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Short Communication

Surgical Site Infections in a Tertiary Referral Hospital in Amman: Causative Bacteria and Antibiotic Susceptibility

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Abstract

Surgical site infections (SSIs) represent a major healthcare challenge. This retrospective study aimed to assess the frequency of SSIs, the bacterial profile, and the antibiogram of the isolates, from a tertiary hospital in Jordan. Data regarding SSIs were obtained from hospital records throughout the year 2015. The prevalence rate of SSIs was 5.4%. Gram-negative bacteria were more common than Gram-positive (57% vs. 43%). *Staphylococcus aureus* (35%) and *Escherichia coli* (24.5%) were the most common etiologies. Among Gram-positive isolates resistance was highest for ampicillin, and least for linezolid, teicoplanin, and vancomycin. Among Gram-negative isolates, resistance was highest for ampicillin, ciprofloxacin, and amoxicillin-clavulanate, and least for gentamicin, piperacillin-tazobactam, and meropenem. Surveillance of SSIs, the causative bacteria, and the bacterial antibiograms, are necessary for implementing strict infection control measures, and in the selection of effective antibiotic treatments to decrease the mortality and morbidity rates associated with SSIs. Most SSI cases were detected in individuals aged fifty-five years old or more, and combined with comorbidities, ex. diabetes mellitus.

Keywords: Surgical site infection, Prevalence, Antibiogram, Jordan, *S. aureus, E. coli*.

1. Introduction

Surgical site infections (SSIs) represent a major part of the health-care associated infections worldwide, and are responsible for the increasing morbidity and mortality rates, length of hospital stay, and health-care costs (Owens and Stoessel, 2008).

Despite advances in infection control and surgical procedures, SSIs are considered a serious healthcare problem with an estimated incidence rate of 2-20%, even in modern hospital settings (Hohmann *et al.,* 2012; Owens and Stoessel, 2008; Vikrant *et al.*, 2015). For example, SSI incidence rates in different socioeconomic level countries were 20.3% in Nigeria, 16% in India, and 14.7% in Japan (Qasem and Hweidi, 2017).

SSIs can be attributed to endogenous or exogenous bacteria during primary infections (infections detected, and causative agents isolated from the patients before starting the surgery). They may occur also as secondary infections after surgeries (Vikrant *et al.,* 2015). Multiple host and pathogen factors affect the risk of SSIs, including old age, existing co-morbidities, prolonged duration of surgery, and preoperative preparation and sterilization techniques (Masaadeh and Jaran, 2009; Owens and Stoessel, 2008).

Bacteriological causes of SSIs vary depending on factors such as geographical location, hospitals, wards, and type of surgical procedures (Owens and Stoessel, 2008). This can become more complicated in places where over-crowding, improper infection-control procedures, and antibiotic misuse exist. In particular, this is true in developing countries with low resources, where even basic operations such as appendectomies can lead to an increased mortality rate due to the high rates of infections (Vikrant *et al.*, 2015).

Surgical site infections are encountered in Jordan in healthcare settings associated with high rates of mortality and morbidity. For instance, SSI incidence in coronary artery bypass graft surgery (CABG) in Jordan reaching 16.8% (Qasem and Hweidi, 2017).

The aim of this study is to assess the bacterial profiles and the associated antibiotic susceptibility profiles in SSIs which occurred in a 450-bed tertiary hospital in Amman, the capital of Jordan.

2. Materials and Methods

This retrospective study was carried out in a tertiary hospital in Amman, Jordan. The hospital has a 450 bed capacity, and performs approximately 1900 surgeries per year.

The scientific approval for this study was obtained from Mutah University, Faculty of Medicine, Jordan. (19/5/2014)

Data on patients with confirmed SSIs for the year 2015 were collected from medical records. Data included age, sex, type of surgery, and presence of comorbidities.

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The data on laboratory sample type, isolated species, and their antibiotic susceptibility, were collected electronically using Hakeem program (Electronic health solutions, 2014).

3. Results

A total of 102 cases were confirmed as SSIs constituting an overall incidence rate of about 5.4%. The mean age of patients was 55.1 years with a range of 25-75 years. Peak incidence was at ages older than fifty-five years. Males represented 46% of the cases with no statistically significant difference from females.

Isolated bacteria and their antibiograms are shown in tables 1 and 2 for Gram-positive and Gram-negative bacteria, respectively. Gram-positive bacteria (Table 1) were isolated from 44 (43%) cases, compared to 58 (57%) for Gram-negative bacteria (Table 2). *S. aureus* was the most commonly isolated species, and was found in 36 (35%) cases. Eight methicillin-resistant *S. aureus* (MRSA) isolates were also reported (7.8%). The second most-common species was *E. coli* which was found in 25 cases (24.5%). Other common bacteria included *Pseudomonas* spp. (15.6%) and *Citrobacter* spp. (9.8%).

The highest rate of resistance within the Gram-positive isolates was for ampicillin (75%) and ciprofloxacin (45.5%), but all isolates were susceptible to linezolid, teicoplanin, vancomycin, and cefoxitin (Table 1). The highest rate of resistance among Gram-negative isolates, was for ampicillin (87.2%), and the least was for meropenem (8.2%) (Table 2).

Patients with comorbidities, in particular patients with diabetes mellitus, were at a significantly higher risk of developing SSIs (data not shown).

Table 1. Antibiotic sensitivity for Gram-positive isolates.

Pathogen/count (Total 44)	Antibiotic susceptible isolates' count, %								
	AMP	CIP	SXT	GN	AMC	LNZ	TEC	VAN	CEF
S. aureus / 36	9, 25%	20, 55.5%	27,75%	22,61%	23, 63.8%	36, 100%	36, 100%	36, 100%	36, 100%
MRSA / 8	0	4, 50%	6, 75%	5, 62.5%	NT	8, 100%	8, 100%	8, 100%	8,100%

AMP: ampicillin, CIP: ciprofloxacin, SXT: trimethoprim sulfamethoxazole, GN: gentamicin, AMC: amoxicillin-Clavulanate, LZD: linezolid, TEC: teicoplanin, VAN, vancomycin, CEF: cefoxitin. NT: not tested.

Table 2. Antibiotic sensitivity for Gram-negative isolates.

Pathogen/count (Total 58)	Antibiotic susceptible isolates' count, %								
	AMP	CIP	CTX	SXT	GN	AMC	CAZ	TAZ	MEM
E. coli / 25	9, 36%	18, 72%	20, 80%	16, 64%	24,96%	17,68%	NT	25, 100%	25, 100%
Pseudomonas/ 16	0	4, 25%	NT	5, 31.2%	14, 7.5%	4, 25%	11, 8.7%	13,81.2%	15,93.7%
Citrobacter / 10	0	7, 70%	0	5, 50%	7, 70%	0	NT	7,70%	9, 90%
Proteus spp./ 4	1, 25%	2, 50%	2, 50%	2, 50%	3, 75%	3,75%	NT	3, 75%	3, 75%
Klebsiella / 3	0	2, 66.6%	1, 33.3%	2,66.6%	2, 66.6%	0	NT	2, 66.6%	3,100%

AMP: ampicillin, CIP: ciprofloxacin, CTX: cefotaxime, SXT: trimethoprim sulfamethoxazole, GN: gentamicin, AMC: amoxicillin-clavulanate, CAZ: ceftazidime, TAZ: piperacillin-tazobactam, MEM: meropenem. NT: not tested.

4. Discussion

Surgical site infections (SSIs) are still a challenging healthcare problem despite the advances in the surgical techniques, and the infection prevention measures (Owens and Stoessel, 2008; Vikrant *et al.,* 2015). The rate of SSIs varies from hospital to hospital with a range of 2.5% to 41.9% (Vikrant *et al.,* 2015; Malik *et al.,* 2011). In this study, the SSIs rate was 5.4%, which is consistent with what was previously reported (Malik *et al.,* 2011), but higher than SSIs rates in the United States (2.5%) and Europe (2-5%) (Satyanarayana *et al.,* 2011). Crowdedness and improper infection-control measures could explain the higher incidence in the current study compared to that in developed countries.

There was no significant difference regarding incidence between males and females, as they represented 46% and 54% of the cases, respectively. However, incidence rate increased with the increasing age, and the presence of comorbidities, mainly diabetes mellitus (data not shown). The mean age of patients was 55.1 years, and the peak incidence was at the age older than 55 years. Patients older than 55 years represented 60% of all SSIs cases. Advanced age and presence of underlying co-morbidities are important factors that increase the rate of SSIs due to conditions such as low immunity and slow healing wounds (Khan *et al.,* 2013).

In this study, the predominant species was *S. aureus* (35%), which is in agreement with previous studies that reported *S. aureus* to be the most common cause of SSIs (Chakarborty *et al.,* 2011; Mulu *et al.,* 2012). *S. aureus* is part of the normal flora and can lead to endogenous infections. However, healthcare workers, the environment, and contaminated instruments, may also be the source of such infections (Anguzu and Olila, 2007; Isibor *et al.,* 2008). All *S. aureus* isolates were susceptible to linezolid, teicoplanin, vancomycin, and cefoxitin, which is important to note when antibiotic guidelines are updated.

On the other hand, *E. coli* was the most common isolated Gram-negative species in this study with a rate of 23.1%, followed by *P. aeruginosa* at a rate of 14.8%. This is consistent to what has been reported previously by other studies (Ahmed, 2012; Anguzu and Olila, 2007; Mulu *et al.,* 2012; Vikrant *et al.,* 2015). Endogenous fecal flora could be the reason for the observed high incidence of *E. coli*, in addition to poor hospital hygiene (Malik *et al.,* 2011; Vikrant *et al.,* 2015). Susceptibility was highest for meropenem, and least for ampicillin.

The rate of SSIs in this study was comparable to that in other studies. However, the antibiogram was different than what was previously reported (Masaadeh and Jaran, 2009; Sohn *et al*., 2002; Vikrant *et al.,* 2015). This could be due to differences in the prevalence of bacterial strains among the population, variable infection-control measures and surgical techniques, and a high-likelihood of antibiotics misuse.

5. Conclusion

The findings of the current study give an additional significant insight into the SSIs prevalence and the antibiotic profile which are necessary for a better implementation of infection-control measures and antibiotic use guidelines. The findings create an awareness which would in turn decrease patients' mortality and morbidity rates, and provide guidance for the proper use of antibiotics and the implementation of strict infection-control measures. Studies with a bigger sample size and at a national level are recommended for more statistically relevant conclusions**.**

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