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Investigation of current practice on antibiotic prophylaxis for orthopedic surgeries of closed fractures in Egypt

A. Hassan[1,2]*, H. Rabie[2], Emad GK Mohamed Elbanna[3]

[1]*Department of Clinical Pharmacy, College of Pharmacy, Jouf University, P.O. Box 2014, Sakaka, Aljouf, KSA.*
[2]*Department of Clinical Pharmacy, Faculty of Pharmacy, Beni-Suef University, Alshaheed Shehata Ahmed Hegazy St., 62574, Beni-Suef, Egypt.*
[3]*Department of Orthopedic Surgery, Faculty of Medicine, Beni-Suef University, Beni-Suef, Egypt.*

Abstract

Background: Antibiotic prophylaxis for patients undergoing closed fracture surgeries is crucial to reduce the risk of infections and bacterial resistance, but its practice in Egypt and the Middle East remained unexplored.

Objectives: This study aimed to investigate the current practice on perioperative antibiotic prophylaxis for closed fractures surgeries and surgical site infections in the Beni-Suef region and to identify the associations between surgeons' characteristics and the antibiotic prophylaxis.

Method: A cross-sectional survey was conducted in orthopedic surgeons using a structured questionnaire. All data were gathered and analyzed using descriptive statistics and a Chi-squared test.

Results: The results showed that 94 orthopedic surgeons completed the questionnaire with the response rate 67.1%. Of these, only 25.5% used cefazolin as the prophylactic choice and 26.5% began the antibiotic infusion within 1 hour pre-incision. Nearly all of them continued administering the prophylactic antibiotic for two or more days after the operations. Additionally, 35.1% utilized oral antibiotic supplement and 33% adjusted the antibiotic doses. The surgeons' characteristics were significantly associated with the antibiotic prophylaxis as specified (p = 0.001 to 0.047).

Conclusion: The low adherence of orthopedic surgeons to the guideline recommendations were attributed to their experiences and warranted the needs for an awareness program.

Keywords: Antibiotic prophylaxis, Closed fractures, Current practice, Egypt, Orthopedic surgery

INTRODUCTION

Infections during or after surgeries are a matter of great concern worldwide. Surgical site infections (SSIs) have widely been known as one of the most occurring healthcare-associated infections that cause disastrous sequelae, such as the increased rates of morbidity and mortality, length of hospital stay and overall healthcare costs [1]. More than one third (about 38%) of all postsurgical infections are SSIs that may be catastrophic after closed bone fractures operations [2]. Regarding a closed fracture, it is a broken bone with soft-tissue injuries (e.g. a broken wrist, hip or knee) but does not penetrate the skin [3]. Patients with closed fracture require surgeries, albeit not urgent, and appropriate treatment. The rates of SSIs after closed fracture operations range from 1 % to 4 % [4, 5]. Although the infection rates of the surgeries are quite marginal, the nosocomial infections are rather serious and sometimes life-threatening. Thus, the preventive use of antibiotics, together with its resistance, is worth exploring in closed fracture surgeries.

Antibiotic prophylaxis is currently recommended for the clean implant procedure to avoid clinical and economic consequences of infections [6, 7]. Perioperative antibiotic prophylaxis has proved to prevent SSIs and other hospital-acquired infections, e.g. respiratory and urinary tract infections [8]. Many guidelines for the antibiotic prophylaxis in orthopedic surgeries [2, 7] have been introduced so that patients' blood and tissue drug concentrations can exceed the minimum inhibitory concentration (MIC) for likely encountered organisms, thus avoiding SSIs. Based on the guidelines, a narrow-spectrum antibiotic, like a first-generation cephalosporin (e.g. cefazolin) should initially be infused 1 hour before the surgical incision, repeated if the operation lasts longer than 3 hours or in presence of prolonged blood loss, and discontinued within 24 hours of postoperation [9]. Many studies have shown the benefits of antibiotic use prior to the skin incision of closed fracture surgeries, i.e. a decrease in the rate of antibiotic resistance [10-12]. Nevertheless, antibiotic prophylaxis for patients undergoing closed fracture operations and its resistance are not fully explored in Egypt.

Despite the widespread use of prophylactic antibiotic protocols, several practicing orthopedic surgeons still do not adhere to them [13, 14] or inappropriately select an antibiotic or timing that may result in an increase in SSI incidence, the up-growth of resistant organisms or rising healthcare costs [13]. The issue of antibiotic prophylaxis by orthopedic surgeons is therefore of paramount importance. Additionally, the surgeons' views on the use of prophylactic antibiotics, especially in the case of closed fracture surgeries should be elicited. From an extensive literature search, no data on the current practice of antibiotic prophylaxis for patients with closed fracture operations have been reported in Egypt or the Middle East. Hence, this study aimed to investigate the current practice of orthopedic surgeons on perioperative antibiotic prophylaxis for closed fractures surgeries and surgical site infections in Beni-Suef region, which is renowned for orthopedic surgeries in Egypt. Moreover, it was also intended to identify the associations between surgeons' characteristics and the antibiotic prophylaxis.

MATERIAL AND METHODS

A cross-sectional survey was approved by Beni-Suef University Research Ethical Committee in the end of 2017 (FWA00015574). The study was conducted in Egyptian

orthopedic surgeons around Beni-Suef Region during Jan – April 2018. The methods of the study are elaborated below.

Population and sample

The inclusion criteria for this study were Egyptian orthopedic surgeons. They could be one of three groups, i.e. orthopedic surgery residents who were medical graduates doing a 3-year residency program, specialists who finished a 3-year residency program plus a Master's degree, or consultants who are completing a 3-year residency program and a Master's degree plus Medical Doctorate degree. Additionally, they worked at the university, governmental or private hospitals in Beni-Suef Region. The surgeons who did not respond or complete the questionnaire were excluded. The sample size (n) was determined using the equation [15], $n = 4(Zcrit)^2p(1-p)/d^2$, and based on the estimation of 50% of Egyptian orthopedic surgeons who complied with the guidelines and a 95% confidence interval with the expected width (d) of 20%. A sample size of 96 was thus determined. If an estimated response rate was 70%, 137 copies of the questionnaire should be distributed.

Study instrument

A structured questionnaire was developed according to the literature related to antibiotic prophylaxis for closed fracture surgeries. It was kept short with three parts (20 items) to suit the busy orthopedic surgeons. Part 1 included respondents' characteristics, such as the type of orthopedic surgeon, consultant experience, estimated number of closed fracture surgeries performed in the last year (2017) and type of hospital. Part 2 was involved in antibiotic prophylaxis, i.e. the choice of antibiotics, dosage, route, time and duration of administration for closed fracture surgeries. The last section (Section 3) enquired about the adverse effects and postoperative site infections experienced in practice. One open-ended question was included at the end for any comments. The questionnaire was checked for face validity, i.e. clarity, accuracy and wording, by two experts in the field of orthopedic surgery and antibiotic applications.

Study procedure

All eligible orthopedic surgeons were purposively contacted in person by the researcher (Hassan). They were affirmed that the study was designed to record their actual daily practice in Beni-Suef Region but not to inspect their knowledge of related guidelines and recommendations. The surgeons could ask any questions about the 20 items or pertaining answers in doubt. Some could fill in the questionnaire in 5 – 10 minutes, but others required more time to complete it due to busy schedules. The researcher then came back to collect the copies few days later. If they did not finish up the questionnaire in one week, they would be reminded by phone or seeing in person. All copies of the questionnaire were manually collected and incomplete copies were excluded.

Data analysis

Two members of the study team analyzed the questionnaire results. They entered all data into Microsoft Excel v. 2010 (Microsoft Corporation, Washington) to summarize the results. The data were further transferred to IBM SPSS Statistics v. 22 (IBM Corporation, New York) for the statistical analysis using descriptive statistics, i.e., percentages. A Chi-squared test, or Fisher's exact test, was used to test the associations between surgeons' characteristics (i.e. the orthopedic surgeon or hospital type) and antibiotic prophylaxis. A significance level (α) was set at 0.05.

RESULTS

A total of 94 orthopedic surgeons completed the questionnaire with the response rate of 67.1% (94/140). They were all male surgeons. As shown in Table 1, they were specialists, orthopedic surgery residents and consultants (41.5%, 36.2% and 22.3%, respectively). For 21 consultants, they mostly had experiences less than 5 years (52.4%). The majority of orthopedic surgeons performed their orthopedic surgeries in governmental hospitals (60.6 %) and less than 50 cases of closed fracture cases (31.9%) in the year 2017. The current practice of antibiotic prophylaxis and postoperative site infections are detailed below.

Antibiotic administration and dosing

All respondents, as summarized in Table 2, replied that they routinely administered systemic prophylactic antibiotics, albeit different choices, to their patients who had no co-morbidity or history of allergy and underwent closed fracture surgeries. However, none of them used multiple antibiotics for prophylaxis. The most commonly prescribed antibiotic reported was ceftriaxone (51.1%) as the first-line single prophylaxis, followed by cefazolin (25.5%) and cefotaxime (21.3%). Only 2.1% used other antibiotics, such as ciprofloxacin, clindamycin and amoxicillin-clavulanic acid. Regarding the choice of antibiotic 'cefazolin' (Fig. 1 and Table 3), there were more consultants (52.4%) than specialists (23.1%) and orthopedic surgery residents (11.8%) who made use of the drug for closed fracture surgeries. Additionally, orthopedic surgeons working in the private or university hospitals tended to utilize cefazolin more than those in the governmental hospitals, i.e. 33.3%, 30.0% and 21.1%, respectively. About one-third of the respondents (35.1%) did routinely administer supplementary oral antibiotics for the prophylaxis. Nearly all of them reported that they did not have a specific antibiotic (92.6%), or specific regimen (100%), for a particular procedure, but very few agreed on this, e.g. teicoplanin for the total hip replacement. Moreover, only 19.1% did apply a topical antibiotic at the incision site after the procedures, i.e. mostly Bivatracin® spray (bacitracin plus neomycin). Most respondents (67%) chose to give a standard dose of the perioperative antibiotic to all patients, whereas the rest (33%) preferred to use adjusted dosages based on a patient's weight.

Timing of antibiotic administration

Although there was a wide variation in respondents' practices on the time of the first-dose administration for antibiotic prophylaxis (Table 2), all of them began to give an antibiotic before the closure of an incision and continued over 24 hours after surgery. Approximately one-third of the respondents (33%) started a prophylactic antibiotic more than 2 hours prior to incision (PTI), but the remaining commenced on the infusion roughly 1 – 2 hours PTI, 30 –

60 mins PTI, less than 30 mins PTI, during incision, intraoperative or no fixed timing, i.e. 17%, 7.4%, 19.1%, 13.8%, 6.4% and 3.2%, respectively. Slightly more than half (56.4%) told that they usually re-administered the antibiotic intraoperatively in prolonged procedures (i.e. longer than 3 hours) or in the case of increased blood loss. When asked about the time of discontinuation for antibiotic prophylaxis, the majority (62.8%) stopped it within 3 – 7 days, followed by longer than 7 days (18.1%) and within 48 hours (9.6%). It should be noted that 9 respondents (9.6%) had no particular time for cessation, as it was determined on a case-by-case basis, i.e. the injury severity, fracture type or operative intervention.

Table 1: Respondents' characteristics (n = 94).

Characteristic	Number of surgeons (%)
Type of orthopedic surgeon[a]	
Orthopedic surgery resident	34 (36.2)
Specialist	39 (41.5)
Consultant	21 (22.3)
Consultant experience (for a consultant only)	
< 5 years	11 (52.4)
5 – 10 years	7 (33.3)
> 10 years	3 (14.3)
Number of closed fracture surgeries performed in 2017	
< 50 cases	30 (31.9)
50 – 100 cases	14 (14.9)
100 – 200 cases	27 (28.7)
> 200 cases	23 (24.5)
Type of hospital where to perform the surgeries	
University	10 (10.6)
Governmental	57 (60.6)
Private	27 (28.7)

[a] *Orthopedic surgery resident* is a medical graduate doing a 3-year residency program.
Specialist is a medical doctor who finishes a 3-year residency program plus a Master's degree.
Consultant is a specialist who completes a 3-year residency program and a Master's degree plus Medical Doctorate.

Adverse effects and postoperative site infections

Many of the respondents (68.1%) experienced some side effects of the prophylactic antibiotics used in their patients (Table 2). Considering the adverse effects related to prophylactic antibiotic use, Top 5 effects were gastrointestinal side effects (63.8%), wound dehiscence (10.6%), pruritis (6.4%), vaginitis (5.3%) and development of resistance (4.3%). Most respondents (73.4%) claimed that the average rate of infection after closed fracture surgeries in their institutes was approximately 1 – 5%, but the rest were not sure about that. In regard to the frequency of readmissions related to postoperative surgical site infections (SSIs) in closed fracture surgeries, most (62.8%) were not sure of the exact figure. Nevertheless, 37.2% specified that the frequency was 1 – 2%. For the type of SSIs that respondents mostly faced, all (100%) agreed that the superficial infection always observed by 1 – 5%, whereas some reported that the deep infection (31.9%) or postoperative organ-space type (7.4%) could also occur.

Table 2: Antibiotic prophylaxis and postoperative site infections (n = 94).

Item description	Number of surgeons (%)
Systemic prophylactic antibiotics routinely administered to patients undergoing closed fracture surgeries (without comorbidity or history of allergy)	
Yes	94 (100.0)
No	-
Most common prophylactic antibiotics used for closed fracture surgeries	
Cefazolin	24 (25.5)
Cefuroxime	0 (0.0)
Cefotaxime	20 (21.3)
Ceftriaxone	48 (51.1)
Vancomycin	-
Gentamicin	-
Other, e.g. ciprofloxacin, clindamycin, amoxyclav, etc.	2 (2.1)
Oral antibiotics routinely administered to supplement the systemic prophylactic antibiotics for closed fracture surgeries	
Yes	33 (35.1)
No	61 (64.9)
A specific antibiotic for a definite procedure	
Yes	7 (7.4)
No	87 (92.6)
A specific regimen for a definite procedure	
Yes	-
No	94 (100.0)
A topical antibiotic used after the procedures	
Yes	18 (19.1)
No	76 (80.9)
Perioperative antibiotic dosage given to patients with closed fracture surgeries	
Standard	63 (67.0)
Adjusted based on weight (mg/kg)	31 (33.0)
Time of first-dose administration for antibiotic prophylaxis commonly performed	
> 120 mins prior to incision	31 (33.0)
61 – 120 mins prior to incision	16 (17.0)
30 – 60 mins prior to incision	7 (7.4)
< 30 mins prior to incision	18 (19.1)
During incision	13 (13.8)
Intraoperative	6 (6.4)
Postoperative	-
No consistent timing	3 (3.2)
Time of discontinuation for antibiotic prophylaxis usually preferred	
After a single dose	-
24 hours	-
48 hours	9 (9.6)
3 – 5 days	36 (38.3)
7 days	23 (24.5)
Longer than 7 days	17 (18.1)
No particular time (case-by-case basis)	9 (9.6)
Another dose given intraoperatively to patients with long procedures	
Yes	53 (56.4)
No	41 (43.6)
Patients experiencing any side effects with the use of prophylactic antibiotics	
Yes	64 (68.1)
No	30 (31.9)

Table 2: Antibiotic prophylaxis and postoperative site infections (contd).

Item description	Number of surgeons (%)
Adverse effects noted for prophylactic antibiotic use[a]	
Gastrointestinal side effects	60 (63.8)
Wound dehiscence	10 (10.6)
Pruritis	6 (6.4)
Vaginitis	5(5.3)
Development of resistance	4 (4.3)
Wound infection	3 (3.2)
Allergic rhinitis	1 (1.1)
None noted	30 (31.9)
Average rate of infection after closed fracture surgeries in the institution	
1 – 5%	69 (73.4)
Not sure	25 (26.6)
Frequency of readmissions related to postoperative surgical site infections in closed fracture surgeries	
1 – 2%	35 (37.2)
Not sure	59 (62.8)
Type of surgical site infections mostly found[a]	
Superficial	94 (100.0)
Deep	30 (31.9)
Organ space	7 (7.4)

[a] More than one answer was allowed; this made the total percentage greater than 100.

Associations between surgeons' characteristics and antibiotic prophylaxis

In Table 3, the orthopedic surgeon group, i.e. orthopedic surgery resident, specialist or consultant, was significantly associated with their antibiotic choices (p = 0.001), oral antibiotic supplements (p = 0.019), antibiotic dosage adjustment (p = 0.002) and times of the first-dose administration (p = 0.001) and discontinuation (p = 0.026) for antibiotic prophylaxis for closed fracture surgeries. Moreover, the type of hospital where orthopedic surgeons performed their operations, i.e. university, governmental or private, was also significantly associated with the antibiotic choices (p = 0.043), dosage adjustment (p = 0.010) and time of the first-dose initiation (p = 0.047). The significant results indicated the different distribution of data. With respect to the choice of prophylactic antibiotics, consultants tended to use cefazolin (52.4%) more than cefotaxime and ceftriaxone, but orthopedic surgery residents and specialists preferred ceftriaxone (79.4% and 43.6%) to others. Furthermore, there was a tendency that orthopedic surgeons working in the governmental hospitals utilized ceftriaxone (63.2%) more than other antibiotics, but those working in private or university hospitals did not have any obvious preference.

Oral antibiotics administration to supplement the systemic prophylactic antibiotics was noticeable in residents (52.9%) and it decreased with increasing surgery experiences, i.e. only 28.2% in specialists and 19.0% in consultants. It was also common practice among orthopedic surgeons working in the university hospitals (50%) compared with those in private and governmental hospitals (40.7% and 29.8%), as demonstrated in Table 3. As for the adjustment of the antibiotic dosages, many consultants (57.1%) did this compared with some specialists (38.5 %) or residents (11.8 %). The tendency was also found in orthopedic surgeons working in the private, university and governmental hospitals, i.e. 55.6%, 30% and 22.8%, respectively. Orthopedic surgery residents (91.2%) initiated the prophylactic antibiotics more than one hour before the surgical incision, but specialists (43.6%) and consultants (33.4%) preoperatively offered the first dose within an hour. As with the hospital type, orthopedic surgeons working in the private hospitals adhered the most to the antibiotic initiation within an hour prior to the incision. For the time of antibiotic discontinuation, consultants and orthopedic surgeons from the private hospitals seemed to the drug between 48 hours and 5 days after the surgeries.

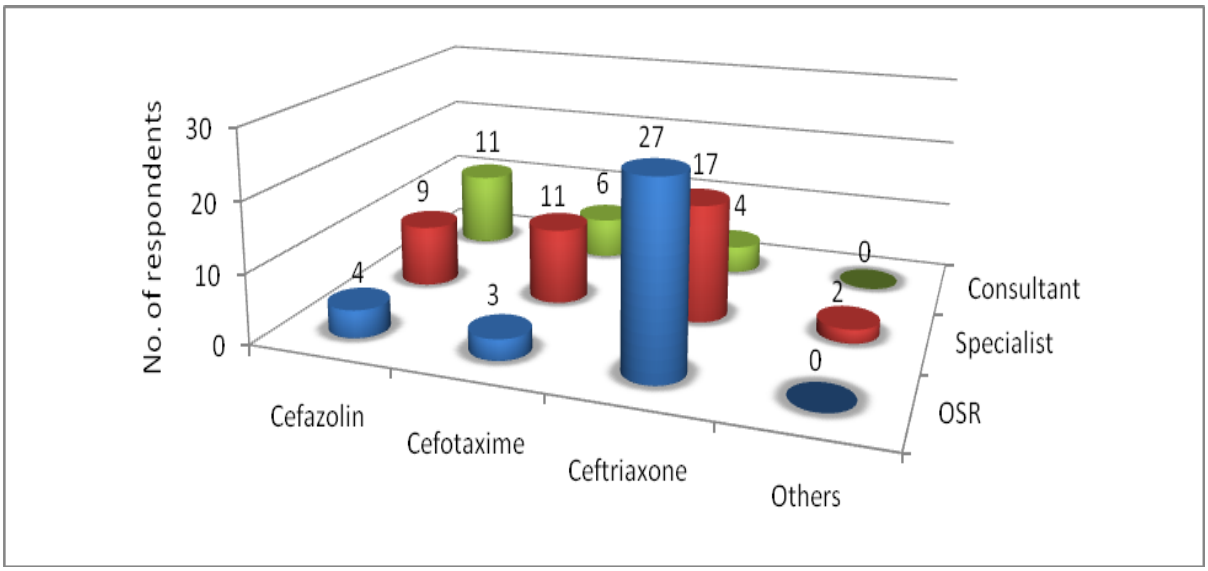

Fig.1: Preferred prophylactic antibiotics for closed fracture surgeries categorized by types of orthopedic surgeons: orthopedic surgery resident (OSR), specialist and consultant.

Table 3: associations between surgeons' characteristics and antibiotic prophylaxis (n = 94).

Item description	Ortho surgery resident (n=34)	Specia-list (n=39)	Consul-tant (n=21)	*P* value	Univer-sity (n=10)	Govern-mental (n=57)	Private (n=27)	*P* value
Most common prophylactic antibiotics used for closed fracture surgeries								
Cefazolin	4 (11.8)[a]	9 (23.1)	11 (52.4)	0.001*	3 (30.0)	12 (21.1)	9 (33.3)	0.043*[b]
Cefotaxime	3	11	6		4	7	9	
Ceftriaxone	27	17	4		3	36	9	
Other	0	2	0		0	2	0	
Oral antibiotics routinely administered to supplement the systemic prophylactic antibiotics for closed fracture surgeries								
Yes	18 (52.9)	11 (28.2)	4 (19.0)	0.019*	5 (50.0)	17 (29.8)	11 (40.7)	0.361
No	16	28	17		5	40	16	
Perioperative antibiotic dosage given to patients with closed fracture surgeries								
Standard	30 (88.2)	24 (61.5)	9 (42.9)	0.002*	7 (70.0)	44 (77.2)	12 (44.4)	0.010*
Adjusted (mg/kg)	4	15	12		3	13	15	
Time of first-dose administration for antibiotic prophylaxis commonly performed								
> 1 hour	31 (91.2)	10 (25.6)	6 (28.6)	0.001*[b]	4 (40.0)	35 (61.4)	8 (29.6)	0.047*[b]
≤ 1 hour	1	17	7		3	10	12	
During incision or intraoperative	1	11	7		2	11	6	
No consistent timing	1	1	1		1	1	1	
Time of discontinuation for antibiotic prophylaxis usually performed								
48 hours – 5 days	14 (41.2)	18 (46.2)	13 (61.9)	0.026*[b]	5 (50.0)	23 (40.4)	17 (63.0)	0.149
≥ 7 days	20	14	6		4	26	10	
No particular practice	0	7	2		1	8	0	

* Statistically significant (p value < 0.05)
[a] Percentage calculated based on the total number of its group
[b] Fisher's exact test

DISCUSSION

The current administration of prophylactic antibiotics for closed fractures surgeries was reflected by three groups of orthopedic surgeons, i.e. surgery residents, specialists and consultants, with different qualifications and experiences. All of them were aware of the necessity of administering a prophylactic antibiotic for closed fracture surgeries to prevent surgical site infections. However, they had their own preferences for antibiotic choices, dosages and times of initiation and discontinuation. According to the perioperative antibiotic prophylaxis guidelines jointly developed by the American Society of Health-System Pharmacists, the Infectious Diseases Society of America, the Surgical Infection Society and the Society for Healthcare Epidemiology of America, the routine use of cefazolin is recommended, unless contraindicated, for clean orthopedic procedures, such as the treatment of closed fractures [16-18]. This survey showed the low level of compliance with the guidelines for cefazolin use as the first-line surgical prophylactic antibiotic, as evidenced by the limited number of respondents (25.5 %); the majority (72.4%) preferred to use a third-generation cephalosporin,

i.e. cefotaxime or ceftriaxone. This was in contrast to the study of Canadian orthopedic surgeons on total joint replacement surgeries that reported the high level of adherence (97.3%) to the use of cefazolin as the drug of choice [19]. When cross-tabulated against different groups of orthopedic surgeons, a significant association was found for the antibiotic selection with the up-level of experiences ($p < 0.001$), i.e. cefazolin being utilized mostly in consultants rather than specialists or residents. Their previous training and experiences might have a great impact on their preferences for prophylactic antibiotics. Regarding the hospitals where the respondents operated their surgeries, cefazolin was more exploited in private and university hospitals than those government-owned hospitals. This was probably because the hospital formulary with the restrictive list of prophylactic antibiotics was followed in order to control the drug expenditures.

Although there is no evidence to support the administration of supplementary oral antibiotic prophylaxis, nearly one-third (35.1%) of the respondents still stuck to this supplement. As with the selection of a prophylactic antibiotic, this practice also decreased with the increasing surgery experiences and the high usage was found in governmental and private hospitals. Bratzler *et al*. [7] suggested that it is very important to give enough doses, which should be adjusted to the body weight or body mass index, especially for cefazolin with 2 grams instead of 1 gram for patients weighing greater than 80 kg. In this study, only one-third of the respondents adjusted the prophylactic antibiotic doses for patients with closed fracture surgeries. Nevertheless, consultants (57.1%) as experts on orthopedic surgeries paid more attention to the dosage adjustment in comparison to specialists and residents. The most important issue in the guideline recommendations is the time of administration for the prophylactic antibiotic [16] that should be within 1 hour preoperatively [20]. This study revealed the heterogeneity of the first-dose administration time among orthopedic surgeons dealing with closed fractures. Only 26.6% of respondents complied with the initial dose recommendation and the non-adherence could clearly be observed in most orthopedic surgery residents (91.2%) that started the first dose of the antibiotic more than 1 hour prior to the surgeries. This result was obviously different from the study of Rosenberg, A.D., et al. [20] that reported the rate of adherence to the guidelines exceeding 60%. The discrepancy of adherence is partly due to the different study designs, surgery conditions, surgeons' training and organizational culture.

In 1999, The Centers for Disease Control and Prevention (CDC) and Hospital Epidemiology released the guidelines that support the intraoperative antibiotic re-administration to maintain therapeutic levels of the antibiotic throughout long procedures or till a few hours post-surgery [2]. Numerous respondents (56.4%) in this study re-administered an antibiotic for long procedures that they thought were prone to infections. According to the guidelines, it was proved no benefit of extended administration of prophylactic antibiotics beyond 24 hours postoperative. The long duration of prophylactic antibiotic administration is one of the commonly occurring errors in surgical antibiotic prophylaxis that bring about the increased overall cost of prophylaxis [21]. For this present study, there seemed to be a consensus among all orthopedic surgeons in this Beni-Suef region to extend the administration of a prophylactic antibiotic beyond one day after the operations, especially for continuing antibiotic doses at least 48 hours, which resulted in high doses of prophylactic antibiotics; this possibly caused patients some adverse effects and more serious events of antibiotic resistance. This is again different from the study of Rosenberg, A.D., et al. [20] that noted over 60% of adherence and few problems with the prolonged antibiotic use for prophylaxis. For the respondents with non-adherence, they elaborated that they did not trust the "cleanliness" of their hospitals' environment. They also had the conception that aseptic techniques were not sufficient with the increased risk of infections. This might be a sound explanation, as the WHO guidelines report that more than 90 % of microorganisms are present in the visible dirt [22]. Moreover, it also may be due to the shortage of awareness programs or campaigns in the regional hospitals about rational drug use regarding prophylactic antibiotic administration.

Many of the respondents reported some side effects with the use of prophylactic antibiotics, which have also been reported in other studies especially if the antibiotics are inappropriately used [20, 22-24]. This study results implied that a significant ratio of the regional orthopedic surgeons did not adhere to the basic recommendations of the guidelines concerning prophylactic antibiotic administration in their everyday clinical practice. This leads to the overuse of preoperative prophylactic antibiotics in the Beni-Suef region that largely contributes to the occurrence of multidrug resistant bacteria. In fact, infectious disease pharmacists or pharmacists who are responsible for antibiotic use should get involved in the antibiotic stewardship and support the rational use of the prophylactic antibiotics for closed fracture surgeries.

Limitations of the study. This study was just a self-completion survey and could not explore the reasons for various points of non-adherence. Ideally, other methods, e.g. an in-depth interview or focus group, should be conducted to triangulate the data and make the data more reliable. Due to the busy life of all orthopedic surgeons and long distance between hospitals, it was not practical to make use of other research methods. In addition, this study was carried out in a single region with the small number of orthopedic surgeons. Thus, it is feasible to fully mirror the current practice of orthopedic community at large on antibiotic prophylaxis for orthopedic surgeries of closed fractures.

CONCLUSION

The current practice on antibiotic prophylaxis for orthopedic surgeries of closed fractures was reflected by orthopedic surgeons with a wide variation in the selection and administration of the prophylactic antibiotic. The associations between surgeons; characteristics and antibiotic prophylaxis were also identified. The low adherence to the guidance recommendations in terms of

antibiotic choices, oral antibiotic supplements, dosage adjustment and time of administration and cessation is mainly attributed to individual experiences and previous training. However, an awareness program or campaign about antibiotic prophylaxis should urgently be implemented to improve the practice in the region so that the rate of surgical site infections and bacterial resistance would be minimized. Apart from that, pharmacists should directly be involved to promote the rational use of prophylactic antibiotics. Further studies are required to evaluate the measures used to increase the adherence of orthopedic surgeons and avoid the surgical site infections and emergence of resistant strains.

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