before incision)	-
Any of the guideline A,B,C	Appropriate compliance with all recommendations	0(0%)

NSIPP = National Surgical Infection Prevention Project; **STS** = the Society of Thoracic Surgeons.

CONCLUSION

Study findings indicate that adherence to international guidelines for antimicrobial prophylaxis is far from optimal in cardiothoracic department at Ain Shams University teaching hospitals, leading to the inappropriate administration of many antibiotics. Developing local hospital guidelines, as well as giving the clinical pharmacist a central role in the administration, monitoring, and intervention of antimicrobial prophylaxis may improve the current practice.

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